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Malaria

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ABSTRACT

Introduction: Malaria is an acute febrile infectious disease caused by protozoa of the genus Plasmodium that are transmitted by the bite of infected female mosquitoes of the genus Anopheles. In 2020, the World Health Organization (WHO) reported 241 million cases and 627 thousand deaths from the disease. This figure represents an increase from an estimated 227 million cases and 558,000 deaths recorded in 2019. In Brazil, the Amazon region is considered an endemic area for malaria, accounting for 99% of autochthonous cases. Objectives: The study of this chapter is to present all the main aspects relevant to the understanding of malaria and its consequences on the individual and society. Etiological Agent: Protozoa of the genus Plasmodium, with the species Plasmodium falciparum, Plasmodium vivax and Plasmodium malariae being the main species found in Brazil. Transmission: Malaria is a disease transmitted to humans through the bite of infected female mosquitoes of the genus Anopheles. Biological cycle: The biological cycle of Plasmodium sp. involves two hosts, the human and the female infected Anopheles mosquito. Clinical manifestations: The interval period between apyretic events varies according to the species of each etiological agent, which presents distinct intervals to complete the schizogonic cycle in red blood cells. The species of P. vivax and P. ovale (found in Africa) have a cycle of approximately 48 hours, the cycles of P. malariae are around 72 hours, while P. falciparum does not show synchronicity between symptomatic events. Diagnosis: The signs and symptoms of malaria are quite nonspecific and can commonly be confused with other infections. Slides stained with Giemsa and observed under light microscopy are widely used and analyzed by thick drop and blood smear. One of the options is rapid tests, currently offered in resource-scarce areas where microscopy services are not feasible or unavailable. Treatment: Treatment of malaria will vary according to the infecting species. Prophylaxis: For individuals who are outside the endemic area, it is necessary that they inform themselves before traveling to these regions. Attention should be paid to the departure time, avoiding being outside the premises during night periods, since the vector usually leaves soon after dusk. Repellents and barrier methods should be used, such as clothing that covers the body area well, as well as mosquito nets and screens on beds and doors. Conclusion: The chapter allows the deepening of the main topics about malaria, thus ensuring greater knowledge about the disease, the care of the infected individual, and the care that society needs to have in the face of this disease.

Keywords: Malaria, *P. falciparum*, *P. vivax*, *P. malariae*.

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INTRODUCTION

Malaria is an infectious, endemic disease that is present in most of the tropics and its transmission occurs continuously in about 85 countries and territories. In 2020, the World Health Organization (WHO) reported 241 million cases and 627 thousand deaths from the disease. This figure represents an increase from an estimated 227 million cases and 558,000 deaths recorded in 2019.

In Brazil, the Amazon region is considered an endemic area for malaria, registering 99% of autochthonous cases, that is, 99% of malaria cases throughout Brazil come from the Amazon region. The region comprises the states of Acre, Amazonas, Amapá, Pará, Rondônia, Roraima, Tocantins, Mato Grosso and Maranhão. In areas outside the Amazon region, more than 80% of the recorded cases are imported from the states belonging to the endemic area and from other Amazonian countries or the African continent. Despite this, there is residual transmission of malaria in states of the extra-Amazon region, mainly in areas of the Atlantic Forest, such as São Paulo, Minas Gerais, Rio de Janeiro and Espírito Santo.

Malaria is an infectious, non-contagious, acute febrile disease caused by protozoa of the genus *Plasmodium* transmitted by the bite of infected female mosquitoes of the genus *Anopheles*, also known as capuchin mosquitoes. The disease is also known as malaria, malaria, malaria, malaria, intermittent fever, benign tertian fever, malignant tertian fever, as well as popular names such as malaria, seezão, tremedeira, mixer or fever.

The mosquitoes that transmit the disease to humans are most abundant at twilight times, that is, at dawn and dusk. However, they are found feeding throughout the night.

ETIOLOGIC AGENT

The parasites that cause malaria belong to the phylum Apicomplexa, family *Plasmodiidae* and the genus *Plasmodium*. There are hundreds of species of plasmodium, but only a few parasitize exclusively on humans. They are: *Plasmodium falciparum*; *Plasmodium vivax*; *Plasmodium malariae; Plasmodium ovale* (species found in Africa) and *Plasmodium knowlesi* (found in Asia)

Plasmodium falciparum is responsible for malignant tertian fever, with fever peaks at intervals of 36 to 48 hours. *Plasmodium vivax* is responsible for benign tertian fever, with 48-hour cycles. *Plasmodium ovale* has a limited distribution to the African continent and is responsible for another form of benign tertian fever, that is, with 48-hour cycles. *Plasmodium malariae* causes quartan fever, promoting fever peaks every 72 hours.

However, another species of plasmodium, *Plasmodium knowesi*, has been linked to clinical cases of malaria on the Asian continent and is closely linked to forested regions.

VECTOR/TRANSMISSION

Malaria is a disease transmitted to humans through the bite of the infected female mosquito of the genus *Anopheles*, popularly known as muriçoca, sovela, capuchin mosquito and boll weevil. In Brazil, 3 main species are involved in the transmission of the disease: *Anopheles darlingi* (main vector species), *Anophleles albitarsis* and *Anopheles aquasalis* (found predominantly in the coastal region of the country). The mosquitoes that transmit the disease to humans are most abundant at twilight times, that is, at dawn and dusk. However, they are found biting throughout the night. The preferred sites chosen by malaria-transmitting mosquitoes to lay their eggs (breeding sites) are collections of clean, shaded and low-flow waters, which are very frequent in the Brazilian Amazon.

The cycle begins when the mosquito bites an individual with malaria, sucking the blood with the parasites (plasmodiums). In the mosquito, plasmodia develop and multiply. The cycle is complete when these infected mosquitoes bite a new individual, infecting the person with the parasites. In this way, the transmission cycle involves: the plasmodium (parasite), the anopheline (mosquito vector) and humans.

The incubation period, i.e., the interval between the acquisition of the parasite by the bite of the female mosquito and the appearance of the first symptoms, varies according to the species of plasmodium. For *Plasmodium falciparum*, minimum of seven days; *P. vivax*, 10 to 30 days and *P. malariae*, 18 to 30 days. There is no direct person-to-person transmission of the disease. Other forms of transmission can also occur in rarer cases by: blood transfusion, use of contaminated syringes, laboratory accidents, and congenital transmission. Malaria is not transmitted through water.

EVOLUTIONARY FORMS OF THE PROTOZOAN AND BIOLOGICAL CYCLE

The main evolutionary forms of *Plasmodium* sp. are:

Sporozoites: Sporozoites are the infective form of the parasite transmitted to humans by the bite of an infected female mosquito. They are inoculated into the bloodstream during the insect's feeding and then go to the liver.

Merozoites: When invading hepatocytes (liver cells), sporozoites transform into rounded structures called merozoites, and are difficult to detect at this stage. In addition to growing, merozoites begin a cycle of asexual reproduction, known as pre-erythrocytic schizogony, as it happens before blood parasitism. This asexual reproduction gives rise to a multinucleated cell, known as a tissue schizont, containing several merozoites inside. Merozoites are released into the blood, either by rupture of hepatocytes or via exocytosis.

Trophozoites: Merozoites invade red blood cells (RBCs), where they transform into young trophozoites. Inside the red blood cells, trophozoites consume the hemoglobin present in red blood cells. The iron present in the molecule is very toxic to the etiological agent and as a protective

measure the crystallization of this substance occurs, generating hemozoin, also known as malarial pigment, which is stored in the vacuole of *Plasmodium*. After their development, they are called mature trophozoites, when they begin the process of asexual reproduction, called blood schizogony. This is followed by the rupture of the red blood cells, with the release of new merozoites that will invade new red blood cells. It is at this time, when several red blood cells rupture simultaneously, that the infected individual presents the fever. Some young trophozoites do not evolve into mature trophozoites, but differentiate into gametocytes, which will continue the cycle in the insect vector.

Gametocytes: Differentiation into gametocytes generates forms known as female gametocytes and male gametocytes, which after ingested by a female *Anopheles*, will give rise to gametes, and sexual reproduction will occur.

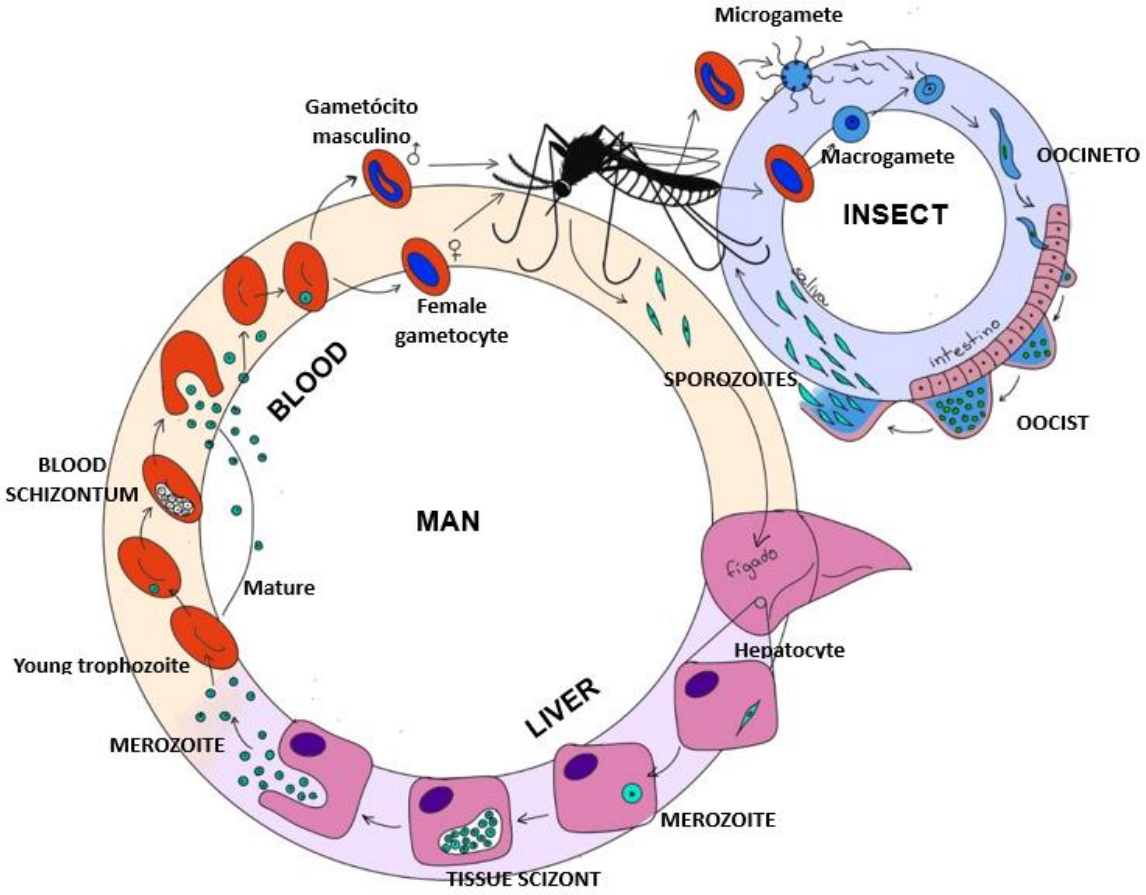
Male and female gametes: Upon reaching the intestine of the insect that has favorable factors, such as high pH and low temperature, gametogenesis begins, the female gametocyte transforms into a macrogamete, and the male gametocyte, after undergoing an exflagellation process, gives rise to eight microgametes, which will fertilize the macrogamete, originating a zygote, or egg cell, known as ookinete.

Ookinete: After one day of the formation of the zygote, it differentiates into an ookinete, which performs contractile movements to move to the wall of the middle intestine of the infected insect, where the cyst is performed, and from this moment on, it is called oocyst.

Oocyst: The oocyst is found within the intestinal epithelium of the infected mosquito. It will do asexual reproduction, called sporogony, producing new sporozoites. The sporozoites, released in the midgut of the mosquito, are transported by the hemolymph to the salivary glands. The cycle is completed when the mosquito bites another individual, transmitting the sporozoites and restarting the cycle.

Figure 1 shows the biological cycle of *Plasmodium* sp. in both hosts.

Figure 1 - Schematic representation of the biological cycle of *Plasmodium* sp. Source: Elaborated



CLINICAL FORMS

The incubation period of the disease varies according to each species of plasmodium. *P. vivax* has an incubation time of around 14 days, *P. falciparum* is approximately 12 days, and *P. malariae* can vary between 18 and 40 days for the onset of the first symptoms.

Malaria is an acute febrile illness and initially the symptoms are nonspecific, and the patient may present fever, headache, tiredness, myalgia and malaise. After this period, the patient may develop malarial access or malarial paroxysm, which occurs suddenly, coinciding with the rupture of the red blood cells. From this moment, which lasts around fifteen minutes to an hour, the patient may present intense cold, chills, paleness, cyanosis, and even intensification of fever. After this period, a high fever is established, which can reach up to 41°C, which can last from 2 to 4 hours. Finally, the symptoms remission occurs with normalization of the temperature, the patient feels relieved and goes through a period of intense sweating.

The interval period between febrile peaks varies according to the species of infecting plasmodium, which has distinct intervals to complete the schizogonic cycle in red blood cells. The species of *P. vivax* and *P. ovale* have a cycle of approximately 48 hours, the cycles of *P. malariae* are around 72 hours, while *P. falciparum* does not present synchronicity between symptomatic events, and febrile attacks can vary from 36 to 48 hours.

In cases of P. *vivax infection*, depending on the treatment performed, the patient may have remission of symptoms and cure. However, due to latent hypnozoites in the liver, after a period, it may present a new symptomatic picture due to the reactivation of the hepatic forms. This phenomenon is called late recurrence of the disease and happens with the species *P. vivax* and *P. ovale*.

Cerebral malaria is the most severe manifestation of the disease and occurs in approximately 2% of non-immune individuals affected by *P. falciparum*, which is responsible for approximately 80% of malaria deaths. During the infection of red blood cells, *P. falciparum* induces the parasitized cell to express proteins of the adhesin class in its cell membrane, leaving the parasitized red blood cell with deformities called "*knobs*" on its surface. Thus, the parasitized cells adhere to other red blood cells, parasitized or not, to other cells and to the vascular endothelium, causing obstruction of the microcirculation with involvement of the adjacent tissue.

Complications that can occur in pregnant patients infected with malaria include miscarriage, prematurity, stillbirth, and maternal death, as well as low fetal birth weight. In rare cases, eclampsia and nephrotic toxemia may occur. Acute renal failure is common in adults, where renal impairment causes reduced urine production, no more than 400ml per day. Jaundice may be present in cases of elevated serum bilirubin due to excess hemolysis and hepatic involvement.

DIAGNOSIS

CLINICAL DIAGNOSIS

The signs and symptoms of malaria are quite nonspecific and can commonly be confused with other infections. Fever, fatigue, arthralgia, headache and vomiting present in the malarial manifestation are also common bacterial and viral infections, which frequently affect humans. This makes it difficult to identify malaria using clinical findings alone. This fact is minimized in endemic areas for the disease, when faced with a febrile condition, the initial suspicion is the disease.

LABORATORY DIAGNOSIS

Microscopic visualization and identification of parasites in the blood of patients is still the gold standard for diagnosing malaria. Slides stained with Giemsa and observed under light microscopy are widely used and analyzed by means of a thick drop (more sensitive) and blood smear (more specific).

An important point to be emphasized is that a negative result does not necessarily mean that the patient is not infected, since the identification of parasites depends on the examiner and his technical skill, as well as the quality of the materials provided. Thus, in socially disadvantaged regions, with few resources and few qualified professionals, there is a need to repeat the technique

and microscopic visualization after a few hours when there is high suspicion and a negative result. Another situation that can hinder diagnosis is in the case of pregnant women with suspected malarial infection. In this case, placental sequestration of parasitized erythrocytes and low levels of parasitic circulation can also lead to a false negative.

Considering the scenarios presented, it is possible that other diagnostic techniques will be employed. One of the options is rapid tests, which do not depend on qualified professionals to perform them, currently offered in areas with scarce resources, where the microscopy service is not feasible. The test is able to identify specific antigens of *P. vivax* and *P. falciparum*, such as histidine-rich protein 2 (HRP2). They also identify mixed infections, which was not possible until a few years ago. However, to date, there are no approved or satisfactory tests to detect infections of *P. malariae*, *P. ovale* and *P. knowlesi*.

Another option for diagnosing malaria is molecular tests, such as polymerase chain reaction (PCR), which has high accuracy. PCR can be useful in cases where there is low parasitemia, but despite having many advantages, the technique is difficult to implement in endemic areas, due to its high cost, need for skilled labor, and delay in releasing results.

Treatment

A complete malarial treatment needs to prevent parasitic reproduction in the bloodstream, aiming at the patient's clinical improvement; It must act on latent forms in the liver, to prevent late recurrences of the disease and also act against gametocytes, as these remain viable in the bloodstream for up to 60 days. In these cases, the patient is clinically cured, but remains a source of infection for the insect vectors.

Uncomplicated malaria:

One of the main goals in the treatment of uncomplicated malaria is to prevent a worsening of the disease, as well as to reduce clinical symptoms. In endemic regions, it is important that treatment prevents transmission to other individuals.

P.vivax *or* P.ovale *malaria*

These two species are responsible for the latent forms of the disease, requiring the use of medication that eliminates the hypnozoites, found in the liver of the infected patient. In this scenario, the combination of two drugs is used: chloroquine and primaquine. Chloroquine is an active drug against the parasitic forms found in the blood, while primaquine will be able to eliminate the parasitic form found in the liver. The patient should use chloroquine for 3 days, with the association of primaquine for 7 days. However, primaquine should not be used by pregnant women and its use

should be carefully monitored in order to avoid unwanted cytotoxic effects in the patient. Another drug being studied for the treatment of this scenario is tafenoquine.

P.falciparum and mixed infections

Unlike other species, *P. falciparum* has a high resistance to chloroquine, thus requiring combination therapy with artemisinin derivatives (ACT). Therapeutic regimens include drugs such as: artesunate and mefloquine; artemether and lumefantrine. ACTs can and should be used by pregnant women, as long as they are accompanied throughout pregnancy.

Complicated malaria

In case of complicated malaria, mainly caused by *P. falciparum*, the patient should preferably be treated in a hospital unit. The faster the diagnosis and treatment occurs, the greater the chances of success. The WHO guideline regarding treatment is the use of artesunate, complemented by another reference treatment (according to the species) and the use of primaquine at the end of the therapeutic regimen.

Prophylaxis

For individuals who are outside the endemic area, it is necessary that they inform themselves before traveling to these regions. Exposure should be avoided at times of greatest activity of the insect vector, which begins at dusk and lasts during the night. Repellents and barrier methods should be used, such as wearing clothing that covers the body areas well, as well as mosquito nets and screens on beds and windows.

Much of this care is also directed to residents of endemic areas, in addition to the use of larvicides and insecticides in their homes, avoiding the accumulation of stagnant water, and health education.

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The role of the obstetric nurse: Non-invasive care technologies and pain relief in childbirth

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ABSTRACT

This article aims to describe the non-invasive care technologies used by obstetric nurses in the process of pain relief in the parturitive process. This is a narrative review of the literature carried out between January 2022 and October 2023. A search was conducted for articles published in the last 05 years in the Virtual Health Library (VHL). The interest in developing this work arose from the reflection on the role of the obstetric nurse and the importance of non-invasive technologies used in the parturitive process. The literature review, as a fundamental step for the study, allowed us to gather relevant theoretical information on the subject. The researched literature points to the technologies used by obstetric nurses, favoring the participation of women in the parturition process. The use of these technologies has marked the distinction of the obstetric nurse's practice in the obstetric field, because of which the role of the obstetric nurse in the qualification of care is evidenced, based on the principles of humanization and with the use, as a work tool, of non-invasive care technologies in the parturition process. In this sense, the woman's choice is respected and her protagonism in labor and birth is favored. Therefore, in the technologies used by these professionals, it is characterized by care based on the physiology and exercise of the woman's autonomy, rescuing childbirth as a physiological process.

Keywords: Obstetric Nursing, Labor, Nursing Care, Labor Pain.

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INTRODUCTION

The process of parturition is a relevant topic, which demands in-depth study and analysis, since it involves the lives of women, babies and families. For this reason, this issue has attracted increasing attention from civil society, health professionals and the legal field.

Historically, the monitoring of labor and delivery took place in the home environment, in which the woman was assisted by another woman, usually a midwife or a "groomer" of her trust, and supported by her family members. Midwifery is an art and historical practice, and for many years it was considered an activity exclusively for midwives, who were also responsible for taking care of women during pregnancy, labor, delivery and puerperium, in addition to the newborn1. Midwives were holders of empirical wisdom, shared and passed on from generation to generation by their mentors, associated with their own experience1.

Childbirth is a remarkable moment of relevance for society, as it is a means of maintaining human life; for the family, with the arrival of a new member, the fulfillment of cultural and social desires is fulfilled, as a human, biological and psychological experience. Especially with the process of hospitalization of labor and birth, the physiological act of giving birth came to be seen as pathological, favoring the technique and practices that were medicalized and centered on the hospital environment. In the twentieth century, more expressively after the Second World War, in the name of reducing the high rates of maternal and infant mortality, childbirth was institutionalized[2]. This process involved the advent of technology, contributing to the gradual departure of childbirth care from the home environment to the hospital environment, a process that affected not only obstetric care, but the entire health area3.

In this sense, the present study is justified by the interest in developing a reflection on the role of obstetric nurses in pain relief during labor and birth and the importance of the technologies used by these professionals. In this sense, the objective of this study is to describe the pain relief technologies used by nurses in parturition and the role of this professional.

HISTORICAL PERSPECTIVE AND LEGAL FRAMEWORK

In a historical temporal assessment, in Brazil, in 1998, the Ministry of Health (MS) officially recognized childbirth care by obstetric nurses in hospitals affiliated with the SUS and normalized the remuneration of these professionals. In 1999, as a defining framework for a new childbirth care policy, the Ministry of Health proposed the creation of Normal Birth Centers (BC), units that allow care for births of usual risk outside hospitals. Professional care during labor and birth, for women and newborns, is provided exclusively by obstetric nurses, and there is no need for the presence of medical professionals[4].

The obstetric nurse is a professional qualified to provide care for normal childbirth without

dystocia, with skills and competencies that provide technical and scientific safety supported by law, therefore, it is up to the obstetric nurse to understand all dimensions of the labor and birth process. Their professional training is based on ethical principles and scientific evidence, aimed at providing care using fewer interventions and adopting a more humanistic approach, with respect to the physiological processes and individualities of each woman[5]. The obstetric nurse seeks to ensure a healthy and iatrogenic-free delivery, with physical and emotional support, aiming at the well-being of the woman and newborn. This is because the act of caring begins with reproductive planning, going through prenatal care and continuing until the puerperium.

Ordinance No. 2,815 of May 29, 1998 of the Ministry of Health (MS), includes in the table of the Hospital Information System of the Unified Health System (SUS) the procedure "normal delivery without dystocia performed by an obstetric nurse" and its main purpose is to recognize the care provided by this professional category, in the context of humanization of childbirth. In addition, the Ministry of Health (MH) technically and financially promoted specialization courses in obstetric nursing because it noticed the small number of professionals working at the beginning of this century, even though it is estimated that the number of deliveries performed by these professionals is higher than that recorded in the SUS[6].

Nursing has its professional practice regulated by Law No. 7,498/86, Decree-Law No. 94,406/87, which also supports the professional practice of obstetric nurses. In this legislation, the nurse is privy to, among other functions, the direction of the nursing body that is part of the basic structure of the health institution, public or private, and the head of the service and nursing unit. In relation to obstetric care, the nurse provides nursing care to pregnant women, parturients, postpartum women and newborns; monitoring the evolution of labor; obstetric care in emergency situations and delivery without dystocia[7].

Technical knowledge, preparation and evidence-based practice are relevant for nurses to provide humanized care during labor. The obstetric nurse's practice is not limited to the delivery room, contemplating sexual and reproductive planning, working from the prenatal period to the puerperium. Its role encompasses welcoming women; the promotion, encouragement and support of breastfeeding; guidance and support for the exercise of women's autonomy and their sexual and reproductive rights, encouraging practices favorable to maternal and newborn health, in usual situations and/or in cases of complications8. The obstetric nurse does not replace the physician in high-risk pregnancies, as this is part of the multidisciplinary team, which in interdisciplinary work, provides singular care9.

Still in public policies in the area of women's health, in 2001 the Ministry of Health published the Manual Childbirth, Abortion and Puerperium – Humanized Assistance to Women. The publication defines the concept of humanization of care and defends a new perspective, in which the

care provided should be effectively beneficial, unnecessary interventions should be avoided, and maternal privacy and autonomy should be preserved[10].

The Federal Council of Nursing (COFEN) assigns to the obstetric nurse the competencies of welcoming women and assessing maternal and fetal obstetric clinical conditions. It includes, along with the promotion of the humanized care model for labor and birth, the offer of non-pharmacological methods of pain relief, the freedom to choose the position during childbirth, the immediate contact of mother and newborn, the preservation of perineal integrity, encouragement of exclusive breastfeeding until the newborn is 6 months old, as well as respect for the ethnic and cultural issues of women and their families11.

HUMANIZED ASSISTANCE

Qualified assistance during labor is essential for the best results to be achieved for the mother and the baby, both from a physical and emotional point of view. In order to achieve these goals, it is necessary that attitudes, measures and interventions adopted by care professionals are based on the best available evidence12.

The term "humanize" and its derivatives have acquired equally diverse meanings in different contexts. With regard to the phenomenon of childbirth, it refers to an attention that starts from the recognition of the fundamental rights of mothers and newborns and the right to appropriate technologies in care. This set of demands includes the right to choose a place, people and forms of care during childbirth; the preservation of the bodily integrity of mothers and babies; respect for childbirth as a highly personal, sexual and family experience; health care and emotional, social and material support in the pregnancy-puerperal cycle; Protection against abuse and neglect[13].

The humanization of childbirth care also implies, and mainly, that the professional's performance respects the aspects of physiology, without unnecessary interventions, recognizes the social and cultural aspects of labor and birth, and offers the necessary emotional support to the woman and her family, facilitating the formation of family affective bonds and the mother-baby-family bond[14]. The nursing care technologies employed by obstetric nurses contribute to the rescue of labor and delivery as a physiological event, preventing traumatic effects for the woman and her baby, thus the humanization of labor and birth has become a premise for some health institutions and professionals, who have come to understand the woman/parturient as the main subject in pregnancy. in childbirth, in the puerperium and in the care of the newborn, excluding ineffective obstetric routines and valuing the woman as the conductor of childbirth, attending to her in all dimensions and valuing the essential aspects of the human being[15].

The model of humanized care in parturition is an ideal that is increasingly becoming an experienced reality. To humanize is to provide quality care to the parturient through pain relief,

promotion of physical and emotional comfort, freedom of choice of her companion, and how she wishes to have her child, favoring positive experiences in a peaceful process16.

It should also be noted that, in article 2 of Ordinance No. 569, of June 1, 2000, it is described that every pregnant woman has the right to dignified and quality care during pregnancy, childbirth and puerperium, that is, for a long time there have been means to protect women, with the aim that they are respected and have their rights guaranteed17.

The birth plan is an important tool to stimulate the empowerment of pregnant women, favoring the woman's protagonism in her delivery. This is an educational instrument with high educational potential, which stimulates communication between the woman and the health team. The birth plan is a document that the woman can use to fill in her personal information and preferences for the experience of labor, delivery and immediate postpartum. This document gathers all the woman's wishes for the birth of the baby, from admission to discharge from the delivery service. This includes, for example, the choice of companion, positions and measures in an emergency situation18.

In summary, prenatal care, labor and delivery, and the right to informed choice are intertwined, ensuring that expectant mothers receive information and adequate support to make informed decisions about their health and that of their baby.

PAIN AT THE TIME OF CHILDBIRTH

The pain experienced by women during the parturition process is a subjective experience where different behaviors can be identified in relation to them, which vary according to culture and time. The fear of pain during childbirth is one of the main reasons that lead women to opt for cesarean section. Pain also results in a psychic response and reflects on physical actions. The pain that women feel during labor and delivery is individual and influenced by different factors[19].

Labor pain differs from other types of pain for several reasons, because it has an intermittent character, converging with uterine contraction, which gradually increases in duration and intensity until it reaches its peak. In the interval between contractions, there is often no pain, pressure, or discomfort, allowing the woman to relax, meditate, breathe deeply and often even sleep20. Pain during labor is a common symptom, which involves biological aspects such as uterine contractions, cervical dilation, fetal pressure, individual tolerance, and pain perception factors, which can be cognitive, environmental, and social. In addition, it is an important physiological aspect, responsible for triggering the release of endorphins and other endogenous substances also related to the feeling of pleasure and satisfaction during childbirth[21].

It can be seen that a person's painful experience is influenced by numerous factors, including previous experiences with pain, anxiety, culture, age, gender, and expectations. These factors can increase or decrease the perception of pain, according to the sociocultural and psycho-affective

context of the parturient. The pain threshold is the minimum stimulus to which a person reports pain, with tolerance being the maximum amount of pain a person can tolerate. The sensory experience of pain depends on the interaction between the nervous system and the environment. The processing of noxious stimuli and the resulting perception of pain involve the central and peripheral nervous systems[22]. Pain modulation is carried out by endogenous analgesic mechanisms, characterized by a pathway in which pain information travels through the nervous system to the brain. The pain-causing agent is detected by nociceptors, axons of nerve cells located in the spinal cord, which carry painful information from its peripheral origin to the central nervous system. The uterus, including the cervix, has sensory fibers that reach the spinal cord, accompany the sympathetic nerves, the cervical and pelvic uterus plexuses, which unite with the hypogastric nerve that passes through the round ligament of the uterus, receiving other branches of the labia majora from the anterior region of the abdomen and the rectal muscle. Following the iliac crest, joining the superior hypogastric plexus, entering the lumbar sympathetic chain and the lower lumbar thoracic chain, passing through the communicating branches and posterior roots of dorsal segments 11 and 12 and later through segments (T10 and L1)[19].

The adrenocorticotropic hormone (ACTH), oxytocin and prostaglandins, act as a modulator, inhibitor and stimulant of pain, respectively, in any situation of stress, contraction or hypertonia of the sympathetic system can produce pain. Oxytocin and prostaglandins, as contraction hormones act together, estrogen, increases the concentration of prostaglandins causing the contraction of the endometrium and consequently the expulsion of the fetus. The presence and action of these substances are present continuously, in situations of synthetic oxytocin perfusion or use of drugs whose active ingredient is prostaglandin, the production of endorphins is inhibited, with an increase in the intensity of pain perception[20].

Pain influences the stimulation of oxytocin production, and it is conducive to avoiding pharmacological analgesia methods at the beginning of labor[23]. One of the mechanisms of oxytocin production at the beginning of labor occurs due to hormonal exchanges, the placenta and the stimulation of the cervix caused by active fetal movements.[20] Situations that stimulate a trigger in the release of hormones from the adrenaline family tend to stimulate the neocortex, inhibiting the labor process.

Another hormone of paramount importance is oxytocin, called the love hormone. The hormones secreted during childbirth originate in the archaic part of brain structures, such as the hypothalamus and pituitary gland. It can be stated that the behavior of mother and baby is under the influence of numerous hormones that are secreted during labor and delivery[23].

Labor is divided into four stages: the first stage begins with regular uterine contractility, effacement of the cervix, the beginning of the descent of the uterine cervix, and ends with complete

dilation of the cervix; the second stage begins with the complete dilation of the cervix and ends with the expulsion of the fetus; the third stage runs from the end of fetal expulsion to complete expulsion of the placenta and its membranes; The fourth stage takes place during the two hours after placental delivery, also called immediate puerperium[24].

Physiological childbirth refers to childbirth that can take place freely, without limiting the expression of the woman's behavior, without pharmacological procedures, or surgical interventions. In addition, it is a universal phenomenon that occurs among most women23. Women need to be understood as protagonists in their physiological processes, in the face of individual demands, with respect to the freedom to give birth. These factors contribute to women going through labor, reinforcing their importance and their central role in this process. In this context, the obstetric nurse has been the professional who presents the practice based on the use of non-invasive care technologies as a scientific, safe and favorable strategy.

NON-INVASIVE OBSTETRIC NURSING CARE TECHNOLOGIES

The non-pharmacological approach to labor and birth contributes to pain relief and the maintenance of the perception of personal control of the parturitive process, reducing discomfort and favoring a positive birth experience[12].

Obstetric nursing care technologies are defined as the set of techniques, procedures and knowledge used by nurses during their professional care relationship, understanding childbirth as a physiological process, respecting its nature, the bodily and psychic integrity of the women assisted26.

The use of these technologies by obstetric nurses marks the distinction of their practice in the obstetric field, thus being an important contribution to the full exercise of women's citizenship. The technologies used are non-invasive, encouraging women to be empowered to use their instinct at the time of childbirth27. During the labor period, pregnant women are encouraged to practice comfort, pain relief, anxiety and fear of childbirth, without the use of medications, and may use scientifically proven methods.

The main non-invasive obstetric nursing care technologies for pain relief in labor and delivery are: distraction and relaxation techniques, pelvic movements, ambulation, use of the ball, support bar, delivery stool, massage with vegetable oil, controlled breathing techniques, sprinkler bath, ambient music21. Below, more about some of the technologies used has been described.

Continuous support: it can be offered by a person of the pregnant woman's choice, such as her companion, for example, being this one's partner, mother or friend. The right to a companion is recognized by the Ministry of Health6. Scientific studies have shown that prenatal care and the parturition process, when performed with the presence of a companion, bring benefits and avoid problems to women's health. Women assisted by the Unified Health System (SUS) have the right to

choose a person they trust to be present in the delivery room and also during the postpartum period. The presence of a companion during childbirth and postpartum in SUS maternity hospitals is guaranteed by Law 11.108, of April 20056. The emotional support of a companion is important and effective, contributing to the labor and delivery process. It is necessary for the parturient to trust the people around her and to perceive the harmony between them. There needs to be understanding, patience, competence and respect for their rhythms and timings. Ongoing support can also be offered by the childbirth care health professional.

Ambience, Silence, Privacy, Darkness – For most women, an environment in the dim light or in the dim light is more conducive to relaxation. The childbirth environment should be comfortable for the parturient, favoring relaxation and undoing external distractions and sensory stimuli. A serene environment helps women to concentrate on themselves28. When the environment generates some kind of fear and anxiety, there is an increase in the secretion of adrenaline and possibly inhibition of labor.

Walking and Pelvic Movements - it is important for women to move freely and adopt positions that best suit them. Walking during labor increases the intensity of contractions (shortening labor), favors the blood flow that reaches the fetus through the placenta, being more abundant and reducing the perception of pain[27.] The freedom to move is very important, this means allowing the woman to walk, rock, perform a rotational movement with the hip, sit, lie down and get up whenever she wants, these being fundamental rights of women in the parturitive process.

Positioning – The position chosen by the woman during labor interferes physiologically and anatomically in this process. Some positions can increase blood flow to the uterus or can give more comfort. Choosing more comfortable positions tends to relieve fatigue, promoting greater comfort by activating circulation. In vertical positions, the contractions become more intense and with longer duration, favoring the effacement of the uterine cervix and the descent of the fetal presentation due to the force of gravity, with lower energy consumption of the parturient and improvement of cardiac output27. The squatting position is a position that favors the physiological process of childbirth, because the pelvis reaches maximum opening, added to the action of gravity and effective uterine contractions, which facilitates the descent of the fetus29. In the lateral position, contractions occur more intensely and shorter, a position that does not have the help of gravity, but can provide comfort and rest for the parturient27. The left lateral decubitus helps to reduce pressure on the inferior vena cava and abdominal aorta, improving blood supply and, consequently, oxygen supply to the baby29. The supine position promotes the compression of these vessels, which can lead to maternal hypotension, reduction of fetal heartbeat, as well as larger and shorter contractions. In this position, when the uterus is forced, it compresses the organs of the respiratory system and the inferior vena cava, which can cause the sensation of "shortness of breath" and hinder expulsive efforts. Widely

used in hospitals, its use promotes a longer expulsive period[27].

Warm sprinkler bath - labor in water becomes easier, more comfortable, and more efficient, due to the buoyancy or upward force of the water, reducing gravity, facilitating the variety of positions, minimizing the feeling of heaviness during contractions[29]. Warm water promotes comfort and relaxation and may reduce the need for pharmacological methods of pain relief30. With the heat of the water, there is a reduction in the secretion of adrenaline and relaxation of the muscles28.

Swiss Ball – consists of an inflatable rubber ball, used to relieve pain and discomfort in labor, as well as to favor its evolution. On the ball, the parturient can sit with the spine well aligned, being able to relax still or perform rotating movements (waddling). In addition to aiding in fetal descent, it also relieves pain. During contractions, the movements relieve tension, providing comfort between and during contractions, favoring the physiological process of birth31. The woman in the sitting position performs a pelvic balance, assisting in the descent and rotation of the fetus, providing a feeling of relaxation.

Delivery stool – its use aims at relaxation, increased dilation and reduction of pain, allows the parturient to sit, rest her feet on the floor and her arms on the bed, on her companion or professional who is accompanying the delivery. In this position, it is possible that the companion or the obstetric nurse massages the lumbar region of the parturient 31.

Wheelie – it is similar to a chair with an inverted seat, where the pregnant woman supports the chest and arms throwing the weight forward and relieving the back, widely used to help relieve pain, promote pelvic balance and the progress of labor31. During contractions, the parturient can also stay in this position to receive lumbar massage, in order to relax and relieve pain during labor.

Massage and Aromatherapy – the nerve impulses generated by massage in some regions of the body will compete with the pain messages being sent to the brain, reducing painful sensations. They are different nerve impulses, competing for the same receptors in the brain[32]. Aromatherapy is a therapeutic method in which the application of essential oils is used, these extracted through flowers, leaves, fruits, stems, seeds or roots. Aromas are reproduced by almost all ancient civilizations, being used through the use of essential oils, incense, perfumes and creams. When used in labor, it can bring benefits such as relieving painful sensations and progression of labor, reducing anxiety and fear, among others, making childbirth more comfortable and increasing the parturient's sense of well-being in such a remarkable and unique moment33.

Rebozo - is a technique that uses a shawl to perform massages and assist in the movement of the pelvis, rhythmic, smooth and controlled movements can be performed, in order to promote muscle relaxation and ligaments of the lumbar and pelvic region. This care favors the descent of the fetal presentation and, when necessary, corrects cases of asynclitism, being contraindicated in the face of maternal discomfort, non-reassuring fetal heart rate, abnormal vaginal bleeding and risk of

cord prolapse or placental abruption[32].

Controlled breathing – Practicing slow, deep breathing can provide confidence in your ability to stay calm during labor. In turn, deep breathing contributes to the prevention of hyperventilation, and deep breathing can also be used as a strategy to relax29.

The obstetric nurse (OBE) plays a fundamental role in guiding women about the options available for pain relief and relaxation during labor and delivery. In this dialogue, this professional informs about the advantages and disadvantages and, together, there is the choice of the most favorable technologies for the woman, according to the needs and convictions of the woman, safeguarding maternal and fetal safety21.

METHODOLOGY

This is a narrative-type bibliographic research, carried out through the review of the reading, selection and registration of topics of interest for the research34. To carry out this research, the qualitative approach was chosen, as it seeks to understand the phenomena through their description and interpretation[35].

A literature review of articles published in the last five (5) years on the theme was carried out, seeking to answer questions on the subject, revealing ideals and practices related to the process.

To this end, a bibliographic survey was carried out in the Portuguese/Spanish languages, in the Virtual Health Library (VHL), using the databases LILACS (Latin American and Caribbean Literature in Health Sciences), IBECS (Spanish Bibliographic Index in Health Sciences), MEDLINE (International Literature in Health Sciences).

The search for articles was carried out using the following keywords: Obstetric Nursing; Labor, Nursing Care, Labor Pain. At first, the search was carried out with the use of a single descriptor or word, where a large number of articles to be worked on were found.

Chart 1: Quantitative distribution of the bibliographies found in the VHL through the individual descriptors.

DESCRIPTORS	LILACS	IBECS	MEDLINE
Nursing Obstetric	417	42	29
Labor	580	111	124
Assistance from Nursing	5252	1564	733
Labor Pain	166	733	31

Source: The author, 2023.

Subsequently, the search for descriptors was carried out in an associated way, so that the

articles could be closer to the theme addressed. In this way, the result is organized in table 2.

Chart 2: Quantitative distribution of the bibliographies found in the VHL through the associated descriptors.

DESCRIPTORS	LILACS	IBECS	MEDLINE
Enfermagem Obstétrica AND Trabalho de Parto	125	04	11
Enfermagem Obstétrica AND Trabalho de Parto AND Assistência de Enfermagem	93	04	09
Enfermagem Obstétrica AND Trabalho de Parto AND Assistência de Enfermagem AND Dor do Parto	24	01	00
Total	24	01	00

Source: The author, 2023.

By means of refinement, the articles were directed to the proposed theme, thus performing the pre-reading, which was done by examining the cover page or summary of the bibliography indexes and footnotes. With these elements, it was possible to have a global view of the text, as well as its usefulness for the research35. The next stage was then reached, which was the selection of the material related to the research. Selective reading is then carried out, which is deeper than pre-reading, as it allows the resumption of the same material with different purposes, in which the subjects that are related to the objective of the work were selected, thus forming the potential bibliography, adding up to a total of 13 articles.

Table 3: Total articles used in the formation of the Potential Bibliography

DESCRIPTORS	LILACS	IBECS	MEDLINE	TOTAL
Obstetric Nursing; Childbirth Pain; Labor and Delivery; Nursing Care **Nursing**	**12**	**01**	**00**	**13**

The articles obtained were numbered according to the year of publication, in ascending order and analyzed in a descriptive manner, guided by the objectives proposed here. In possession of the articles in full, we opted for the analytical reading. The purpose of this stage was to organize and summarize the information contained in the sources in order to obtain answers to the research problem[35]. Finally, the construction stage was reached, through interpretative reading, in which the reader interacts with the text and leaves his passive position of receiver of the message, becoming a builder of new knowledge.[34th]

Table 4: Selected articles from the Potential Bibliography

1- Non-invasive care technologies used by obstetric nurses: therapeutic contributions. (Port/ESP – 2022)
2 - Use of non-pharmacological methods of pain relief in normal childbirth. (Port. 2021)
3 - Coexistence and prevalence of obstetric interventions: analysis of childbirth care models in public and private maternity hospitals in Belo Horizonte. (Port/Esp – 2021)
4 - Women's expectations and (dis)satisfaction with normal childbirth care Hospital: perspectives for quality. (Port/ESP – 2021)
5 - Obstetric nurses in the parturition process: women's perception. (Port/ESP – 2020)
Maternal and perinatal parameters after non-pharmacological interventions: a trial randomized controlled trial. (Port/ESP – 2020)
7 - Care practices in habitual risk deliveries attended by nurses Obstetric. (Port - 2020)
8 - Care technologies for pain relief in parturition. (Port/English – 2020)
9 - Obstetric nurses' performance in habitual risk childbirth: a care guide. (Port – 2019)
10 - Obstetric violence: an integrative review. (Port – 2019)
11 - Analysis of maternal and neonatal outcomes associated with the interventions performed during labor of low-cost nulliparous women. (Port – 2019)

12 - Effectiveness of non-pharmacological procedures for pain relief Parturients: contributions to obstetric nursing. (Port/ING – 2019)
13 - Contributions of Obstetric Nursing to Good Practices in Labor and vaginal delivery. (Port – 2019)

RESULTS AND DISCUSSION

From the interpretative analysis of the data extracted from the 13 articles read in full, it was identified that the articles address the importance of humanization in parturient care; the role of the obstetric nurse in the parturition process as a care differential and the non-invasive technologies used in nursing care for pain relief in the parturitive process.

THE HUMANIZATION OF PARTURITION CARE

In the contextualization presented by the authors of the texts, it was possible to verify that in order to humanize care, the nursing team needs to be available to provide comprehensive care to the parturient. It was found that, although humanization is widely discussed, in some institutions it is still possible to find practices related to the biomedical model, performed by the nursing team, which is characterized by technocratic care, where actions are very fragmented and individualized. In order to change this reality, it is necessary to be involved and open to the process of updating care practices, towards comprehensive care with appreciation of the individuality of each assisted woman.

It was observed that the humanization of care for women consists of welcoming the parturient, respecting her individuality, offering a safe environment, providing the opportunity for the presence of a companion of the woman's choice and avoiding harmful interventions, rejecting the use of harmful technologies, rescuing childbirth as a physiological process. It is worth noting that in the proposals for the humanization of childbirth care, professionals are engaged in comprehensive care and assistance, respecting women's choices, recognizing them as protagonists of labor and birth. It is necessary to recognize the vulnerability of women in the process of labor and birth, in which varied feelings can emerge and beyond the sensation of pain. At this moment, pain is understood not only as a universal manifestation of an organic process, but also as a symbolic construction that varies according to the sociocultural context and the subjectivity of the woman. Women must be cared for considering their uniqueness and with respect, and for this to occur, professionals have to engage in this purpose, which is to humanize care.

THE ROLE OF THE OBSTETRIC NURSE IN PRE-DELIVERY AND DELIVERY, AS A DIFFERENTIAL OF CARE.

It was evidenced that the care provided by the obstetric nurse is specialized and constantly

undergoes improvement with a view to sensitive and attentive care, based on technical and scientific competence. However, these professionals face challenges in their daily practice, providing challenges for their performance.

The work of these professionals is based on the knowledge of the physiology of labor and birth, recognizing and valuing the social and cultural aspects of childbirth. The obstetric nurse has the responsibility to recognize the parturient's situations and condition, using active listening as care tools. Obstetric nurses should develop critical and reflective reasoning about their actions so that they can act effectively in the promotion of care, so that the proposed strategies are successfully achieved, favoring a pleasurable, positive birth experience. It was verified through the listed texts that the care provided by the obstetric nurse in physiological childbirth presents an essential differential of care, as it contemplates the woman in her integrality, different from the biomedical model. The obstetric nurse has been working in accordance with the new guidelines of the World Health Organization and the Ministry of Health, developing humanized care practices in favor of physiological delivery.

THE NON-INVASIVE TECHNOLOGIES USED BY THE OBSTETRIC NURSE IN LABOR FOR PAIN RELIEF.

Non-invasive technologies for obstetric nursing care are based on the humanistic model of care, which are mainly characterized by non-invasion and respect for women's autonomy and privacy.

It was verified, when analyzing this category, that the non-invasive technologies used by obstetric nurses favor the rescue of physiological childbirth, since it favors the empowerment of women for decision-making, favoring a more natural and satisfactory experience. Care technologies are said to be non-invasive because they offer women the right to use them or not. The objective of the use of these technologies is for the woman herself to have the freedom of choice in her labor, being the protagonist of her process, and the obstetric nurse contributes to this process. Therefore, it is necessary that this professional is able to provide physical and emotional support to the parturient, through non-invasive technologies such as, for example, relaxation techniques, stimulation of ambulation, favoring the use of water through immersion or sprinkler baths, the participation of a companion of the parturient's choice, and a pleasant environment. The articles show that technologies can be used in an associated way, such as: bathing, ambulation, pelvic movements, massage and the participation of the companion, always respecting the woman's opinion. The birth environment should be conducive so that the parturient can relax, perceive her needs and with the minimum of external distractions and sensory stimulation.

The term care technologies was defined as "all the techniques, procedures, and knowledge used by the obstetric nurse during the patient care process. When it comes to obstetric care, the use of

care technologies brings childbirth closer to a natural, pleasurable and interactive phenomenon between mother and baby.

FINAL THOUGHTS

There is a growing social movement for the humanization of parturition care in Brazil, with the purpose of respecting the physiology of childbirth and the role of women in this process. In view of the objective delimited in the process of carrying out this research, the professional training of obstetric nurses in the process of humanization is essential, with this the need for personal and institutional attitudes is evident, which seek to raise awareness that this professional has technical skills, knowledge and legal anchorage to qualify care, in the principles of humanization. The results obtained in the present study are subsidies for reflections on the parturition process, as well as for the role of the obstetric nurse and the care strategies based on humanization by these professionals.

It should be noted that in recent years, childbirth care in Brazil has been a subject present in militancy in the obstetric scene, by women and professionals engaged in feminist movements, causing the theme to reach an effervescence in the academic environment, in government agencies and in social networks. Thus, emphasis is placed on discussions such as: obstetric violence, high rates of cesarean sections and the challenges faced by obstetric nurses in the exercise of their profession. This study demonstrated aspects related to fundamental human rights, such as the dignity of the human person, the patient's autonomy and the duty to inform.

It is hoped that this study will contribute to the visibility of the importance of professional training, with a view to updating and improving the care provided, based on scientific knowledge combined with welcoming and respect for the uniqueness of the assisted woman. The use of non-invasive care technologies favors the participation of women during pregnancy, labor and birth, knowing the changes in their body, with decision-making based on guidance, clarification and encouragement of participation. Finally, although the hegemonic physician-centered model is the most recurrent in Brazil in an interventionist and often traumatic scenario for women, the care provided by obstetric nurses has enabled improvements and favorable changes for the obstetric area. This is because their care is based on good obstetric practices, scientific evidence, welcoming, theoretical, practical and legal frameworks that anchor the practice of obstetric nurses.

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Evolution of soybean cultivation in lowlands: An overview from the producers' point of view

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ABSTRACT

It is known that soybean cultivation in recent years has shown a growing behavior in its use in succession with the production of irrigated rice in lowland areas. As a result, there are gaps both in the implementation of this succession and in its duration. Soy becomes an important ally to these production systems due to nutritional factors both for the environment (soil and weed control) and for the economic side of the property. Aiming to have an overview of the real situation of the properties in the physiographic region of the western border of Rio Grande do Sul, the present work proposes a research with the survey of general characteristics of the implantation and persistence of the succession systems of soybean with rice in lowlands, a since knowing the production deficiency gaps, you can have a better problem solving focus. A tester was developed and imposed on 10 properties that already have the system implemented. The questions involve since the beginning of the implantation, as well as the current progress of the system, correlating sowing, cultural and harvest management factors. With the results obtained, it was concluded that the gaps in the soybean-rice production system are in the phase of establishing crops and maintaining them, that is, in sowing and spraying, since the soybean harvest when detected with that of rice becomes easier due to its greater fluidity and lower depreciation of the machinery.

Keywords: Agricultural research, Lowlands, Soybean farming, Rice farming.

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INTRODUCTION

Currently, CONAB (2022) estimates a production of 10.5 tons of rice (*Oriza Sativa* L.) throughout Brazil in the 2021/22 harvest, 10.5% lower than in 2020/21, with Rio Grande do Sul (RS) responsible for approximately 957.4 thousand hectares planted, with a total production of 7,360.5 tons, 11% lower when compared to the previous year. Predominantly, the rice areas are leveled to increase the efficiency of rice production (GIACOMELI et al., 2021), allying with the rammed earth system at level for water retention in the frames.

The stagnation of irrigated rice production, together with the resistance of invasive plants to herbicides used in rice cultivation (RAO et al., 2007), in addition to the instability of the price of the product, makes it necessary for the producer to pay attention to the diversification of the system so as not to take risks with monoculture. As an option for crop rotation with irrigated rice in lowlands, we have the soybean crop (*Glycine max*), which in the 2020/21 harvest was present in 370,594 hectares (39.2%) of the 945 thousand hectares of rice cultivation, according to the Riograndense Rice Institute (IRGA, 2021).

The cultivation of soybean in rotation with rice becomes an important ally for weed control, which is one of the problems present in rice growing areas in RS (MARCHEZAN, 2016; ROSSO et al., 2018), is also a good alternative due to its good economic return, in addition to the producer being able to rely on technologies already existing in the production medium, thus enabling its cultivation by them (HIRAKURI et al., 2021).

There are about so many variabilities in the production systems, also the climatic variations imposed, in addition to the fluctuations in the prices of the inputs used, make it necessary to understand the main challenges and the main advantages in the view of the rural producer of the means of production, so that the focus is on identifying and solving the possible barriers imposed. thus, making it possible to improve the systems.

However, the present study is characterized as a tool for understanding the aforementioned issues, in order to have a perspective on the view of rice and soybean producers in fragile lowland areas, with a main focus on areas of the western border of Rio Grande do Sul (RS). In this sense, the objective of this work was to understand the situation of the production systems from a point of view directly linked to the producers of the Western Frontier of RS in the implementation and permanence of rice and soybean rotation systems in floodplains.

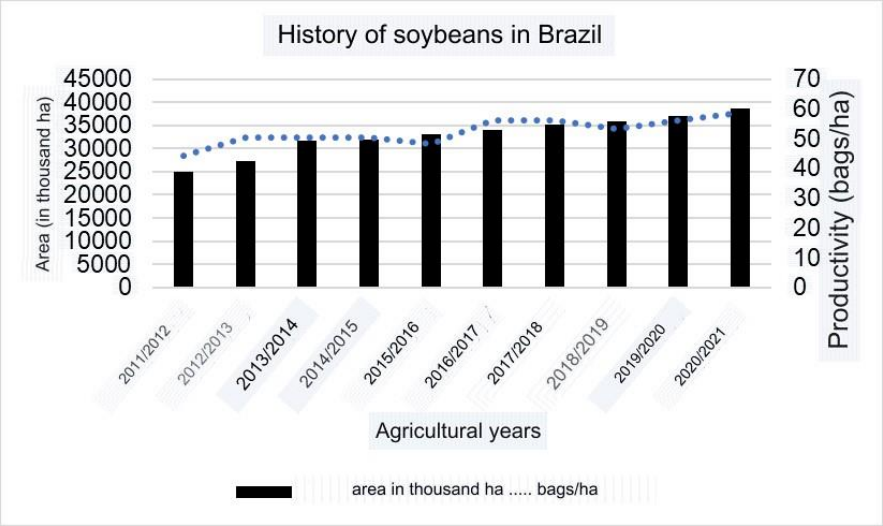
LITERATURE REVIEW

SOYBEAN CULTIVATION IN BRAZIL AND RIO GRANDE DO SUL

Soybeans are a widely produced legume worldwide, they are also the main source of protein meal and the second largest source of oil (UNITED STATES, 2021). Soybean cultivation in Brazil

began in 1901, but showed greater expansion along with Japanese immigration in 1908 (APROSOJA, 2022). Brazil is considered the second largest producer and exporter of soybeans (CONAB, 2020). When considering the last 10 harvests in Brazil, Hirakuri et al. (2021) observed an upward trend in production areas, from 25Mha in the 2011/2012 harvest to 38.5Mha in 2020/2021. Figure 1 shows the increase in average productivity over this period.

Figure 1 - Evolution of soybean areas and productivity in the last 10 harvests in Brazil.

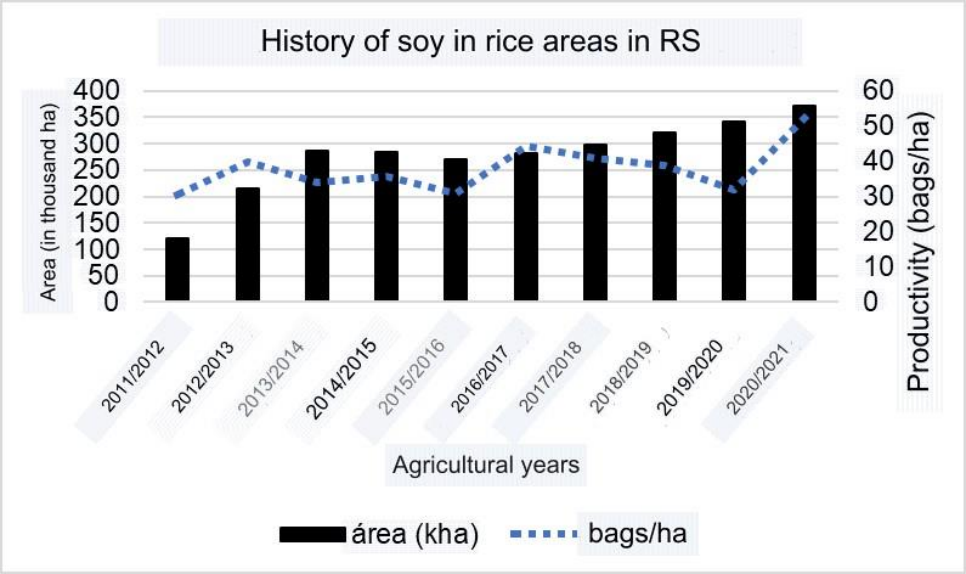


Fonte: Adapted from CONAB (2020).

Soybean cultivation in Rio Grande do Sul began in 1914, but only became economically important around 1941 in Santa Rosa (NUNES, 2022). RS presents an evolution in the area and in soybean production, according to the Riograndense Rice Institute (IRGA, 2022) we have a great advance of soybeans in rice areas, reaching a 205% increase when we compare the 2011/2012 harvest with that of 2020/2021, with the increase in the area from 121kha to 370kha, with productivity averages of 30.5 bags/ha and 52.3 bags/ha, respectively (Figure 2).

The productivity averages shown in Figure 2 are lower than the national averages (Figure 1), however the evolution towards higher productions is a trend. Present in the expansion of soybean cultivation are the areas in Figure 2, where soybean is adopted as a crop for rotation with irrigated rice, connected to this are factors of soybean remuneration capacity and the technologies present for the viability of this cultivation (HIRAKURI et al., 2021).

Figure 2 - Evolution of soybean areas and productivity in the last 10 harvests in Rio Grande do Sul.



Source: Adapted from IRGA (2022).

However, most of the production areas in Figure 2 are floodplain soils. Goulart (2016) mentions that the use of rainfed plants in lowland environments still encounters the resistance barrier of some farmers, as they are environments with low hydraulic conductivity problems. Vogel et al. (2021) state that unlike rice, soybeans need a well-drained environment. Environments with the use of ridges to elevate the root system of the soybean plant becomes a simple and effective method to avoid high levels of moisture in the soil. Takahashi et al. (2006) also point out that this soil management provides an increase in roots and nodulation, thus increasing the capacity for N absorption, provided via biological nitrogen fixation.

Rice vs. soybean succession

What is called rotation by many is actually a succession, because it involves only two cultures one after the other, what often changes is the intensity of this succession. In crop rotation, two or more plants should be grown in the same area over a period of one year (SILVA, 2017). At the beginning of soybean cultivation in succession with rice, there was the great premise of controlling the main weed of rice, red rice (*Oriza sativa* L.) which, according to Agostinetto et al. (2001), limits the yield of commercial rice, and is even capable of making its cultivation unfeasible in some areas. Currently, the use of technologies available in rice seeds alone is not effective for weed control, due to the resistance acquired to their active ingredients, thus making the monoculture of irrigated rice unfeasible (GASTAL et al., 2004; GOULART, 2016).

Several benefits are evidenced in systems that use crop variation in the same area, such as improved soil structure (SANTOS et al., 2000), greater economic stability of the system (HIRAKURI et al., 2021), nutrient cycling (DALLA NORA et al., 2013), however, there are limitations regarding the plant options that can be used in lowlands.

Soybean becomes a good ally for the floodplain production system. Goulart et al. (2020) mention that the soybean crop was genetically adapted to well-drained environments, but originated from the flooded areas of northern China (EVANS, 1996). Thomas et al. (2000) point out that there may still be genes capable of adapting their cultivation in floodplain soils. Silva et al. (2017) point out that the crop succession system should be planned, considering factors such as the requirement of the crops, edaphoclimatic characteristics of the area, and suitability for each crop. According to a report by Canal Rural (2020) using IRGA as a source, the succession of rice with soybeans increases rice productivity by 20%, when compared to systems with monoculture or integrated with beef cattle.

For greater security of the production system, the amounts of planted area of each crop must be adjusted, so that dependence on only one means of production does not occur. Hirakuri et al. (2021) simulated three systems: rainfed soybean with irrigated rice, rainfed soybean with soil chiseling and irrigated rice, and soybean in the irrigated furrow-ridge system and irrigated rice, where an area with 300 hectares in rotation was considered, all with ryegrass (*Lolium multiflorum) winter cover*. As a result, the authors found that, even with the additional costs of the construction operations of the furrow-camalhão and irrigation for soybean, there is still greater viability and better commercial return of soybean in the system.

Soybean soils and cultivars

In Rio Grande do Sul, there are five major physiographic regions, which, according to the Soil Museum of Rio Grande do Sul, of the Federal University of Santa Maria (MSRS, 2022), affect the formation and distribution of soils in the state. According to Pinto et al (2017), areas with an altitude below 200 meters cover a total of 4.4 million hectares, corresponding to 16.5% of the total area. Cunha & Costa (2013) and Goulart et al. (2020) mention that these areas were used only for raising cattle on native pastures until the arrival of irrigated rice production in these environments. Table 1 shows the main soil classes of RS, according to the Brazilian Soil Classification System (SANTOS et al., 2013), where all the soils mentioned represent 17.3% of the total area of the state, with the Haplic Planosol being the most recurrent type in floodplain environments.

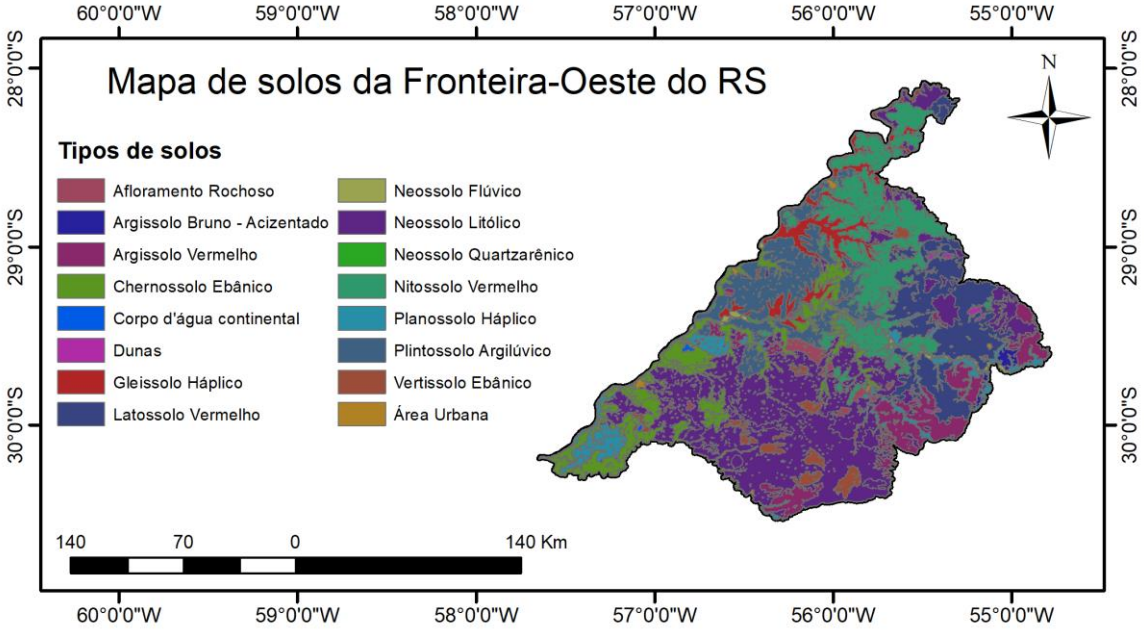
Table 1 - Main types of soils in floodplain areas of Rio Grande do Sul in their total area and relative percentage.

Class	Area (ha*)	% Status	% Floodplain
Haplic Planosol	2.520.423	9,37	54,27
Gleissolo Háplico	250.520	0,93	5,39
Melanic Gleisol	9.432	0,34	1,97
Organosol	39.572	0,15	0,85
Ebonic Chernosolus	276.199	1,03	5,95
Chernossolo Argilúvico	195.832	0,73	4,22
Chernossolo Háplico	228.540	0,85	4,92
Vertissolo Ebânico	61.110	0,23	1,32
Argissolo	181.312	0,67	3,90
Hydromorphic Quartzarenic Neosol	342.852	1,28	7,38
Ortic Quartzarenic Neosol	333.549	1,23	7,19
Neossolo Flúvico	122.372	0,45	2,64
Total	4.561.713	17,3	100

Fonte: Adaptado de Pinto et al. (2017); Santos et al. (2013); Streck et al. (2008); Lemos (1973).
*ha= hectares.

The Western Frontier region also has a high diversity in floodplain soils (Figure 3), not all of them are soils with floodplain characteristics because they are soils at higher altitudes, however, a good portion is still used for the cultivation of irrigated rice, due to the proximity or adjacent to the lowlands. According to Medeiros et al. (1995), the Western Frontier has a predominance of a friable sandstone cover, where there are sanding processes, areas presented in Figure 3 as Dunes.

Figure 3 - Soil map of the Western Border of Rio Grande do Sul.



Font: IBGE (2021).

Pinto et al. (2017) mention that soils such as those present in the western region of RS have naturally high density, high micro/macropore ratio, leading to difficulties with drainage combined

with practically impermeable subsurface layers, which results in difficulty in soil management. The conditions mentioned most of the time become interesting for rice cultivation, since they help in flood irrigation, however, they make the environment restrictive for rainfed crops.

The variability in soybean production in RS over the years is worrying, the southwest region is usually one of the regions that suffers the most from the interference of summers, usually presenting yields below the state average (IBGE, 2021).

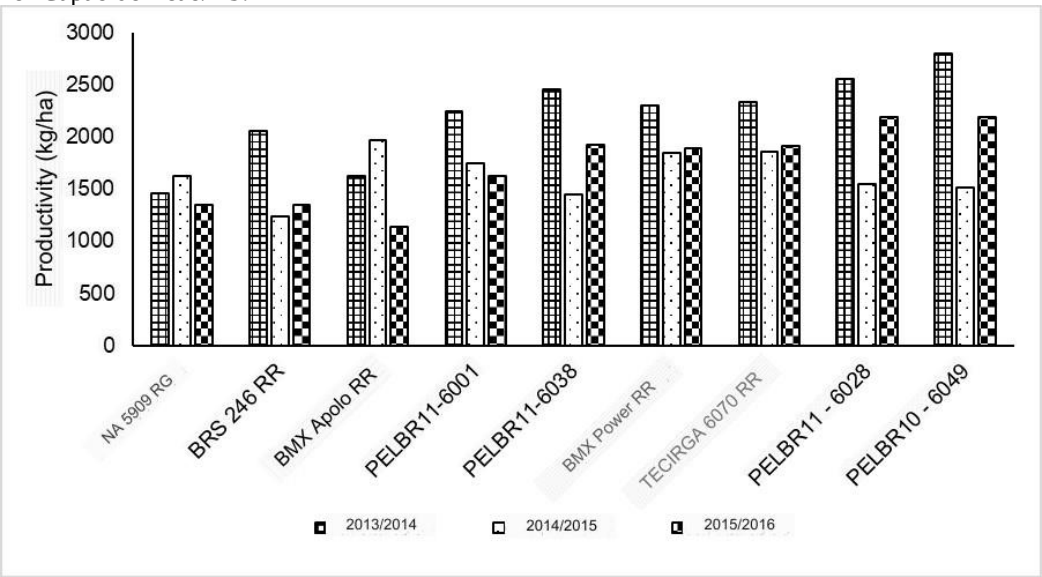
For the adaptation of soybean cultivation in poorly drained environments, in addition to having soil management that facilitates this production, it has cultivars adapted to the environment, or at least partially adapted. According to Goulart (2016), as much as there is great variability of cultivars, none is totally tolerant to water excess.

Thomas et al. (2005) mention that the use of unadapted or poorly adapted genotypes results in physiological and morphological changes, in addition to inefficiency in nodulation, which can lead to plant death when periods of hypoxia (scarcity/lack of air to the root) occur. According to Zanon et al. (2015), in the southern region of Brazil, from the 2000s onwards, the use of soybean cultivars with an indeterminate cycle and relative maturity group (GMR) between 4.5 and 6.5 began. When focusing on soybean cultivation in lowlands, Oliveira (2017) shows that certain characteristics are necessary, such as: resistance to certain diseases, plant height and first pod insertion (GMR<6.7), stable productivity and a good level of tolerance to water stress.

In RS, the group of cultivars with GMR between 4.5 and 6.5 occupied more than 90% of the area sown with soybean between 2010 and 2015, allowing planting in September and October, or even in January and February (off-season) (ZANON et al., 2016). Oliveira (2017) mentions that IRGA has already been present with programs for the improvement of soybean cultivars for lowlands, which led to the launch of a cultivar.

EMBRAPA is one of the institutions that continue with the breeding program, aiming at adaptations to lowlands in RS, having a program for the development of new cultivars, through the program an increase in productivity of some cultivars of 21% to 26% was evidenced, when compared to the control, shown in Figure 4 (FUHRMANN et al., 2014; OLIVEIRA et al., 2015).

Figure 4 - Grain yield of commercial cultivars, at 30% moisture and soybean lines of the EMBRAPA breeding program under evaluation in the 2013/14 to 2015/16 harvests, in lowlands at the EMBRAPA Experimental Station in the municipality of Capão do Leão/RS.



Fonte: adaptado de Fuhrmann et al. (2014), Oliveira et al. (2015), Oliveira (2017).

AGRICULTURAL MECHANIZATION IN LOWLANDS

The emergence of the first mechanized agricultural practices was in the eighteenth century, but the real expansion of the use of agricultural machinery arose with the rural exodus, a consequence of the great Industrial Revolution (BARICELO; BACHA, 2013). Vian & Andrade Júnior (2010) state that mechanization streamlines the processes related to agricultural production, which naturally met the demand for labor lagged by the rural exodus.

In Brazil, three phases can be identified in the evolution of the agricultural machinery sector, from 1920 to 1950 the emergence of companies in the area in the country, from 1950 to 1970 with the injection of large national and foreign capital there was a significant increase in production and from 1980 to the present day the marked presence of partnerships and innovations (CASTILHOS et al., 2008). The adoption of mechanized agricultural practices is essential to improve the productivity of rural properties, taking into account that a machine replaces a large part of the workforce, thus making the planting, cultivation and harvesting process more productive (BARICELO; BACHA, 2013).

In the rice cultivation areas of RS, the cultivation system made at a controlled level, with conventional soil preparation, ensures the requirement of many operations throughout the production cycle (DIAS et al., 2020). Scholosser et al. (2004) have already shown that rice plantations in the state have high rates of mechanization in small properties, thus having a greater work capacity. However, Dias et al. (2020) mention that larger properties with lower mechanization rates have to present greater planning of activities to the large areas that need preparation. Araldi et al. (2013) show that mechanization in rice crops is around 30% of production costs, and they also highlight that

efficiency in the field is an important ally for decision-making about machine management (GRISSO et al., 2004).

Márquez (2004) calls the process of seed deposition in the soil as sowing, whether the soil is previously prepared or not, thus enabling the germination and emergence of plants. Seeders are implements intended to dose and place seeds in the soil (VALE, 2007), and there are also seeders-fertilizers, which are machines that dose seed and fertilizer in the same operation (RODRIGUES, 2012).

One of the main adaptations when adopting the rice-soybean rotation system is the sowing of the soybean crop, since in rice continuous flow seeders are used, which are implements that distribute seeds continuously, mostly small seeds that need smaller spacing between them. In soybeans, which are seeds that require a certain amount of spacing, precision seeders are used. Siqueira (2007) mentions that precision seeders contain a straw cutting unit, a mechanism for opening the fertilizer deposition furrow, a furrow for seeds, and a system for closing the rows.

GROOVE-RIDGE SYSTEM FOR IRRIGATION AND DRAINAGE

Ridge irrigation is one of the main methods used in lowland areas. Senar (2019) states that furrow irrigation has a low application efficiency, due to the inadequate convergence of the ramp length of the areas, slope, management, flow, and application time. However, according to Fiorin et al. (2009), the use of microridges proposes a surface drainage with the formation of a path trend for water runoff. Chaiben Neto (2017) mentions that the system becomes suitable for row cultivation, as long as the slope is between 0.1% and 0.4% so that there is no favoring soil erosivity in high rainfall. Parfit et al. (2017) also show that when the furrow system is used for irrigation, applications with flow rates greater than three liters/second are not recommended.

Henrique (1996), when studying the influence of field parameters on the performance of the furrow irrigation system, noticed that the characteristics of soil infiltration and the length of the furrows were the parameters that most affected the performance of the system. Folegatti et al. (1999), studying yield of irrigated common bean submitted to different water depths with furrow irrigation, noticed that the decrease of the water depth from the end to the beginning of the furrow, resulted in lower values of the yield parameters, due to the gradual stress in the treatments of 0% and 50% of the useful depth applied. Chaiben Neto (2019), analyzing furrow irrigation for corn cultivation in irrigated rice areas, noted that management with 0 to 25% of time required to replace the irrigation depth obtained the best application efficiencies.

Embrapa (DA SILVA, 2006), when analyzing two soybean crops in systematized areas with and without slope, found that the average yield of grains by the system with the adoption of ridges was higher than the conventional irrigation system, being 21% higher in areas without slope. The

furrow irrigation system becomes a method that requires more manpower, in addition to requiring experience in the method (CHAIBEN NETO, 2019). Chen & Feng (2013) cite that the cost of installing the furrow irrigation system is lower than the cost of pressurized systems.

METHODOLOGY

The survey was conducted from October to December 2022. To collect the information, a questionnaire of questions was used and made available to rural producers in the Western Border of Rio Grande do Sul, who use rice and soybean rotation systems in floodplains.

SELECTION OF RESEARCH METHODS

To characterize the questions used in the questionnaire that was applied to the producers, two question methodologies were used, qualitative and quantitative (Appendices A and B, respectively). To prepare the questionnaire, the study was referenced by Aaker et al. (2001), which illustrates the main steps in Table 2.

Table 2 - Steps and steps for designing a survey questionnaire.

Stage	Steps
Plan what will be measured	Highlight the objectives of the research
	Define the subject of the survey in your questionnaire
	Obtain additional information about the subject of the research from secondary data sources and exploratory research
	Determine what will be asked about the subject of the survey
Shaping the questionnaire	For each subject, determine the content of each question
	Decide on the format of each question
Text of the questions	Determine how questions will be worded
	Evaluate each of the questions in terms of their ease of understanding, knowledge and skills required, and willingness of respondents
Decisions about sequencing and appearance	Arrange the questions in an appropriate order
	Group all questions in each subtopic to get a single quiz
Pre-testing and fixing issues	Read the entire questionnaire to see if it makes sense, and if it can measure, what is expected to be measured
	Check for possible errors in the questionnaire
	Pre-test the quiz
	Fix the problem

Cast iron: Aaker et al. (2001).

The questions that were incremented in the questionnaire, which was applied, took into account questions so that there was no misunderstanding or to avoid any offense to the target audience, these questions being:

I. In opinion questions, is it interesting to know the degrees of favorability/unfavorability, or is it enough to know if you are for or against?
II. Will respondents be willing to give the information?
III. What objections might someone have to answering this question?

IV. Is the topic addressed too intimate, disturbing, or does it expose people socially in a way that causes resistance and false answers?

V. Is the topic embarrassing for the respondent because it endangers his or her prestige if it is contrary to socially accepted ideas?

VI. Is the question properly neutral, so as not to influence the answers?

VII. Does the question contain opinions or judgments related to the subject?

To meet the questions of interest of the research, quantitative questions and multiple-choice questions were used, thus facilitating the analyses. The quantitative questions were obtained from relative data, so that comparisons could be made between the properties. While the multiple-choice questions were classified into five categories: very poor, poor, average, good, and very good.

DATA CAPTURE AND ANALYSIS

The questionnaire was applied to 10 farms that have the soybean-rice rotation system implemented for at least one (1) agricultural year. The material was made available only online and the time for the application of the questionnaire was free, since some information on the questions may not have been available at the time of completion. Thus, the questionnaire was available for a period of 3 months to correspondents. The application of the questionnaire was done remotely because it contained succinct and easy-to-understand questions, thus making this type of application viable.

For quantitative purposes, the values of soybean area that replaced the irrigated rice over the years that the property uses this system were obtained, thus obtaining the growth rate of the areas over the years. Data were also obtained on how many producers started the system with their own investment and how many had to obtain financing of any kind, in addition to obtaining the quantification of producers who use rented machinery. The equipment available for the study areas was also quantified, as well as the number of sowing rows, spray tips, harvesting platform feet and total tractor power available.

In the case of qualitative data, although they were obtained in multiple-choice parameters, for a better understanding of the results, the questions sought to know the levels of adaptation of rural producers in the cultivation of soybean in lowlands in relation to the environments of sowing systems, cultural treatments and harvesting.

RESULTS AND DISCUSSIONS

The results obtained were analyzed and arranged in relative numbers, so that there was no exposure of any type of result. The relationships were all established in percentages, both qualitative and quantitative. The essay questions helped in the discussion and justification of the results, since

their presentation would be difficult due to the variety of forms that each producer expressed when answering the questionnaire.

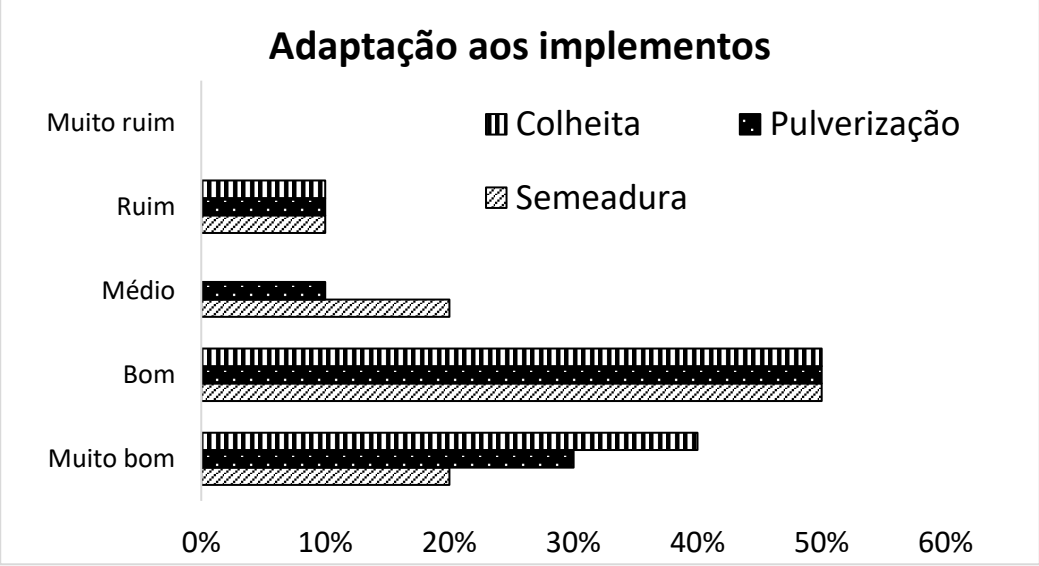
QUALITATIVE PARAMETERS

For the qualitative parameters, the analysis was performed in percentages, relating the suggested conditions, namely: Very good, good, medium, poor and very poor. In the question of adaptation to the implements used in soybean cultivation, varied answers were obtained, as shown in figure 5. All categories, sowing, spraying and harvesting had 50% of responses listing them as good, however, 10% listed them as bad. Only the harvest showed a level of 40% as very good the adaptation to the implements.

When it comes to the adaptation of the equipment, the respondents report the greatest demand for techniques for calibration and adjustment of all the points present in the precision seeders. Silveira (2001) shows that precision seeders actually contain several mechanisms, such as individual lines for seed and fertilizer, where each one has its respective reservoir, seed coating device, conductors, compactor wheels, depth controllers, etc. (MELO, 2013).

When it comes to adaptation to spraying in soybean cultivation, the most frequent reports are the number of applications, which is higher than the reference crop, rice. As recommended by Zanon et al. (2015), the cultivars used in the western border region of Rio Grande do Sul have longer cycles, thus requiring a greater number of applications for protection (mainly fungicides) and ensuring higher grain yield (ALESSIO, 2008).

Figure 5. Results in percentage of the answers about the adaptation to the implements used in soybean cultivation.



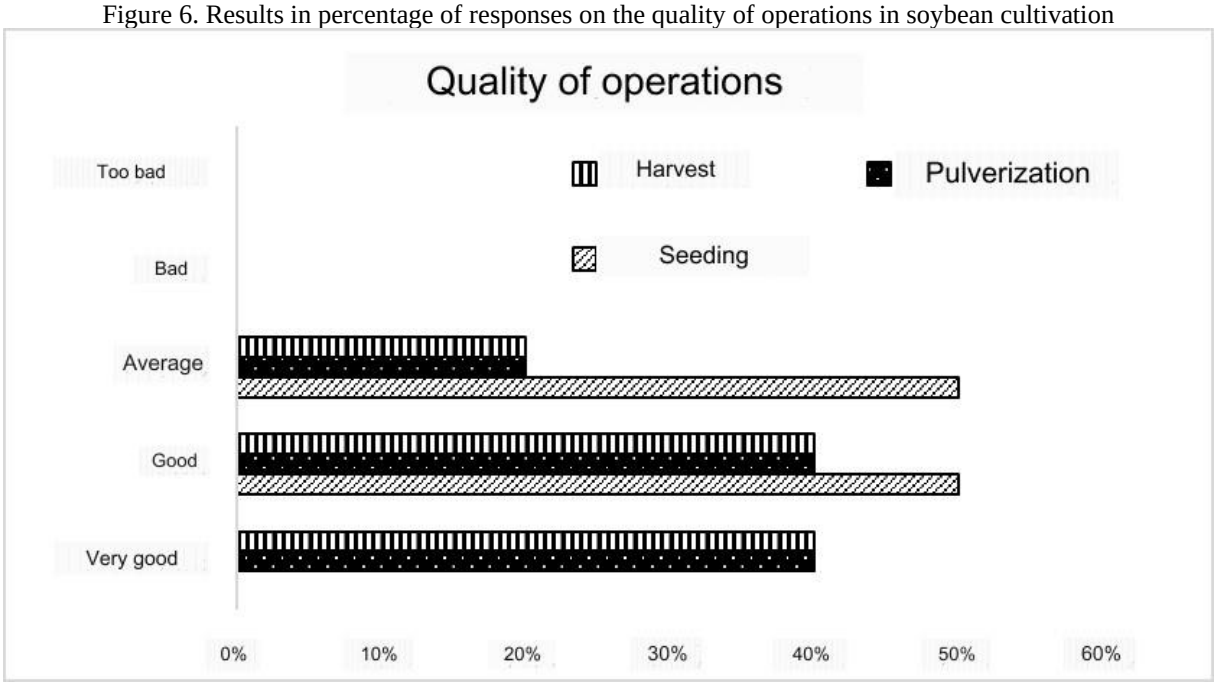
Source: Authors.

In the adaptation to the harvesting implements, the main point highlighted, different from sowing and spraying, was positively addressed a greater fluidity of harvesting, thus having a higher operational yield, in addition to lower depreciation of the harvester. Velasquez et al. (2010), when analyzing the costs in small rice farms, ended up reaching the result that the cost of harvesting rice is around 10.28% of the net production. While for the soybean crop, it is estimated that the total depreciation cost of the machines involved is around 6.76% of the total cost of production (CHBAGRO, 2021).

The qualities of these operations were also questioned, and the results are presented in Figure 6. It is noted that sowing is an operation that still presents 50% of the results as average, since soybean sowing is more difficult when compared to rice sowing. Harvesting and spraying have the same behavior, with 40% being very good and good, but also 20% of respondents rated it as medium.

The main limiting factor in the sowing item mentioned in the discursive questions was speed, which is directly linked to the other limitations, namely: initial plant stand and plant population. Dias et al. (2009), when analyzing different densities submitted to different speeds, came to the conclusion that the greater the number of seeds per meter, the lower the number of acceptable spacing.

Figure 6. Results in percentage of responses on the quality of operations in soybean cultivation



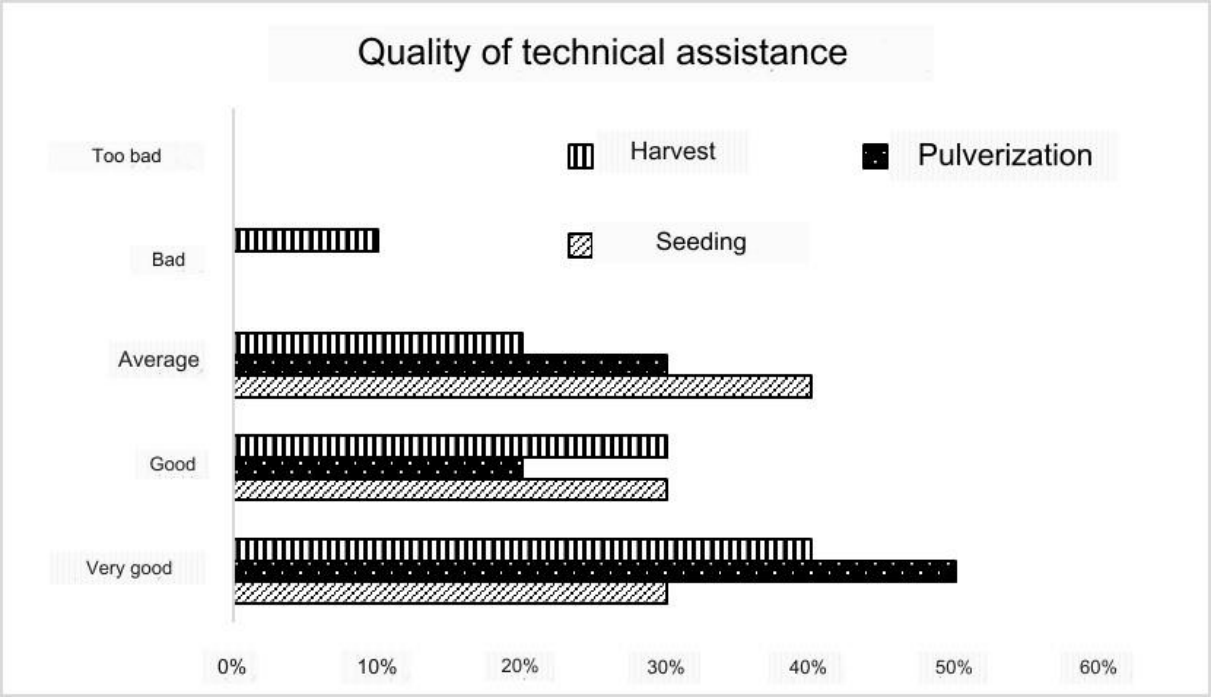
Source: Authors.

In terms of the quality of the operations, when it comes to spraying, there was only the indisposition regarding the kneading of the crop, since the terrestrial applications, in environments without controlled traffic of machines, end up causing a significant kneading in the areas. Mitigating measures can be adopted in relation to this, such as larger spray bars or even differentiated row

spacing, allowing the implementation to move without the occurrence of denting (OLIVEIRA et al., 2014).

When asked about the quality of technical assistance, the answers varied according to the operations under study. When it came to sowing, 40% of the answers were classified as medium, dividing the remaining 60% into good and very good (Figure 7). When it comes to spraying, 50% of the producers rated it as very good, however 30% still rated it as medium and the rest (20%) marked the option good. The harvesting operation turns out to be the most varied in the category, with 40% being very good, 30% good, 20% average and 10% poor.

Figure 7. Results in percentage of responses on the quality of technical assistance in soybean cultivation.



Source: Authors.

The technical assistance presented a lot of divergences between the answers, since it depends a lot on which company it is evidenced or what is the real knowledge of the producer. It was noted that the worst opinions of producers in relation to technical assistance came from producers who are, in some way, also professionals in the area, such as agronomists or agricultural technicians.

EQUIPMENT STATUS

When the questions were on the side of the situation of acquisition of seeding and spraying equipment (Figure 8), only 10% of the interviewees stated that they use the system in which they have both options, i.e., rented and acquired (purchased) equipment. Among the justifications, the most present was to have partnerships with places that rent this equipment used in soybean sowing and spraying operations.

It was noted that the majority (90%) of the producers still acquire such equipment, since the soybean seeders are precision seeders or seeders with a vacuum distribution system, different from the ones most used in rice sowing, which are continuous flow.

Figure 8. Situation of soybean sowing (A) and soybean spraying (B) equipment present in the respondent properties.

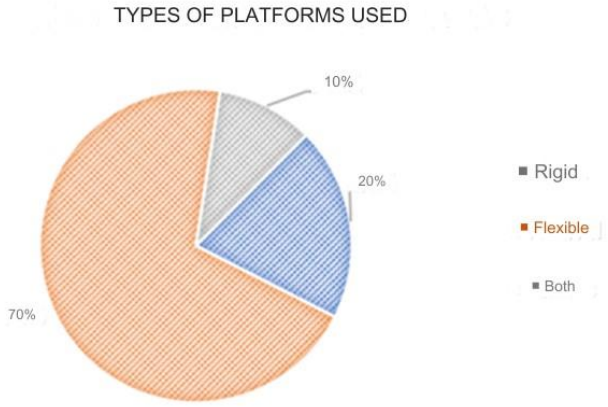


Source: Authors.

Terrestrial spraying equipment in rice cultivation is only used before full crop establishment, then complementation fertilization and agrochemical applications are carried out via aerial spraying (by airplanes). The various inputs for application in soybeans, at different stages of development, end up becoming a new challenge for producers when it comes to application efficiency.

Information was also collected on the type of cutting platform used in the soybean harvest (Figure 9), since in the rice crop rigid platforms are used that work in high cuts, unlike the soybean crop that emits pods on low branches, making it necessary to use flexible platforms so that it is possible to copy the soil as close as possible to the ground to avoid losses of the grains present in the soil. lower docile. One of the main losses in the harvesting process is directly linked to the cutting platform, which can be caused by its unevenness, high reel speeds, too low helical feeder, advanced reel, among other reasons (APROSOJA, 2019).

Figure 9. Types of cutting decks used in the soybean harvesting operation.



Source: Authors.

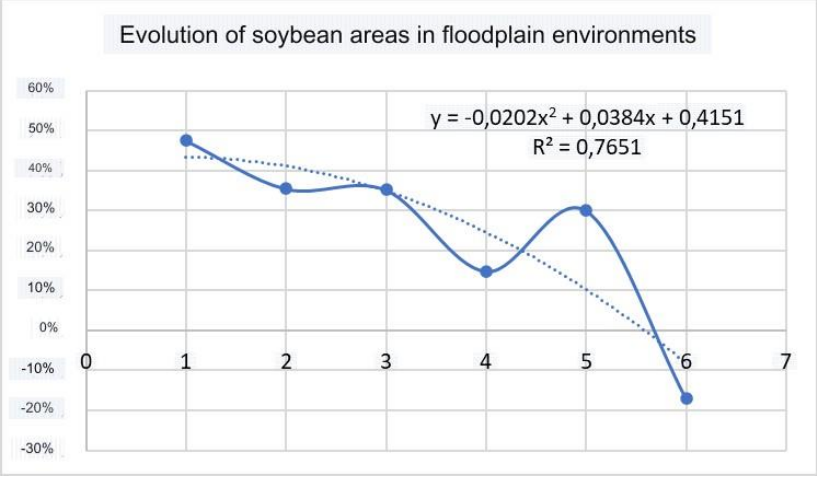
It was noticed that 20% of the producers still use rigid platforms, 70% use only flexible platforms for soybean harvesting and 10% use both. When questioned about the reason for the use of rigid platforms, part of the producers were not aware of the differences that both presented at the time of harvest, and those who did, justified that the prices of flexible platforms are high, even more so the Draper type, when compared to the snail system. Draper platforms contain rubber conveyor belts, which promote better feeding and greater stability, as well as greater adaptation of cutting height and terrain undulations (SAMOGIM, 2020).

EVOLUTION OF SOYBEAN CULTIVATION IN RICE LANDS

The relative evolution of the areas had decreasing peaks in the first years, tending to increase when the agricultural years present greater stability in rainfall, as in the year 2020/21. The areas for the subsequent year had an increase, however, the 2021/2022 agricultural year did not show good stability. As shown in figure 10, in relative numbers of the properties analyzed, year 5 coincided with the year 2021/22, showing a significant increase in percentage compared to the previous year.

The downward trend in the first years of cultivation is due to the increase in the complexity of the system when the soybean crop is introduced, since it is a crop, considered among the respondents, that requires greater precision and accuracy when compared to rice cultivation, from sowing to harvesting, as presented in item 4.1.

Figure 10. Relative evolution of the areas of the producers responding to the questionnaire.



Source: Authors.

According to IRGA (2021), the Western Border of Rio Grande do Sul has a growing demand for areas for soybean cultivation, resulting in contrasts with the results presented here. The recurrence of these areas that have already been implemented the soybean-rice succession system, in years of water scarcity, require further studies to have a real behavior.

AVERAGE MECHANIZATION RATIOS

The mechanization indices with the average of the soybean areas, in general, all respondents are within the average, since their operational capacities were simulated (Table 3).

Table 3. Indexes with the averages and simulation with the same operational capacity and days of service execution.

Indexes	values	Cop (ha/hours)	JD (Hors/Diya)	Stamp (ha/he)	Medium area (ha)	Days to Execution
Mechanization (KW/ha)	0,86					
Seeding (ha/row)	21,15	5,09	11,00	56,02	678,40	12,11
Spraying (ha/nozzle)	13,93	15,86	11,00	174,41	678,40	3,89
Harvest (ha/ft)	12,74	4,54	11,00	49,99	678,40	13,57

Cop= Operational capacity; Jd= Daily working hours; Cap= Ability to execute on the day; ha = hectares.
Source: Authors.

The simulation with a working day of 11 hours/day, taking into account an average area of approximately 678 hectares, with 70% efficiency. Acceptable values were obtained, for sowing it takes an average of 12 days, considering the number of rows available and an average spacing of 50 centimeters for soybean.

For spraying, using the same simulation, with the same working day, it would take approximately 4 days to realize the total area, which means optimal operational capacity. For the harvest of the soybean crop, when the same conditions are used, there are approximately 14 days to carry out the agricultural operation.

CONCLUSIONS

I. For sowing and spraying operations, there is still a need for improvement in the regulation parts and adjustments for the sample of producers that the research covered.

II. The operation of soybean harvesting, when compared to rice harvesting, in the view of producers, is an easier practice and with greater agility and fluidity, even though 20% of the interviewees use inappropriate cutting equipment.

III. The technical assistance in the view of most producers is efficient, with most of them in the categories being very good and good, although in the harvest operation they have results that present the parameter bad.

IV. The evolution of soybean areas in terms relative to the previous year showed a decreasing trend, except when analyzed after the year with regular rainfall.

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Dentistry from the perspective of multidisciplinary, integrated and humanized hospital care for hospitalized patients

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ABSTRACT

Hospital dentistry was officially recognized as a specialty in 2024. However, dental surgeons have been working in this area for decades, especially when requested by other health professionals, who are usually members of hospital care teams. This chapter seeks to present how the multidisciplinary, comprehensive and humanized approach to patients admitted to or in Hospice Units or under palliative care takes place and the competencies and benefits of Dentistry, together with the other specialties, for the quality of life of this target population.

Keywords: Multidisciplinary care team, Hospital dental team, Quality of life.

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INTRODUCTION

Hospital Dentistry (OH), in Brazil, was recognized as a specialty by the Resolution of the Federal Council of Dentistry, CFO-262, on January 25, 2024 (CFO, 2024). However, many Brazilian Dental Surgeons (DC) have been working in this type of care for decades, but particularly when requested by other members of the team of health professionals who work in this environment.

Since it became official as a dental specialty, there has been a growing search for greater knowledge about how the insertion of HC in tertiary care occurs (represented by high complexity and performance in large hospitals), with respect to the principle of "comprehensiveness in health", "organization of lines of care" and "humanized care" (Fitzgerald, 2023; Fontes *et al*, 2022; Vargas *et al.*, 2020).

There is much to explore on this topic, mainly because the concept of "Oral Health" (BS) is often linked as something apart or a fragment of human health, disregarding its relationship with the quality of life and well-being of the individual (Hescot, 2017), of the population; And that's worldwide.

In the present chapter we will present some possible benefits or better results achieved with Dentistry in the hospital multidisciplinary team.

These are based on scientific evidence and the authors' experiences, whether in the local scope of hospital care, teaching, research and extension.

MULTIDISCIPLINARY APPROACH TO PATIENTS ADMITTED TO HOSPITAL UNITS

Multiprofessional care can be defined as a work methodology that involves health professionals with specialized experience, skills, and knowledge. They "complement" each other, to offer holistic and comprehensive care. They share common health goals and exert combined physical and mental efforts in patient assessment, planning, and care. This is accomplished through interdependent collaboration, open communication, and shared decision-making. This, in turn, generates value-added results for the patient, the institution, and the team (Chagas *et al.*, 2024; Fernandes and Faria, 2021).

In all spheres of patient care, teamwork provides direct and indirect improvements to all those involved in the process, such as reducing hospitalization time, improving recovery time and treatment adherence, enabling a greater chance of cure. The discussion of cases among team members has a positive impact on therapy planning and implementation, clinical decision-making, and referrals to specialties (Fernandes and Faria, 2021).

In order for multidisciplinary teams to achieve the expected benefits, each member must establish adequate communication with the other, who not only has a different specialty (area of domain or competence), but also different work routines and norms. It is also necessary to establish a

hierarchy for the coordination of interventions and a routine of meetings, which can hinder equal and mutual relationships, leading to an intrinsic tension in the team's work. Interactions need to be in balance, so that collaborative efforts achieve the desired goals and strengthen the bond and trust between the professionals involved (Nylén, 2018).

Systematized meetings between health professionals strengthen comprehensive care in the provision of care, as they provide the health team with the opportunity to examine the condition and clinical progress of patients, in addition to discussing diagnostic/therapeutic options and making important decisions, especially regarding the care of critically ill patients. In these rounds, problems related to patients are listed, establishing goals to be achieved by the team. The auxiliary resource of the *checklist* contributes to greater quality, safety, and reduction of adverse effects (MARAN *et al*, 2022).

A multidisciplinary team considered minimal in a Prolonged Care Inpatient Unit (UCP) or in Hospitals specialized in Prolonged Care (HCP) in the Brazilian territory needs to comprise: physician, nurse, nursing technician, social worker, physiotherapist, psychologist and speech therapist (Brasil, 2012). When directed to hospitalized and critical patients, it is composed of a medical technician with qualification in Intensive Care Medicine to be responsible for the Adult ICU or with qualification in Pediatric Intensive Care Medicine, to respond to the Pediatric ICU; in addition to a pediatrician working in Neonatology, to be responsible for the Neonatal ICU, a nurse coordinator of the nursing team (including nursing technicians) and a physical therapist coordinator of the physical therapy team (Brasil, 2010).

Considering the demands presented, especially after the first wave of COVID-19 in our country, there is an "expanded" look at multidisciplinary teams in the hospital environment. And this has impacts, from education and continuing education to the transversality and humanization of health actions; as well as for the self-care of the care team. This is in order to effectively contribute to the quality of life of the assisted individual, their families and the agents involved in this dynamic. In this context, the patient's needs are highlighted; especially when under Palliative Care/PC and Integrative and Complementary Practices or PICS.

The positive perception regarding the importance of dental care in the hospital has been mentioned in studies on the subject. According to data obtained from residents in other health areas, the presence of HC in multidisciplinary teams in hospital units contributes to the training of these professionals, to the exchange of interprofessional knowledge and to the promotion of comprehensive care. Dental evaluation in hospitalized patients is relevant, as oral health conditions impact systemic conditions and patient recovery and comfort; as well as improving safety measures and facilitating inpatient communication (Afrashtehfar, 2022; Silva *et al.*, 2023).

SCOPE OF HOSPITAL DENTISTRY (OH)

According to Article 1, sole paragraph of Resolution CFO-262/2024, Hospital Dentistry comprises a set of preventive, diagnostic and therapeutic actions for orofacial diseases, oral manifestations of systemic origin or sequelae of their respective treatments, in patients in a hospital environment, hospitalized or not, or in home care. These are inserted in the context of the work of the multidisciplinary team, aiming at the maintenance of SBl and the improvement of quality of life (CFO, 2024).

Article 3 of the same Resolution establishes the following areas of competence:

I – working in multidisciplinary, interdisciplinary and transdisciplinary teams, with the objective of promoting health based on scientific evidence;

II – the provision of dental care to inpatient and outpatient patients, urgencies and emergencies to highly complex patients in critical situations who require basic life support;

III – participation in the dynamics of institutional work, recognizing oneself as an agent of this process;

IV – the application of the knowledge acquired in clinical work, diagnosis, indications and use of scientific evidence in hospital dentistry care;

V – the development of scientific and technical projects, as well as research aimed at promoting the use of new technologies, methods and drugs in the field of Hospital Dentistry;

VI – action in the integration of programs for the promotion, maintenance, prevention, protection and recovery of the patient's health in a hospital environment.

During the first wave of COVID-19 (from March 2020 onwards), HCWs were kept away from the "front line of care" due to the increased risk of infection, due to the characteristics of many procedures inherent to the profession. However, there was a call for the availability of dental care in emergency situations, in the hospital environment; reinforcing the comprehensiveness of health professions and BS as a unique part of the general health and well-being of the individual where the risk of systemic impairment was at risk in hospital units that did not have the possibility of this type of care (Bradley and Meeta, 2021). Figure 1 shows the commitment of CD in the care of a child hospitalized in critical condition, during maneuvers to maintain oral hygiene.

Figure 1. COURY, R.M.M.M.S.M in assistance at HUAC.



OH in Brazil is still consolidating, with an insufficient number of HCs working in hospitals, in contrast to many developed countries that found themselves at this juncture, starting at the beginning of the twentieth century (Blum *et al.*, 2018). Thus, it is still unclear all the advantages resulting from dental care in the hospital environment. Figure 2 shows a model of the benefits highlighted in the literature.

Prevention of Ventilator-Associated Pneumonia (VAP) - nosocomial pneumonia	Reduction of biofilm and the risk of infections from the oral microbiota	Prevention/treatment of periodontal disease and caries (pain).
Prevention/Treatment of TMD and Orofacial Pain	Prevention/treatment of osteoradionecrosis	Prevention of dental aspiration
Prevention/treatment of oral mucositis, ulcerative lesions on the lips and soft tissues	Prevention of bleeding	Prevention/treatment of scabrous tongue, oral candidiasis and depapillary tongue (burning mouth), and xerostomia (dry mouth)

Better indicators of quality of life and possibility of oral nutrient intake, prevention/treatment of dysgeusia (changes in taste).	Better patient evolution scores/ Reduced length of hospital stay	Cost reduction

Source: Fonseca *et al.* (2021); Patel *et al.* (2021), Quintanilha *et al,* (2023).

FINAL THOUGHTS

Despite being considered a new dental specialty in Brazil, OH can collaborate with the multidisciplinary team in this area, establishing protocols together for the most appropriate approach to the hospitalized patient, according to the characteristics and demands presented. BS is part of the general health and well-being of the individual and much progress must be made in this field of knowledge in order to effectively collaborate with the quality of life of hospitalized patients or those under home care.

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Health in danger: "Sick buildings syndrome"

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ABSTRACT

Sick Building Syndrome (EDS) was recognized by the World Health Organization (WHO) in 1982. It is a set of diseases triggered by the proliferation of infectious microorganisms and chemical particles in closed buildings.

The users of these buildings, in general, are affected by various pathologies, which leads to greater absenteeism at work, resulting in a decrease in the productivity of workers.

This syndrome increases with each passing day, especially in large urban centers, bringing problems to the occupational health of the population, and this work is fundamental to understand the mechanisms that cause this pathology, as well as its prevention, providing important information to have healthier built environments.

Keywords: Sick Building Syndrome, Occupational Diseases in Buildings, Health Hazards.

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INTRODUCTION

Whereas most of the population spends much of their time inside buildings, such as workplaces (Shopping Malls, Commercial Buildings), Schools, Housing, Public Buildings, among others.

These buildings can offer unfavorable conditions that can trigger discomfort, dissatisfaction, increase the risk of accidents, decrease productivity, increase costs and cause damage to the health of their occupants (IIDA, 1992).

Well-being in buildings is directly related to indoor air quality, ambient temperature, light, and peer relationships.

The biggest problem occurs in commercial buildings, where the circulation of people is greater. According to the World Health Organization, people spend at least 80% of their time indoors, breathing around 10,000 liters of air a day.

With the evolution of architecture, a great diversity of products for upholstery, finishing and furniture have emerged, which contain chemical substances that are dispersed in the indoor air of buildings. These materials were developed without a major concern for their emissions. The deterioration of indoor air is due to these emissions of chemical substances, volatile organic compounds, which are part of the composition of construction, cleaning and furniture materials (BRICKUS, AQUINO NETO, 1999).

The first reports of damage to health due to diseased buildings were around the 1970s.

In 1976, at the Bellevue Stratford Hotel in Philadelphia, an extreme case of Sick Building Syndrome occurred during the convention of the American Legion of Veterans, which brought together approximately 4,000 former soldiers. The participants began to fall ill, with cough, fever and difficulty breathing (called Legionnaires' lung disease) and unfortunately more than 30 of them died. After a series of investigations, it was discovered that the cause of the disorder had been the presence of the bacterium Legionella Pseumophila in the hotel's ventilation system (STERLING; COLLETT; RUMEL, 1991).

It wasn't until 1980 that the World Health Organization (WHO) recognized Sick Building Syndrome (EDS) as a disease.

In Brazil in 1998, former Minister of Communications Sérgio Motta died of respiratory failure due to legionellosis, prompting the Ministry of Health to regulate air-conditioned environments.

SICK BUILDING

DEFINITIONS

The **sick building syndrome** refers to the cause-and-effect relationship between the conditions of an internal environment and the aggression to the health of the occupants, with polluting sources of physical, chemical or biological origin. A **building** is considered **sick** when about 20% of its occupants have health problems associated with staying inside. Construction-related symptoms can have a substantial impact on health (eCYCLE, 2022).

For the Institute of Public Health of Portugal, sick building syndrome (EDS) is defined as "a situation in which the occupants/workers of a building experience occupational discomfort and/or acute health problems. It can also be called "Building-Related Diseases" (DRE) when the symptoms of a specific disease are related to a particular building and are attributed to airborne contaminants (SILVA, 2017).

The WHO has identified two types of diseased buildings:

Temporarily Diseased Buildings

Are those in which newly constructed buildings, or with recent refurbishment, have irregularities that disappear over time (approximately six months). It causes temporal EDS, in which symptoms diminish or disappear over time.

Permanently Ill Buildings

When symptoms persist despite measures being taken to address the problems. They may have design errors, lack of maintenance, or other factors that caused permanent damage.

BRAZILIAN LEGISLATION ON BUILDINGS

Soon after this tragedy with the former Minister, the National Health Surveillance Agency (ANVISA) published Ordinance No. 3,523 of August 1998, establishing a technical regulation containing basic measures regarding the procedures for visual verification of the state of cleanliness, removal of dirt by physical methods and maintenance of the state of integrity and efficiency of all components of air conditioning systems. to ensure indoor air quality and the prevention of health risks to the occupants of air-conditioned environments. The Ordinance also requires all artificially air-conditioned environments for public and collective use to prepare and maintain a plan for the maintenance, operation and control of air conditioning systems (BRASIL, 2003).

In October 2000, ANVISA published Resolution 176 with the objective of creating criteria that would evaluate the adequacy of the procedures adopted by the maintenance companies of the establishments containing biological, chemical and physical parameters through which it is possible

to evaluate the quality of indoor air (BRASIL, 2003a). In 2003, ANVISA published Resolution No. 9, which contained revised technical guidelines from the previous Resolution. (BRAZIL, 2003b). In 2003, Resolution/RE No. 9 contained revised techniques from the previous one (BRASIL, 2003c).

FACTORS OF THE SICK BUILDING

According to Environmental Health Magazine, about 60% of people living in diseased buildings may experience complications from Sick Building Syndrome.

To stop this problem, new buildings must be designed with safer materials. It is necessary to design ventilated environments with renewed air, in addition to always having adequate maintenance.

The most common symptoms are: eye irritation, respiratory manifestations (nose and throat), mental fatigue, headache, airway infection, cough, hoarseness, difficulty breathing, itching, joint pain and tearing, and skin rashes and irritation. These symptoms can appear alone or in combination.

The causes that contaminate the internal environment can originate from chemical, biological, physical, psychosocial and other factors.

Chemical Factors - are the most contaminating. Chemical contaminants include Volatile Organic Compounds (VOCs), Particulate Matter, Carbon Monoxide, Asbestos, Nitrogen Dioxide, Ozone, Formaldehyde, Sulfur Dioxide, Ammonia and Radon 222. Radon gas seeps from the ground, usually has its highest concentration at the lowest level of the building and infiltrates the foundations and accumulates inside the buildings with cracks in the concrete, floor drains, sewage pumps, exposed soil and building drains, at points of connection of the building (floor and wall mortars, loose and loose pipes), in groundwater installations of artesian wells, cisterns, and can also originate from outdoor air, water, and natural gas (SEVERO; SOUSA (2018). According to the National Institute of Metrology, Quality and Technology (Inmetro), about 42.3% of 78 establishments for private and collective use are contaminated by chemical pollutants.

Table 1 shows a list of the main chemical pollutants, their source of emanation, as well as their effects on humans, according to Resolution RE/ANVISA 176/2000.

Table 1 - Main chemical pollutants

Agentes químicos	Principais fontes em ambientes interiores	Principais medidas de correção em ambientes interiores
CO	Combustão (cigarros, queimadores de fogões e veículos automotores).	Manter a captação de ar exterior com baixa concentração poluentes; restringir as fontes de combustão; manter a exaustão em ár que ocorre combustão; eliminar a infiltração de CO provenie fontes externas; restringir o tabagismo em áreas fechadas.
CO2	Produtos de metabolismo humano e combustão.	Aumentar a renovação de ar externo; restringir as fon combustão e o tabagismo em áreas fechadas; eliminar a infiltra fontes externas.
NO2	Combustão.	Restringir as fontes de combustão; manter a exaustão em ár que ocorre combustão; impedir a infiltração de NO2 provenie fontes externas; restringir o tabagismo em áreas fechadas.
O3	Máquinas copiadoras e impressoras a laser.	Adotar medidas específicas para reduzir a contaminaçã ambientes interiores, com exaustão do ambiente enclausuramento em locais exclusivos para os equipamento apresentem grande capacidade de produção de O3.
Formaldeído	Materiais de acabamento, mobiliário, cola, produtos de limpeza domissanitários	Selecionar os materiais de construção, acabamento e mobiliá possuam ou emitam menos formaldeído; usar pr domissanitários que não contenham formaldeído.
Material particulado	Poeira e fibras.	Manter filtragem de acordo com NBR-6402 da ABNT; isolamento termoacústico que possa emitir fibras minerais, org ou sintéticas para o ambiente climatizado; reduzir as fontes ir e externas; higienizar as superfícies fixas e mobiliários sem o vassouras, escovas ou espanadores; selecionar os materi construção e acabamento com menor porosidade; adotar m específicas para reduzir a contaminação dos ambientes int (vide biológicos); restringir o tabagismo em áreas fechadas.
Fumo de tabaco	Queima de cigarro, charuto, cachimbo, etc.	Aumentar a quantidade de ar externo admitido para renovaçã exaustão dos poluentes; restringir o tabagismo em áreas fechadas
COV	Cera, mobiliário, produtos usados em limpeza e domissanitários, solventes, materiais de revestimento, tintas, colas, etc.	Selecionar os materiais de construção, acabamento, mobiliário produtos de limpeza e domissanitários que não contenham C que não apresentem alta taxa de volatilização e toxicidade.
COS-V	Queima de combustíveis e utilização de pesticidas.	Eliminar a contaminação por fontes pesticidas, inseticidas e a de combustíveis; manter a captação de ar exterior afast poluentes.

Source: BRASIL (2000). Resolution RE/ANVISA 176/2000

Biological Factors

These are bacteria, fungi, protozoa, arthropods, viruses, etc.

Bioaerosols are particles of biological origin suspended in the ambient air and encompass viruses, bacteria, fungi, spores and pollens. In fungi, the most common are Penicillium and Aspergillus, and the main bacteria are Bacillus, Staphylococus and Legionella Pneumophila (SRIKANT *et all* , 2008 and STETZENBACH *et all* , 2004).

The inhalation of these particles can cause varied respiratory symptoms and depends on the biological properties, chemical composition of the particles, number of particles inhaled, the place where they are deposited in the respiratory system and the sensitivity of the individual (GHOSH & SRIVASTAVA, 2015).

The most common problems are irritating effects, especially of the eyes, nose and skin, allergic reactions such as asthma and rhinitis, infections (pneumonia, tuberculosis, Legionnaires'

disease) and toxic reactions. Individuals with weakened immune systems, such as AIDS patients or those undergoing chemotherapy, are of particular importance, as they are more susceptible to contracting infections when exposed to microorganisms (APA, 2009). Chart 2 shows the main biological factors according to Resolution RE/ANVISA 176/2000.

Table 2 - Main biological pollutants

Biological agents	**Main Sources in Indoor Environments**	**Main Correction Measures in Indoor Environments**
Bacteria	Stagnant water reservoirs, cooling towers, condensate trays, dehumidifiers, humidifiers, air conditioner coils, and humid and hot surfaces.	Carry out the cleaning and maintenance of cooling towers; sanitize condensate reservoirs and trays or maintain continuous treatment to eliminate sources; eliminate infiltrations; sanitize surfaces.
Fungi	Humid environments and other sources of fungal multiplication, such as moist organic porous materials, ceilings, walls and damp insulation; outdoor air, inside conditioners and ducts without maintenance, potted soil with plants.	Correct ambient humidity; keep leaks, infiltrations and water condensation under strict control; sanitize the environments and components of the air conditioning system or maintain continuous treatment to eliminate sources; eliminate contaminated porous materials; eliminate or restrict potted plants with cultivation in soil, or replace with cultivation in water (hydroponics); use G-1 filters for external air renewal.
Protozoa	Contaminated water reservoirs, trays, and maintenance-free conditioner humidifiers.	Sanitize the reservoir or maintain continuous treatment to eliminate the sources.

Table 2 - Main biological pollutants - continued

Biological agents	**Main Sources in Indoor Environments**	**Main Correction Measures in Indoor Environments**
Virus	Human host.	Adjust the number of occupants per m2 of area with increased air renewal; avoid the presence of infected people in air-conditioned environments
Algae	Cooling towers and condensate trays.	Sanitize condensate reservoirs and trays or maintain ongoing treatment to eliminate sources.
Pollen	It's external.	Maintain filtration according to NBR-6401 of ABNT
Arthropod	Household dust.	Sanitize fixed surfaces and furniture, especially those covered with fabrics and carpets; restrict or eliminate the use of these coatings.
Animals	Rodents, bats and birds.	Restrict access, control rodents, bats, birds' nests and their excrement.

Source: BRASIL (2000). Resolution RE/ANVISA 176/2000

Physical Factors

Noise level, lighting, electromagnetic fields, temperature and humidity are all factors that influence having a sick building.

a) Ventilation – when ventilation is ineffective there is a gradual increase of pollutants in the air, which leads to problems with indoor air quality. Several studies indicate inadequate ventilation as the most important cause of EDS and the main cause of IAQ. The ventilation efficiency of a sealed building can be judged by indoor CO2 levels.

b) Temperature - Thermal comfort is determined by several parameters, including air temperature, relative humidity, heat production by the human body, clothing, wind, activity level and others. Comfort occurs when the body temperature is kept within the small ranges, skin humidity is low and the air movement are similar.

The optimum temperature of workplaces varies between 18 °C and 22 °C, except in certain climatic conditions, where it can reach 25 °C. When indoor temperatures in closed environments exceed 22 °C, certain symptoms may occur, such as: irritation of the mucous membranes, headache, lethargy and tiredness (ION & SEBARCHIEVICI, 2011).

c) Humidity – According to the Portuguese Environment Association, relative humidity below 25% is associated with increased discomfort and the sensation of dry mucous membranes and skin, which can lead to irritation. On the other hand, relatively low humidity values also increase static electricity, causing discomfort and can hinder the use of electronics such as computers, photocopiers, etc. (APA, 2009).

d) Lighting – Both the lack or excess of lighting, as well as the intensity of brightness (especially with computer work without breaks), chromatic spectrum and color temperature can cause changes in behavior, affect the quality of vision, causing the occurrence of accidents, in addition to visual discomfort (visual fatigue, eye irritability, headaches, muscle pain, difficulty concentrating), tiredness, depression, loss of productivity, and general discomfort (JAFARI & ASGHAR, 2015).

e) Noise – It can be very harmful to the health of workers, and can even lead to hearing loss. Prolonged exposure to noise decreases workers' coordination and concentration, affecting the performance of tasks, increasing the likelihood of errors and accidents.

The table shows the impact of noise on the health of individuals according to the degree of noise, according to Annex I of NR 15, updated in 2022:

Table 1 - Tolerance Limits for Continuous or Intermittent Noise - NR 15

NOISE LEVEL dB(A)	MAXIMUM PERMISSIBLE DAILY EXPOSURE
85	8 hours
86	7 hours
87	6 hours
88	5 hours
89	4 hours and 30 minutes
90	4 hours
91	3 hours and 30 minutes
92	3 hours
93	2 hours and 40 minutes
94	2 hours and 15 minutes
95	2 hours
96	1 hour and 45 minutes
98	1 hour and 15 minutes
100	1 hour
102	45 minutes
104	35 minutes
105	30 minutes
106	25 minutes
108	20 minutes
110	15 minutes
112	10 minutes
114	8 minutes
115	7 minutes

Font: BRASIL (2021) NR-15 – Anexo 1

Psychosocial Factors

Workplace problems such as stress, violence, harassment and others have been identified as psychosocial factors, leading to reduced performance, increased absenteeism and increased accident rates.

Other Factors (Gender)

There are strong indications that females suffer more from Sick Building Syndrome than males.

HEALTHY BUILDING

Florence Nightingale (1863), nurse who became known with the following Quote: "It may seem a strange principle to declare as the first requisite in a Hospital that it should do the sick no harm." Its objective was to strengthen an environment that would stimulate health in the hospital environment. Its concepts involved the issue of the environment and its environmental components such as: physical, social and psychological in which all are interrelated with each other (GEORGE, 2000 and SILVA, 2017).

Today it turns out that this theory applies not only to the hospital environment, but also to any type of building. A healthy building should be a pleasant, inviting environment, inducing relaxation, tranquility and joy, it should be a healthy space.

In 2020, nine fundamentals of healthy building were listed in the Book: "*Healthy Buildings – How Indoor Spaces Drive Performance and Productivity*" by Professors Allen and Macomber from the T.H. Chan School of Public Health as shown in Figure 1 and described below:

VENTILATION

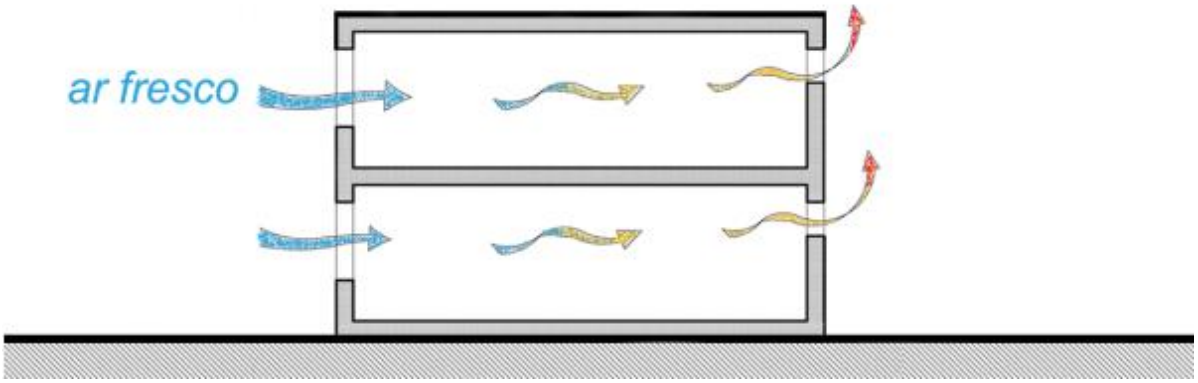
External pollutants can penetrate the interior of the building and compromise people's health. It is necessary to create means to ensure a minimum quality of ventilation in all environments of the project.

Buildings typically recirculate some of the air, which has been shown to lead to a higher risk of infection during outbreaks, as contaminated air in one area circulates to other parts of the building.

For those buildings with mechanical ventilation systems, it is recommended to check that the system is on whenever the building is occupied, and then increase the fresh air intake rates.

For homes and buildings without central systems, opening windows plays an important role in releasing stale indoor air.

Figure 1 – Project with natural ventilation



Source: Allen *at all*, 2020.

Good filters and frequent cleaning of the surface are important, indoor humidity levels should be adjusted and overcrowding should be avoided.

AIR QUALITY

One of the main fundamentals of healthy building, since the presence of volatile organic compounds (VOCs) among others can bring respiratory problems.

If it is absolutely necessary to recirculate the air, you can minimize cross-contamination by increasing the level of filtration.

Most buildings use low-quality filters that can capture less than 20% of viral particles. Most hospitals, however, use a filter with a MERV rating of 13 or higher. And for good reason – they can capture more than 80% of airborne viral particles.

For buildings without mechanical ventilation systems or if you want to supplement your building's system in high-risk areas, portable air purifiers can also be effective in controlling particulate concentrations in the air.

Most quality portable air purifiers use HEPA filters, which capture 99.97% of particles.

The government should also give local authorities the power to compel building owners and managers to carry out indoor air quality checks immediately and implement measures for all facilities used by the public, including schools, hospitals and commercial offices, etc.

THERMAL HEALTH

It is important to keep the temperature and relative humidity within the ranges considered ideal for each environment, as well as to monitor thermal conditions and reduce solar heat gain to save energy and reduce environmental impacts.

WATER QUALITY

Water tests should be done regularly to monitor the amount of residual disinfectants, such as chlorine, the pH level, and temperature, as well as to identify the possible presence of bacteria that may pose a risk to people.

HUMIDITY

It is necessary to protect the building envelope, from the roof to the waterproofing, to prevent the entry of water and the proliferation of mold and moisture. It is important to regularly check the plumbing pipes for signs of leakage or standing water. . Some viruses survive better when the relative humidity (RH) is low. Allen and Macomber's research team found that increasing the RH between 30 and 50 percent led to a 32 percent drop in influenza virus survival. Early results show that the coronavirus survives better on surfaces with a RH of 20%. In general, humid conditions are thought to increase the growth of bacteria, fungi, and other biological contaminants. But some viruses, such as the flu, survive better when humidity is low.

A portable humidifier can be a good strategy to increase the humidity of environments, as shown in Figure 2.

Figure 2 – Humidification of indoor environments



Source: Allen *at all*, 2020.

DUST AND PESTS

The **foundations of the healthy building** are also concerned with the ingress of dust and pests. The recommendation is to clean all surfaces and, in the case of the floor, vacuum it regularly with a HEPA (*High Efficiency Particulate Arrestance*) vacuum cleaner to pick up even microparticles.

NOISE

Noise pollution depends on a number of factors, but it can be controlled by defining "noise zones" in different building areas, using materials that absorb sound and minimise reverberation, and creating quieter areas in commercial buildings.

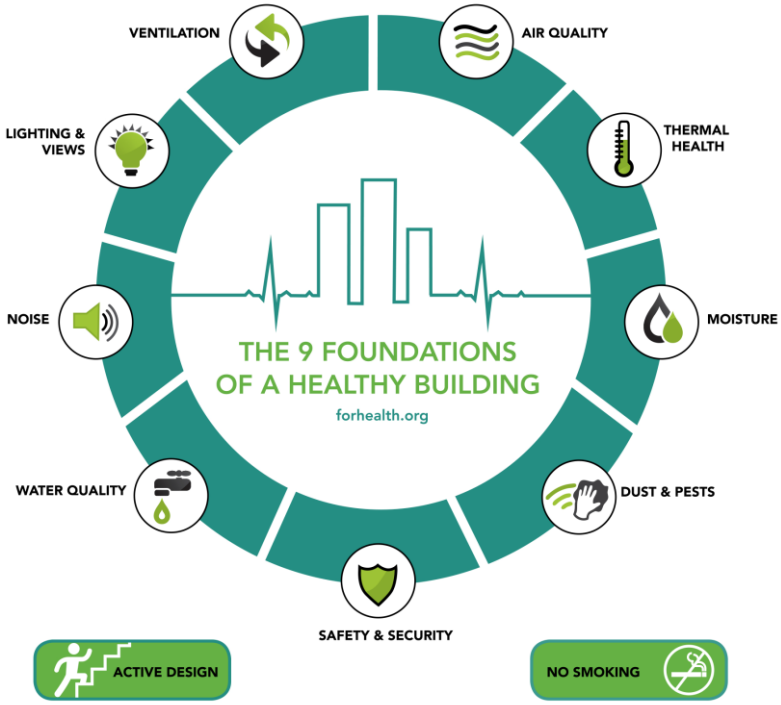
LIGHTING AND VIEWS

Projects must follow good lighting practices in the environments, controlling the amount of light and glare. It is ideal to maximize access to natural light through windows and to control light intensity, spectrum, and time.

SAFETY AND SECURITY

The building needs to meet all safety norms and standards, such as fire suppression systems and smoke detectors, as well as invest in equipment such as surveillance systems and safe visitor flow control.

Figure 3 – Nine Essentials for a Healthy Building



Source: Allen *at all*, 2017.

CONCLUSIONS

The internal environment of buildings, especially in Brazil, is still little studied. In which there is no simple and single solution for sick buildings since the reactions in the occupants are multifactorial.

Proper fresh air renewal and ventilation eliminates or minimizes many symptoms such as: irritations to the eyes, nose, throat and skin due to chemicals present in the air.

As already mentioned, suitable filter systems will remove dust. These filters should be changed periodically, usually at the time of maintenance.

Sick Building Syndrome has a multidisciplinary approach and involves professionals from architecture, engineering (especially occupational safety engineers), medicine (epidemiologists) and public health authorities.

On the other hand, Allen and Macomber (2020) bring us nine fundamentals of Healthy Building, which are: Ventilation, Air Quality, Thermal Health, Water Quality, Humidity, Dust and Pests, Noise, Lighting and Views, and Safety and Protection.

No less important is to emphasize the importance that projects must have regarding the specification of indoor air circulation and the control of air flow in order to have healthy environments.

It is also important that local authorities create specific legislation to require indoor environmental quality in buildings, including schools, hospitals, commercial offices, among others.

Much still needs to be done to prevent Sick Building Syndrome, and entrepreneurs have a very important role in understanding productive work spaces, they must be aware of the various sources of the problem, whether chemical, biological or physical. For better decision-making, it is necessary that preventive measures are adopted, so that we will have a healthy, comfortable and productive environment.

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Chagas disease: A brief summary

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ABSTRACT

Chagas disease (CD) has existed for millions of years as an enzootic in wild animals that began to be transmitted to humans accidentally when it invaded wild ecotopes. However, the disease was described for the first time in 1909 by the Brazilian Carlos Ribeiro Justiniano Chagas (Carlos Chagas), who detected the parasite in a 2-year-old child in the city of Lassance, Minas Gerais. This fact was considered a milestone in the history of medicine due to the simultaneous discovery of the vector popularly known as kissing bug.

Keywords: Chagas disease, Public Health.

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INTRODUCTION

Chagas disease (CD) has existed for millions of years as an enzootic in wild animals that began to be transmitted to humans accidentally when it invaded wild ecotopes. However, the disease was described for the first time in 1909 by the Brazilian Carlos Ribeiro Justiniano Chagas (Carlos Chagas), who detected the parasite in a 2-year-old child in the city of Lassance, Minas Gerais. This fact was considered a milestone in the history of medicine due to the simultaneous discovery of the vector popularly known as kissing bug.

OBJECTIVE

The aim of this study was to demonstrate the importance of knowing Chagas disease.

METHODOLOGY

This is a literature review study on Chagas Disease.

RESULTS

The etiologic agent is the flagellate protozoan *Trypanosoma cruzi*. In vertebrate blood, it is present in the infective form trypomastigote and in tissues, in the amastigote form. In insects, on the other hand, several maturations occur, highlighting the infective form, which are the forms found in the feces and urine of the insect. Transmission is by the deposition of infected feces on the skin or mucous membrane of the man. The kissing bug emits feces at or shortly after sucking the vertebrate. The same kissing bug can eliminate a large number of trypanosomes every time it issues droppings following a rejection. Transmission can also occur through blood transfusion, oral ingestion of contaminated food, congenital transmission, and also through breast milk.

CONCLUSION

Chagas Disease is of paramount importance for Public Health and despite all the strategies formed to combat it, it is necessary to further increase the population's knowledge about the disease through campaigns, school education and thus avoid the transmissibility of the disease.

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The manipulable trigonometric cycle: A tool for teaching trigonometric functions

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ABSTRACT

The present research aims to analyze the use of the Manipulable Trigonometric Cycle as a teaching resource to facilitate the teaching-learning process of trigonometry. It is justified by the reason that some teachers do not teach trigonometry in basic education, as it is considered Mathematics content that is difficult to teach and very difficult for students to understand. Therefore, it was decided to use the manipulable object as an auxiliary tool for teaching trigonometry, believing that it could be a very effective methodology for education. This investigation had a quantitative-qualitative approach, as the quantified data was obtained through the application of the Manipulable Trigonometric Cycle, and they were subsequently analyzed, interpreting the variations in the results and Questionnaires were used to obtain the data. The research sample were students from two classes of the second year of high school integrated into the technical course in agriculture at the Federal Institute of the North of Minas Gerais. Based on the assumption that Manipulable Materials help in the development of learning, stimulates creativity, imagination and autonomy, exercises concentration, promotes socialization, contributes to the construction of students' personality and logical reasoning. It is concluded that the teaching material can become a great ally for the teacher, helping him in the teaching-learning process of the students, thus contributing to an improved construction of knowledge, as long as it is explored properly, so that the student begins to build their own concepts.

Keywords: Mathematics, Trigonometry, Manipulable Trigonometric Cycle.

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INTRODUCTION

Trigonometry is a very important content of Mathematics, especially in the applicability of its concepts, so its teaching in basic education must be well worked so that students have a good learning. But this is not what the students think, because according to Thomaz (1999), the students find Mathematics very complicated, incomprehensible, distant and cold, being a cluster of exercises that they do for the sake of doing and do not know why or for what purpose of this discipline.

This students' perception of Mathematics is reflected in the results of international assessments, such as PISA (Programme for International Student Assessment), which according to INEP (National Institute of Educational Studies and Research Anísio Teixeira), has the initiative to evaluate students in the age group of 15, the age at which students are immersed in the teaching of trigonometry. This evaluation is done every three years and the last one took place in 2015. According to PISA, Brazil lost five positions compared to its previous edition, in 2012, falling from 58th to 63rd place, with only 70 countries participating. This position is due to three areas evaluated: Math, Reading, and Science.

It can be seen that the teaching of Mathematics in Brazil is regressing, and this may be due to the rejection that students have for the subject. As Reis (2005) has already pointed out, some of the causes are, the lack of motivation of the teacher when teaching and the lack of motivation of the students to learn, the idealization accepted by the students that Mathematics is difficult, the rigor of Mathematics, the negative experiences that the students had with this subject, the absence of relationship between the Mathematics taught in schools and the daily life of the students, the relationship that the teacher establishes with the students, the way of teaching and the way of evaluating.

Given these circumstances, this research presents a resource that will facilitate the teaching of trigonometry, in a playful and motivating way so that students, using the manipulable trigonometric cycle, promote a better understanding, visualizing and manipulating the material. This research is justified by the fact that some teachers do not teach trigonometry in basic education, including one of the authors, because it is considered a very difficult mathematics content to teach and very difficult for students to understand. Therefore, it was decided to use the manipulable object as an auxiliary tool for the teaching of trigonometry, believing that it can be a very effective methodology for education.

Thus, this research investigated how the use of the manipulable trigonometric cycle contributes to the teaching-learning process of trigonometry, facilitating the teacher's work in teaching and motivating students to learn.

To try to present an alternative for such investigations, this research has a general objective, to analyze the use of the Manipulable Trigonometric Cycle as a facilitating didactic resource in the teaching-learning process of trigonometry. The Specifics are:

- ✓ Construct a Manipulable Trigonometric Cycle, student version, at low cost, so that it can be reproduced in public schools, especially in state schools, where resources are reduced;
- ✓ Construct a Manipulable Trigonometric Cycle, teacher version, so that it can be reproduced by teachers, in order to present the content collectively;
- ✓ Visualize the values of trigonometric functions in a manipulative way in the cycle;
- ✓ Identify the advantages and disadvantages of using the Manipulable Trigonometric Cycle.

THEORETICAL FRAMEWORK

TRIGONOMETRY TEACHING

Based on the historical context, the importance of trigonometry can be seen. Taking this content of Mathematics to teaching, it is observed that trigonometry has been evolving due to the needs of civilizations, its transmission in teaching is also gradual, since,

> Trigonometry, as we can see, is a very important content, which was developed in order to calculate distances using the measurement of angles as a basis. This content is initially introduced to the student in Elementary School II, with the trigonometric relations sine, cosine and tangent, in addition to the Pythagorean Theorem. And later in high school with the law of sines, law of cosines, area of any triangle, trigonometric circumference, among others, further deepening the concept of Trigonometry and its applicability. (Júnior, 2017, p. 32).

But, in order for all this trigonometry content to be taught in such a way that the student feels attracted and understands all the importance of the subject, Lins (2016) argues that our school system today needs to adapt, promoting knowledge and skills that enable us to share in the globalization process.

This problem happens more frequently in high school, where students are almost ending their school life and eagerly preparing for their entry into the job market, but for the National Curriculum Parameters for High School (PCNEM) learning is much more important, as the text points out:

> In high school, the final stage of basic schooling, Mathematics should be understood as a part of human knowledge essential for the formation of all young people, which contributes to the construction of a worldview, to read and interpret reality and to develop skills that will be required of them throughout their social and professional lives. (Brasil, 2000, p.111).

Taking all this consideration into the teaching of trigonometry today, the (PCNEM) also point out that it is traditionally "presented disconnected from applications, investing a lot of time in the algebraic calculation of identities and equations to the detriment of the important aspects of

trigonometric functions and the analysis of their graphs". (BRASIL, 2000, p. 121-122). This may be one of the many indications of students' distaste for the teaching of Mathematics, where they are only presented with calculations and numbers, without any approach to the why and why of so many calculations.

One of the problems in the teaching of mathematics is the lack of interest of most students in school activities. Prediger, Berwanger and Mörs (2009) conducted research with teachers of the final grades, and they pointed out that there are still students who are interested, study and perform challenging activities in schools, but there are those who are not interested in anything, especially in activities that require logical thinking, such as the contents of Mathematics.

The causes of the problems that are present in education today are several, and one of them is pointed out by Conceição, Mendes and Borges (2015), where the teacher is one of the causes of the classes being boring, causing this lack of interest. In the authors' research, students suggest that math classes should be more interactive and dynamic.

The traditional way of teaching does not arouse interest in students, because students with access to so many means of communication and technologies are disinterested and unmotivated to study in an outdated way. It is not enough for teachers to just master the content of specific mathematics, they also need to be up to date with current educational means, interacting with some technological means and new teaching methods in their classes. (Conceição, Mendes and Borges, 2015).

In order for students to truly learn, it is necessary to know their interests, give them the opportunity to question, disagree, create hypotheses, make assumptions about the level of knowledge they have already learned, participate in classes and in the entire educational process, committing themselves to the school and to their own social education (Bitencourt and Batista, 2011).

It is notorious that the problems encountered in the teaching of Mathematics do not come from just one cause, but from several, and they can be noticed by teachers in their practice in the classrooms.

In the teaching of Mathematics, especially trigonometry, which requires more reasoning and analysis, is where the greatest losses in the quality of teaching occur. The students start to create a certain accommodation, so that, even if the teacher has innovative and motivational methodologies, the students are unmotivated and have an attitude of rejection of the discipline.

In the final grades is where more problems occur in teaching, since there is a lack of motivation and lack of interest of students in studying, there are few practical activities for some contents, a lot of difficulty in interpreting students, lack of a support network for teaching in the classroom, such as reinforcement classes for students who are having difficulties, lack of conditions

for better planning and preparation of classes, such as teaching material and resources. (Prediger, Berwanger and Mörs, 2009).

Nowadays, there is a lack of communication between the mathematical language and the Portuguese language, in which students claim that they are either good in one discipline or in the other, creating a distance between the two disciplines. The lack of Portuguese language in the subject of Mathematics means that students do not interpret and understand mathematical concepts, only memorizing and executing them in a mechanized way. (Conceição, Mendes and Borges, 2015).

Therefore, if young people continue to have this perception that learning mathematics is just memorizing their formulas, without understanding all its fundamentals and without being aware that it is significant knowledge, students will continue to think that it is just an important subject to pass the year and in the future have a good job and not important in itself.

MANIPULABLE TEACHING MATERIALS

After a brief approach to some of the causes of students' lack of interest in studying Mathematics and, primarily, in the content of Trigonometry, one should look for some resource to improve the teaching of Trigonometry, as it is a very important content both in everyday life and in the school context. Many difficulties have been observed in the students' learning in the laws of Trigonometry, difficulties caused by the vision developed by the teacher in the classroom, distant from the student's reality, preferring the technique to the detriment of meaning and applicability. (Souza, 2018).

Therefore, in order for the teacher to achieve all this interest and curiosity of the students to the content of Mathematics, it is suggested by this research the Manipulable Didactic Materials, which are "real objects that the student is able to touch, feel, manipulate and move, objects that represent an idea. For many, a well-conducted activity must go through manipulation, representation and symbolization, which would be the springboard to reach abstractions." (Scolaro, 2018, p. 11).

Manipulable materials were introduced into education because of Pestalozzi and Froebel in the nineteenth century, and in the early twentieth century it was due to Montessori and Decroly (Fiorentini; Miorim, 1990). Pestalozzi argued that education should begin with the perception of concrete objects, carrying out concrete actions and experiments. In Brazil, these didactic resources appeared around 1920, a time marked by the emergence of the empiricist-activist, a trend in the teaching of Mathematics in this period (Nacarato, 2005). So it was from there that the idea of manipulation and visualization of concrete objects, exercising practical activities such as measurements, counts and comparisons, resulting in the assimilation of students from theory to practice.

Many teachers use only the textbook as a work tool, but the illustrations of the manipulable materials in the books do not replace the materials themselves, since, with them, in a Mathematics laboratory, it would be better to visualize the proposed problems (Santos, 2011). Therefore, it is important to use concrete materials, but there are some caveats, because,

> Generally, Mathematics teachers use manipulable material as support for the student's learning difficulties in a given subject, which evidences the strong influence of the New School movement, which involved the use of this type of material with the objective that the student can learn by doing. (Santos, 2011, p. 17).

The New School movement was a mobilization of European and North American educators, around the nineteenth century, which suggested a new understanding of the needs of childhood, aiming at a renewal of the mentality of educators and pedagogical practices, in addition to having the intention of placing the student at the center of the educational process. Educators defended this renewal, due to the accommodation in which children and young people were forced to follow traditional methods. The New School arrived in Brazil in the 1920s with the reforms in education, in several Brazilian states, it sought modernization, democratization, industrialization and urbanization of society. (Menezes, 2001).

Therefore, this resource is important because they are "playful materials, pedagogically structured for the learning of the various mathematical contents, since, through their use, they provide better interaction and socialization among students, contributing to a greater exchange and sharing of ideas among them". (Camacho, 2012, p.27). In addition to the benefits that the teacher will achieve, the use of Didactic Materials (DM) in the teaching of Mathematics, the students, also, with a good use of the classes, make that,

> The use of DM in the classroom expresses a great importance in relation to the construction of knowledge, because each student has his or her own way of learning, and using alternative means this teaching-learning process completes in a significant way, makes it for the student not to learn mechanically, nor to learn non-playfully, but leads him to value action, manipulation and experimentation. (Oliveira; Freire; Santos, 2011, p.07).

In this way, for a better development of the classes, when the teacher is going to teach them, two types of manipulable materials can be developed, namely:

> Static manipulable material: a concrete material that does not allow transformation by continuity, i.e. alteration of its physical structure from its manipulation [...]. The dynamic manipulable material: concrete material that allows transformation by continuity, that is, the physical structure of the material changes as it undergoes transformations, through operations imposed by the subject who manipulates it [...]. (RODRIGUES; Gazire, 2012, p. 190).

Thus, according to Rodrigues and Gazire (2012), dynamic manipulable material is more advantageous than static manipulable material, since it facilitates a better perception of properties, as

well as the realization of rediscoveries that can guarantee a more significant learning in the study of trigonometry.

In this form of interaction of the students, solving the activities, reflection and improvement of cognitive schemes arise during the exploration of the materials, such as knowing how to do, knowing how to question, knowing how to say, knowing how to argue, such as knowing how to live together and work collectively. This knowledge contributes to the construction of autonomy to make choices and decisions, developing citizenship actions (Santos, 2011).

These manipulable handmade resources provide, at any level of education, the full development of mathematical content, but this is relative to the subject and not as a form of recreation (Souza, 2018). Therefore, teaching can often begin with the concrete, that is, revealing the potential of sight and touch, which theory often does not reach, not that they are not important, but they are not sufficient for the student's learning (Santos, 2011).

When choosing this teaching methodology, the educator should first, according to Oliveira, Freire and Santos (2011), answer four questions, namely: Why use manipulable teaching materials? What materials will you use? When and how should it be used? And what concepts will be explored? Using these questions as a reflection will make it much easier to plan lessons when using a manipulative object. In this way, the classes, in addition to being well planned, will be diversified, because,

> The transformation of the classroom into a teaching and learning laboratory will generate a new school environment. The insertion of the student as an active subject in the school process will enable a new reality in the school. Thus, it is necessary to develop a Methodology for the Teaching of Mathematics that aggregates technological development to motor development, associating research in the classroom with electronic resources and handmade didactic materials built by students, in order to better understand the curricular contents. (Souza, 2018, p.16).

"Manipulable materials can be a great ally in Mathematics classes, but not to replace the teacher, but to integrate into their classes; in addition, there is a need for teachers to find theoretical support to support their planning" (Santos, 2011, p.10). Therefore, it cannot be sure that a manipulable object, as a didactic resource, is the solution to the problems of teaching trigonometry, but a very viable attempt due to its importance that can "provide students with greater interaction in the classroom, autonomy and security, creativity, responsibility, motivation, understanding of mathematical concepts, assimilation of content and construction of their own knowledge". (Oliveira; Freire; Santos, 2011, P.08).

METHODOLOGY

The present research had a quantitative-qualitative/qualitative-quantitative approach, since the quantified data were obtained in the construction and application of the manipulable object, and later an analysis of them, tending to interpret the variations of the results.

This type of research has its importance, since it has four methodological definitions, namely: *triangulation*, which seeks to compare and contrast statistical data with qualitative data obtained simultaneously; *embedded*, in which a set of quantitative data supports the other qualitative data or vice versa, both also obtained simultaneously; *explanatory*, where qualitative data are used to clarify quantitative results or vice versa and the *exploratory*, of which qualitative results contribute to the development of the consecutive quantitative method.(CRESWELL; CLARK apud SOUZA; KERBAUY, 2017).

The nature of the research was applied, as she "It aims to generate knowledge for practical application, aimed at solving specific problems. It involves local truths and interests." (Scott; Gerhardt, 2009, p. 35).

The objectives of the research were exploratory, since it provided a "general, approximate view of a given fact. This type of research is carried out especially when the chosen topic is little explored and it becomes difficult to formulate precise and operationalized hypotheses." (Gil, 2008, p. 27). It was also descriptive, since its primary purpose is to describe the characteristics of a given population, phenomenon or the relationship between variables. In addition, explanatory research was used, since it is the one that most investigates the study of reality, since it explains reality and the why of things. (Gil, 2008).

The research design was also based on bibliographic research, as it "is developed from material already elaborated, consisting mainly of books and scientific articles". (Gil, 2008, p. 50). This was the case of this research, as the idea originated from Oliveira's (2015) research based on its construction. The difference in the construction of the material was in the way the rulers are handled to obtain the trigonometric ratios, where in this research it is not necessary to change rulers, with just one the student finds the ratios of the sine, cosine and tangent. But with Oliveira's (2015) construction, students can also obtain the ratios of the cosecant, secant, cotangent.

The research was carried out at the Federal Institute of Northern Minas Gerais (IFNMG) Salinas Campus, located at Fazenda Varginha, km 02 of the MG-404 Highway, CEP no. 39560-000, Salinas/MG. The target audience of this research were students from two classes of the second year of high school integrated into the technical course in agriculture.

The data were obtained during three 50-min classes of a diagnostic questionnaire, to obtain the students' previous knowledge, followed by a workshop with an activity using the manipulable materials, which is the phase of the application of the research, and at the end an evaluative

questionnaire was given to the students, which aimed to evaluate the performance, success, interest, difficulties and importance in the use of the object in trigonometry classes.

ANALYSIS AND DISCUSSION

In this chapter, the analysis and the results obtained in the application of the research will be presented, in the 3 stages: the Diagnostic Questionnaire, the Workshop and the Evaluative Questionnaire, Appendix D.

ANALYSIS OF THE DIAGNOSTIC QUESTIONNAIRE

The Diagnostic Questionnaire was developed with the intention of analyzing the profile of students and verifying their interest in studying Mathematics and their willingness to use manipulable materials in classrooms. Below, I present the quantitative graphs, in view of the students' answers. A total of 51 students participated in this questionnaire. It was found that most of the classes are composed of male students, and the age of the students is between 15 and 17 years old.

Students were asked if they like to study Mathematics and 52% of students answered that they do not like it and 48% answered that they do**.** It can be seen that most of them do not like to study this discipline

Another question was whether students have difficulties in studying mathematics, and most students answered yes**.** This result can be analyzed with some of the students' answers in the Diagnostic Questionnaire, according to some speech extracts; *"I can't interpret mathematical expressions,"* another student justifies, *"I have a big problem interpreting mathematical problems."* This answer is for the reason, according to Conceição, Mendes and Borges (2015), there is a division between the mathematical language and the Portuguese language, because students who like one subject do not like the other, harming the interdisciplinarity of the contents and harming mathematics in the interpretation of the problems.

Most of the students answered that they also have many difficulties in the contents of Trigonometry, in which most find this content complicated, especially in the conversion of angles into radians or vice versa and in the complex formulas of Trigonometry.

Another question was whether the students know any type of manipulable material, and 51% of the students answered yes and 49% answered that they do not**.** It turns out that a little more than half of the students know some kind of manipulable material. The students who answered that they already knew it, also answered what the materials were, in which most were the Rubik's cube, golden material and geometric shapes. They said they used these materials in elementary school, where students reported that they consider it very important as it makes it easier to understand the content.

The last question of the Diagnostic Questionnaire was about the importance of using different methodologies in mathematics classes such as software, applications, video lessons, among others. The vast majority of students, 98%, think it is important to use different methodologies in math classes**.** It is observed that the majority thinks it is important, in which analyzing this percentage with some of the students' answers in the Diagnostic Questionnaire, we have justifications such as: *"changing the way of teaching in some classes helps in learning"; "The class is more enjoyable, dynamic and less tiring and also helps to increase interest in the content."* This answer is discussed by Rodrigues and Gazire (2012), where they address that different methodologies in classrooms make Mathematics more dynamic and understandable, bringing theory closer to the practice of content.

ANALYSIS OF THE ACTIVITY CARRIED OUT IN THE WORKSHOP

The workshop was held at IFNMG – Salinas Campus. In the first class of the workshop, the Trigonometric Manipulable Cycle was presented in the teacher version, explaining how it is used and what it is used for. In the second class, the first part of the Activity/workshop was applied, asking the students to fill in the trigonometric table with the values of the notable arcs of the sine, cosine and tangent, using the Manipulable Trigonometric Cycle, student version. In the third class, the students did the second part of the Activity, Appendix C, in which they used the values of the notable arcs identified in the Trigonometric Manipulable Cycle and filled in the table of the first part of the activity, to construct the graphs of the functions $f(x) = sen\, x,\ f(x) = cos\, x$and $.f(x) = tan\, x$

During the first stage of the Activity, the difficulty that the students had was in the manipulation of the Cycle, and in identifying which ruler they should use to find the values of sine, cosine and tangent, since it was something new for them, but to solve this it was necessary to reinforce the explanation, individually, of how it is to be used. Another difficulty was to recognize which were the axes to find the values of the trigonometric ratios, but it was also a problem solved individually. In Figure 5 we can see a table duly filled in by one of the students, in the first part of the workshop activity. During the application of the workshop, it was noticed that the colors of the Trigonometric Cycle helped the students a lot, as it differentiated the trigonometric axes, making it easier to fill in the table.

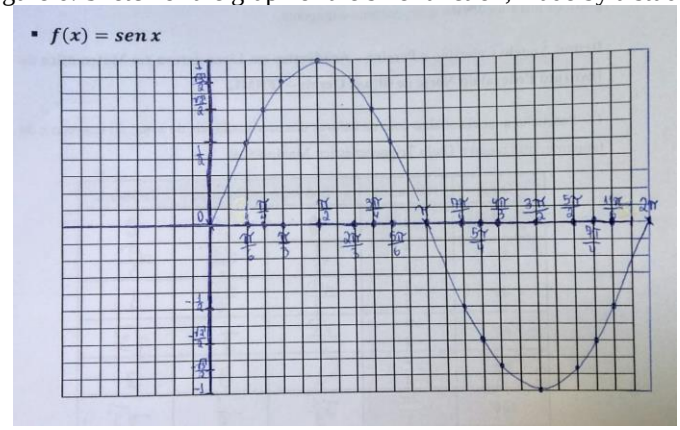
Figure 5: Trigonometric table, made by a student, filled with the values of sine, cosine and tangent

Graus	Radianos	Seno	Cosseno	Tangente
0°	0	0	1	0
30°	$\frac{\pi}{6}$	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{3}}{3}$
45°	$\frac{\pi}{4}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$	1
60°	$\frac{\pi}{3}$	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	$\sqrt{3}$
90°	$\frac{\pi}{2}$	1	0	∄
120°	$\frac{2\pi}{3}$	$\frac{\sqrt{3}}{2}$	$-\frac{1}{2}$	$-\sqrt{3}$
135°	$\frac{3\pi}{4}$	$\frac{\sqrt{2}}{2}$	$-\frac{\sqrt{2}}{2}$	-1
150°	$\frac{5\pi}{6}$	$\frac{1}{2}$	$-\frac{\sqrt{3}}{2}$	$-\frac{\sqrt{3}}{3}$
180°	π	0	-1	0
210°	$\frac{7\pi}{6}$	$-\frac{1}{2}$	$-\frac{\sqrt{3}}{2}$	$\frac{\sqrt{3}}{3}$
225°	$\frac{5\pi}{4}$	$-\frac{\sqrt{2}}{2}$	$-\frac{\sqrt{2}}{2}$	1
240°	$\frac{4\pi}{3}$	$-\frac{\sqrt{3}}{2}$	$-\frac{1}{2}$	$\sqrt{3}$
270°	$\frac{3\pi}{2}$	-1	0	∄
300°	$\frac{5\pi}{3}$	$-\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	$-\sqrt{3}$
315°	$\frac{7\pi}{4}$	$-\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$	-1
330°	$\frac{11\pi}{6}$	$-\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$-\frac{\sqrt{3}}{3}$
360°	2π	0	1	0

Source: Workshop Activity

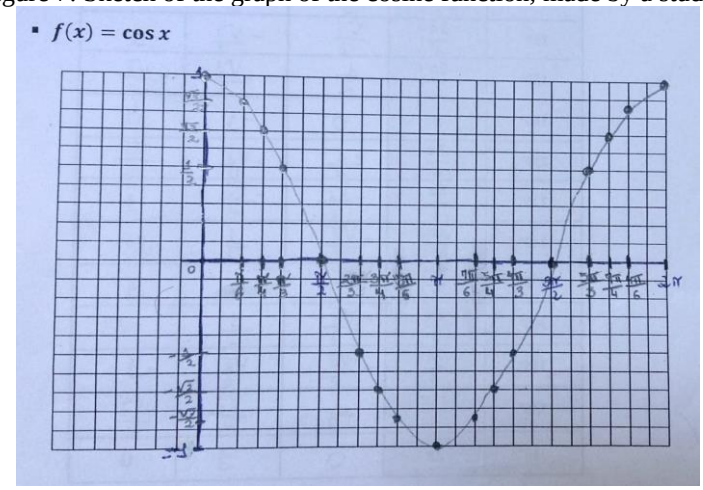
During the second part of the workshop, some difficulties arose from the students in the construction of the graphs, especially in the $f(x) = tan\, x$, since it was the first time that the students visualized and built the trigonometric graphs alone without the teacher having previously presented them on the board. The first difficulty was to assemble the Cartesian planes in the meshes, because the values are very different from what they were used to in other functions, another problem arose when they went to indicate the points of the function in the plane, since some students filled in the table wrong, causing the function to be incorrect. These small problems were solved with the students individually, during the workshop, and this made it possible for the students to elaborate the entire proposed activity. In Figure 6, Figure 7, and Figure 8, we see correctly plotted graphs of some students.

Figure 6: Sketch of the graph of the sine function, made by a student



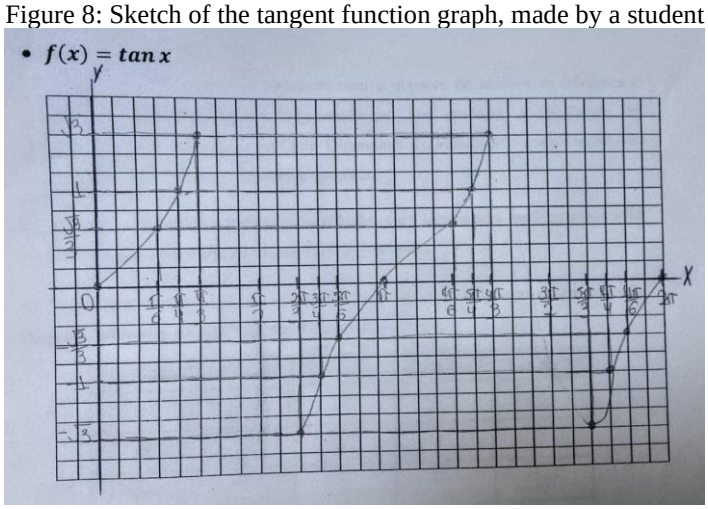
Source: Workshop Activity

Figure 7: Sketch of the graph of the cosine function, made by a student



Source: Workshop Activity

Figure 8: Sketch of the tangent function graph, made by a student



Source: Workshop Activity

Despite some problems in the execution of the Activity in the workshop, the results were very good, as the students were able to achieve the intended objectives. And in order to analyze more precisely the importance of this methodology, we will analyze the Evaluative Questionnaire below.

ANALYSIS OF THE EVALUATIVE QUESTIONNAIRE

The Evaluative Questionnaire was elaborated with the intention of evaluating the use of the Manipulable Trigonometric Cycle, after the completion of the workshop activities. A total of 55 students participated in this questionnaire.

In the Questionnaire, students were asked if they had any difficulty in using the Manipulable Trigonometric Cycle, and 73% of the students answered that they did not have difficulty and 27% answered yes**.** It can be seen that most of them did not present problems in the manipulation of the Cycle. The students who presented difficulties justified why, and most reported that they were having problems at the beginning of the handling of the Trigonometric Manipulable Cycle, because they did

not know that type of material, but as soon as they learned they were able to do the activities. The students also reported that they had a bit of trouble plotting the tangent chart.

Another question was whether the students aroused interest and curiosity in the content covered, based on the method applied in the activity done during the workshop, and 76% of the students answered yes and 24% answered no. It can be seen that most of them aroused interest, in which this percentage can be analyzed with some answers of the students in the Evaluative Questionnaire, according to some excerpts of speech: *"I had a different view of what I thought about the sine, cosine and tangent",* another student commented that: *"It encouraged me to want to learn more about the content",* another student said that: *"I was impressed with the elaboration of the material and how easy it was to do the functions."*

It was observed that from these speech extracts that according to Camacho (2012), this methodology aims to facilitate the understanding of mathematical contents, since it awakens motivation and encourages learning, also awakens students' curiosity, concentration and creativity.

In the questionnaire, the students answered if the use of the Manipulable Trigonometric Cycle helped in the teaching of trigonometric functions and, unanimously, 100% of the students answered yes**.** It can be seen that all students think that the Cycle helps in teaching, in which this percentage can be analyzed with some answers from the students in the Evaluative Questionnaire, where some of the students' comments were that the classes are more diverse, interactive and not tiring, another comment was that it is better than just listening to the teachers.

The students were also asked if they would like to know and use Manipulable Materials more often in the study of Mathematics, and 96% of the students answered yes and 4% answered no**.** It is observed that most of them would like to know and use other manipulable materials, in which we can analyze this percentage based on some extracts of the students' speech: *"Mathematics always needs to seek different methods",* another student commented that: *"he would like to know because he has many difficulties in the subject".*

It was also asked to the students that from the use of the Manipulable Trigonometric Cycle, they think that the use of different methodologies in mathematics classes such as software, applications, video classes, among others, contribute to the teaching-learning process, and again, unanimously, 100% of the students answered yes.

It can be seen that all students think that these differentiated methodologies contribute to the teaching of Mathematics, because according to Santos (2011), the purpose of these methodologies is to assist in the teaching and learning process, showing that the resolution of trigonometric problems can be worked in an attractive, constructive, interesting and motivating way. And so were the students' responses, as we can see in an excerpt of speech: *"I am interested in different things, because it makes the classes more attractive and not repetitive."*

CONCLUSION

This research sought to show a different way of learning to obtain the necessary data for the construction of sine, cosine and tangent graphs, through the Manipulable Trigonometric Cycle, since the students' perception of Mathematics was not very good. The handling of the Manipulable Material allowed the students to make several observations, enabling them to solve the activities more quickly, reducing the time of application of the content, favoring the teacher in the execution of all the curricular content.

Thus, we can say that we were able to answer the question of this research, because several contributions of the Trigonometric Manipulable Cycle were found in the teaching of the Sine, Cosine and Tangent Functions. As for the objectives of this research, it was possible to construct the Cycles both the version for the teacher and the version for the students. And from it it was noticed that when developing the activities with Manipulable Trigonometric Cycle, it was observed that it is a facilitating means in the teaching-learning process, seen as something interesting and motivating to the students, mainly because it promotes a better visualization of the Functions, which was one of the objectives.

With the realization of this proposal, we realized the importance, as teachers, of one of the main tools in the teaching-learning process, planning. Taking the time to think about each stage of the class to be taught, selecting the didactic tools to be used, and choosing the topics to be worked on, enabled moments of pleasure and satisfaction, added to the students' participation.

This research showed an experience that presented significant results for the classes, with the application of a playful activity in the teaching of mathematics in a dynamic and creative way, as proven by the numbers in this sample. Other works can be carried out with proposals or suggestions that inspire teachers to expand new ideas of activities to facilitate the learning of their students. Thus, this research leads us to the constant search for strategies that, like these, can meet the desires of students in search of quality in the teaching-learning process.

Finally, it is important to emphasize that the use of new methodologies is not the act of solving the problems involved in the teaching of Mathematics. And to achieve the main objective of student learning, schools and teachers must always reflect and seek new strategies to be used in the classroom.

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Discipline of Forensic Nursing in undergraduate Nursing: Experiences, didactic strategies, and reflections in a city in the interior of São Paulo

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ABSTRACT

This chapter presents a detailed analysis of the implementation and outcomes of an elective course in Forensic Nursing within a bachelor's degree program in nursing, located at a higher education institution in the interior of São Paulo. With the overarching goal of reflecting upon and sharing accumulated experiences, the research focuses on the application of innovative teaching strategies such as realistic simulation, dialogic lectures, group discussions, case studies, and simulated laboratory activities to engage students and prepare them for the practical and ethical challenges encountered in Forensic Nursing. The qualitative methodology of experience reports enabled the description and analysis of these pedagogical practices and their effectiveness in contributing to the enhancement of education and professional practice in Forensic Nursing, emphasizing the importance of specific training in preparing professionals for forensic demands.

Keywords: Forensic Nursing, Pedagogical Practices, Nursing Education, Innovative Teaching Strategies, Higher Education.

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INTRODUCTION

Forensic Nursing has established itself as an essential field at the intersection of the healthcare system and the judiciary, highlighting the growing need for professionals who integrate medical competencies with the meticulous collection and analysis of forensic evidence. This specialty emphasizes the importance of attention and protection for victims of violence, in addition to their active participation as specialized witnesses in judicial proceedings. This specialty emphasizes the importance of care and protection for victims of violence, as well as actively participating as expert witnesses in legal proceedings (American Nurses Association & International Association of Forensic Nurses, 2021).

The historical development of Forensic Nursing shows how the application of nursing science in contexts where health and justice systems overlap has evolved significantly. Historically, documents point to the emergence of specialized nursing practice in the mid-1970s in the United States of America and Canada (Lynch & Duval, 2011). And, from the first records of specialized nursing practice in the 1970s in the United States and Canada to the formalization of the practice with the founding of the International Association of Forensic Nurses in 1991, the field has expanded its boundaries and clearly defined its scope and objectives (Esteves *et al*., 2014; Valentine *et al,* 2020). The definition of Forensic Nursing according to the International Association of Forensic Nurses (IAFN), is the application of nursing science in situations where the health and justice systems overlap (International Association of Forensic Nurses, 2021). Other authors define forensic nursing as the specialty that "combines the traditional acumen of nursing with those of forensic science and justice" (Lynch & Duval, 2011, p. 55).

In Brazil, Forensic Nursing was recognized by the Federal Council of Nursing (COFEN) as a specialty in 2011, number 17.2 through Resolution No. 389 (Federal Council of Nursing, 2011). Since then, the role and role of forensic nurses has been debated. However, it was in 2017, through Cofen Resolution No. 556, that the areas of activity of this professional were regulated. The Forensic Nurse, in the Brazilian territory, is defined, according to the Federal Council of Nursing in 2017, as:

> ..."bachelor's degree in nursing, holder of a lato or stricto sensu specialization title in forensic nursing issued by a Higher Education Institution (HEI) recognized by the MEC, or granted by Societies, Associations or Colleges of Specialists, registered within the scope of the Cofen System/Regional Councils ..." (Federal Council of Nursing, 2017).

The integration of Forensic Nursing into academic curricula reflects a vital response to contemporary needs for justice and health care. The development of nurses who are not only technically competent, but also prepared to face unique challenges in forensic contexts, demands a pedagogical approach that transcends traditional teaching. The integration of Forensic Nursing into academic curricula emerges as a vital element for the development of nurses who are not only

technically competent, but also prepared to face unique challenges in forensic contexts (Barros & Castellana, 2020; Cazañas *et al*., 2021).

The adoption of innovative didactic strategies in Forensic Nursing education, such as realistic simulations and case studies, represents a significant advance in the training of these professionals. These methodologies not only improve students' understanding of forensic concepts, but also develop critical skills and practical application of knowledge in real-life situations (Joaquim, 2019; Silva *et al*., 2021a).

Forensic Nursing training should balance the development of practical skills with a strong ethical foundation. It is essential that nurses are prepared to meticulously collect evidence and provide specialized care to victims, always respecting their dignity and rights. The integration of theoretical and practical knowledge, combined with reflection on common ethical dilemmas in forensic practice, is crucial to train qualified professionals who are aware of their fundamental role in the interface between health and justice (Esteves *et al*., 2014; Fernandes, Furtado & Alves, 2018).

The effectiveness of Forensic Nursing education can be ensured through rigorous evaluation of educational outcomes. Assessing the impact of the pedagogical strategies employed and identifying areas for continuous improvement are essential steps in refining curricula. This process ensures that students are adequately prepared to face the challenges of forensic practice, ensuring high-quality training that meets the complex needs of this field (Nucci, 2020; Rabelo, 2020).

The practice of Forensic Nursing is grounded in firm ethical principles, with an unwavering commitment to the dignity and human rights of victims. Educating nurses to make correct ethical judgments in complex and often emotionally charged situations is a priority. This involves a deep understanding not only of the legal issues, but also of the humanistic aspects involved in caring for victims of crime and violence (Oguisso & Zoboli, 2017).

The implementation and development of Forensic Nursing in Brazil faces significant challenges, including the need for formal recognition of the specialty and the development of specific educational and public health policies and programs. Despite these obstacles, the growing recognition of the importance of Forensic Nursing is a valuable opportunity to strengthen the profession. This recognition is reflected in the Brazilian Classification of Occupations, which details Forensic Nursing under the CBO code 2235-85, evidencing the formalization of the activity within the Brazilian health system (Ministry of Labor and Employment, 2023). In addition, the expansion of the role of nurses in the justice system contributes to a more humanized and effective care for victims, as well as to the expansion of the reception of demands related to the violation of rights and violence in society (Silva & Silva, 2009; Souza et al., 2020).

The Brazilian Society of Forensic Nursing (SOBEF), founded in 2017, plays an important role in promoting education, practice, and research in Forensic Nursing. Articulating researchers,

professionals, educational institutions and groups contributes to the improvement of standardized and validated guidelines and protocols that contribute significantly to the qualification of professional training and improvement of practice in this area. This collective effort is essential for the advancement of Forensic Nursing in Brazil, ensuring that forensic nurses are well prepared to meet the demands of the field and contribute to justice and the care of victims with competence and ethics (SOBEF, 2019).

The future prospects for Forensic Nursing are extremely promising, indicating a trajectory of growth and increased recognition within the healthcare and legal communities. Robust educational and research development is essential to enhance professional practice and contribute meaningfully to public health and legislation. The consolidation of this specialty requires a joint effort by academic institutions, health agencies, and the justice system, aiming at an effective and humanized integration in the care of victims and in the management of forensic cases (Furtado *et al*., 2021; Esteves *et al*., 2014).

Interdisciplinary collaboration is essential for the effective integration of Forensic Nursing into health and justice systems. Strategic partnerships between educational institutions, public health agencies, and judicial entities can facilitate more efficient and humanized approaches to the care of crime victims, in addition to improving the collection and analysis of forensic evidence. This type of collaboration promotes a broader and more inclusive view of justice, ensuring that forensic nurses can contribute in a meaningful and ethical way (Silva *et al*., 2021a; Silva *et al*., 2021b).

The specialization in Forensic Nursing offers nurses the opportunity to expand their competencies and areas of practice, facing cases that require specialized knowledge about legal and health aspects. This training not only enriches the career of professionals, but also contributes significantly to the justice system and the proper care of victims. The forensic nurse, therefore, emerges as a crucial link in the chain of care, adding inestimable value to the multidisciplinary team (Cazañas *et al*., 2021; Souza *et al*., 2020).

The effective practice of Forensic Nursing requires qualified training and continuous education, in view of the relevance of constant professional updating. Given the complexities and challenges emerging from this unique specialty, it is imperative that there are significant investments in training and professional development. Continuing education programs and refresher opportunities ensure that forensic nurses keep their skills sharp and are prepared to perform competently and ethically in an ever-evolving field (Silva *et al*., 2021a; Silva *et al*., 2021b).

This chapter highlights the need for specific training and innovative didactic strategies in Forensic Nursing, emphasizing the importance of ethical practices and continuous assessment of learning. As forensic nursing education and practice advances, the joint engagement of educational institutions, practitioners, and regulatory bodies in promoting educational programs and policy

development will be critical. This joint effort will not only prepare nurses to competently and ethically address forensic challenges, but will also contribute significantly to justice and care for victims. Thus, this chapter calls on educators, practitioners, researchers, and policymakers to invest in the advancement of Forensic Nursing, ensuring its sustainable development and effective integration into health and justice systems, both in Brazil and globally.

OBJECTIVES OF THE CHAPTER

GENERAL OBJECTIVE

Reflect and share the experiences accumulated during the planning, organization and execution of the elective discipline of Forensic Nursing in a bachelor's degree course in nursing.

SPECIFIC OBJECTIVES

- To detail the pedagogical approaches adopted in the provision of Forensic Nursing for nursing students, highlighting the use of realistic simulations, dialogued classes, group discussions, case studies and simulated laboratory activities.
- Evaluate the impact of didactic strategies on student learning, based on the results of theoretical and practical evaluations carried out during the course.
- To argue about the relevance of specialization in Forensic Nursing for the preparation of nursing professionals in the face of forensic demands in various areas of activity.
- To emphasize the importance of educational practices that respect the ethical precepts of research on human beings, especially in educational contexts that involve simulations and case studies in Forensic Nursing.

METHOD

TYPE OF STUDY

This study adopts a qualitative approach, characterized as an experience report. This method is particularly suitable for investigating in depth the innovations in pedagogical practices and their impact on the teaching and learning of Forensic Nursing during the bachelor's degree in Nursing. The experience report provides a detailed and rich view of educational processes, highlighting the importance of perceptions obtained from professional practice in teaching and research, especially in teaching (Creswell, 2014).

DATA COLLECTION AND ANALYSIS

The analysis was conducted by the professor responsible for the elective discipline of Forensic Nursing, with a total duration of 40 hours. It was based on the author's lived experiences,

including the planning of the discipline and the indirect and direct observations made during the second semester of 2023. This approach allowed us to capture a variety of perceptions and experiences related to the implementation and reception of the Forensic Nursing discipline. Data collection involved direct observations, analysis of teaching documents and assessments, as well as student feedback throughout the course. This method offers a comprehensive perspective of the didactic strategies adopted and the students' interaction with the content.

ETHICAL CONSIDERATIONS

All phases of this study were carried out in accordance with the ethical guidelines for research with human beings, and it was classified as an experience report arising from the educational experience without the need for previous systematization of the research. Consequently, it was not necessary to refer the patient for approval by a Research Ethics Committee (REC). Even so, the fundamental ethical principles were strictly observed, ensuring the confidentiality and anonymity of the participants involved in this experience report, in line with current ethical norms (National Health Council, 2012, 2016, 2022).

RESULTS AND DISCUSSIONS

The results presented portray the experience of offering the discipline entitled "**Forensic Nursing - Elective I**" and offered to undergraduate classes in the 6th and 8th semesters of a bachelor's degree course in nursing at a higher education institution in a small city in the state of São Paulo, Brazil.

The discipline was developed in 8 classes lasting approximately 5 hours each, totaling 40 class hours, in the 2nd semester of 2023, with content detailed in table 1 below.

Table 1 – Detailed Syllabus of Classes: Content, Didactics and Assessment

No.	Classes	Content	Teaching	Class Evaluation
1	Introduction to Forensic Nursing	Overview of Forensic Nursing and its importance	Exhibition classroom as slides	Positive feedback, initial quiz to assess prior knowledge
2	History of Forensic Nursing	History and evolution of Forensic Nursing	Guided discussion and video presentation	Case Study to Contextualize Historical Evolution
3	Forensic Thanatology	Study of death under legal and ethical aspects	Realistic simulation and dialogued lessons	Use of images and videos, feedback via applied exercises
4	Forensic Anthropology	Application of anthropological knowledge in Forensic Nursing	Case Study & Evidence Analysis	Assessment through practical exercises and group discussions

5	Forensic Botany	Use of Plants in Forensic Case Resolution	Hands-on laboratory classes	Feedback from students on laboratory activities, application exercises
6	Forensic Biology	Fundamentals of biology applied to forensics	Dialogued class with the use of anatomical models	Quiz with images and case study to consolidate learning
7	Forensic Toxicology	Toxic substances and their effects on the human body	Toxicological collection and analysis simulation	Hands-on evaluation with analysis protocols, real-time feedback
8	Collection and Preservation of Traces	Methods of Collecting and Preserving Evidence at Crime Scenes	Hands-on demonstration and workshop	Case study with real-world scenario analysis, evaluation by protocol

Source: Author's own, 2024.

These results highlight and detail the sequence of theoretical and practical classes, providing a succinct view of the content covered in each session, the didactic methodologies applied and the evaluations carried out, based on the students' feedback, the use of exercises, case studies, as well as the use of images and videos (chart 1).

To ensure a thorough and structured understanding of the essential concepts in Forensic Nursing, the curriculum structure has been meticulously designed to cover both theoretical and practical aspects. This intentional approach aimed to establish a solid knowledge base, gradually advancing to more specialized and complex topics, crucial for the development of highly trained professionals ready to overcome the specific challenges encountered in the forensic field.

After immersion in the theoretical and practical subjects, the student assessment process was carefully designed to test the acquisition of knowledge and stimulate practical application and critical reflection on the content studied. Chart 2 details the planned evaluations, including case studies, preparatory review tests for conceptual evaluation, and protocols for nursing consultations in forensic situations.

The diversity in the forms of assessment reflects the commitment to a teaching that not only verifies the absorption of content, but also prepares students for the reflective and grounded practice that is essential in the field of Forensic Nursing. This evaluative approach was adopted, considering it to be crucial for the development of capable, reflective professionals prepared to face the challenges of the area with competence and ethics.

Table 2 - Detailed Assessments: Types, Specifications and Practical Applications

No.	Type of Assessment	Areas	Specification	Class-Related
1	Case Studies	---	Critical analysis of real cases	All focus on practical application
2	Proofreading	---	4 alternative questions and 4 multiple-choice questions, diversified	Lectures
3	Protocol for Nursing Consultation in Forensic Situations	Elderly Health, Mental Health, Child Health, Women's Health	6 units, each developing a specific consultation protocol	Practical Classes

Source: Author's own, 2024.

The elective discipline of Forensic Nursing was successfully concluded, evidenced by the expressive final average of 8.5 achieved by all participating students. This result reflects the high engagement of the students and the effectiveness in the assimilation of the proposed content. The implementation of this discipline represents a significant advance in the training of future nurses, providing them with essential knowledge to excel in an area that is constantly expanding and in increasing demand for qualified professionals.

The positive results of the course were complemented by the favorable perception of the students, with 95% of them evaluating the active learning methodologies as effective and enriching. The relevance of the discipline was reinforced by Barros and Castellana (2020), who highlight the need for up-to-date and comprehensive training to face the challenges of Forensic Nursing. This didactic experience not only enhanced teaching and professional practice, but also prepared students to be competent forensic nurses who were well suited to the demands of the field.

The didactic strategies employed during the course were crucial to make learning engaging and effective. Methods such as realistic simulations, group discussions, and practical case analysis provided students with a deep immersion in the reality of Forensic Nursing. These innovative approaches were instrumental in preparing students, offering a robust combination of theory and practice essential for the competent practice of the profession.

The positive response of the students to the methodologies employed — such as realistic simulation and group discussions — evidenced the effectiveness of these strategies in promoting rich and engaged learning, which is essential for a deep understanding of the fundamental principles of Forensic Nursing (Kent-Wilkinson, 2009). The integration between theory and practice, reflected in the results of the assessments, has proven to be a crucial pillar in the teaching of complex specialties, as evidenced by the high level of critical analysis and understanding achieved by students (Barros & Castellana, 2020; Nucci, 2020).

The positive feedback from the students and the results of the evaluations reinforce the importance of innovative didactic strategies and the need for specific and comprehensive training in Forensic Nursing. Such strategies not only enhance the learning experience, but also prepare students to apply theoretical knowledge in practical contexts, developing critical thinking and decision-making skills essential for effective performance in real forensic environments (Joaquim, 2019; Martinis & Oliveira, 2015).

Scholars and researchers in the field of education emphasize the value of realistic simulations and group discussions, not only for the assimilation of content, but also for the development of critical professional skills (Joaquim, 2019; Santos & Paschoal, 2017). Thus, the use of such resources of the forensic nursing discipline offered can be considered valuable and of great contribution to the achievement of the proposed objectives.

This study underlined the need for specific training in Forensic Nursing, preparing professionals to meet the complex demands in the various areas of activity, but also the relevance of disciplines that address this theme in professional training. This is in line with legal precepts and proposals in progress in the country and around the world (Federal Council of Nursing, 2017, 2022; WHO recommendations and the 2030 agenda).

The importance of adopting educational strategies that respect ethical principles is emphasized, especially in contexts that do not require evaluation by a Research Ethics Committee, emphasizing the confidentiality and integrity of those involved. The limitations identified in this study are centered on the impossibility of comparisons in the Brazilian context, given the scarcity of published studies and experiences developed in Brazil. Such limitations will certainly be overcome by the development of new studies and future research that include the perspectives of students and other stakeholders, exploring the long-term impact of didactic, practical, professional and quality strategies on forensic care.

As emphasized, studies that demonstrate the evolution of the specialty in the country and the relevance of new initiatives in favor of the consolidation and expansion of Brazilian forensic nursing (Fernandes, Furtado, & Alves, 2018; Furtado *et al*., 2021).

The inclusion of the discipline of Forensic Nursing in the undergraduate nursing curriculum highlights the effectiveness of teaching methods that cultivate not only the transmission of knowledge but also the development of practical and analytical skills. This case study reveals how innovative pedagogical strategies enhance specialized learning, contributing to the educational literature and offering important insights for educators and policymakers.

This is once again in line with expectations and recommendations aimed at the development of this area in health care and the guarantee of fundamental human rights in line with health and

justice policies (Kent-Wilkinson, 2011; Fernandes, Furtado & Alves, 2018; Brazilian Society of Forensic Nursing, 2019).

In summary, the introduction of the discipline of Forensic Nursing in the curriculum of bachelor's degrees in nursing proved to be a valuable pedagogical initiative. The results achieved reiterate the importance of continuing to explore the development of teaching methods that not only promote the acquisition of knowledge, but also the development of practical and analytical skills crucial for forensic practice in nursing.

CONCLUSION

This experience report highlights the significant impact of the introduction of the discipline of Forensic Nursing in the baccalaureate nursing curriculum. Through a careful analysis of the innovative pedagogical strategies employed, it became evident that these not only engaged the students, but also provided deep and practical learning. The strong adherence of students to the simulations and practical activities reflects the success of these methodologies, as demonstrated by the excellent performance in the assessments.

The results obtained underline the effectiveness of a curriculum that balances theory and practice, preparing students to face both the practical and ethical challenges of Forensic Nursing. The positive feedback from the students emphasizes the importance of group dynamics and simulations, which not only facilitated the understanding of the concepts, but also fostered the development of essential critical skills.

In conclusion, the successful implementation of this discipline underscores its potential to significantly enrich nursing education, preparing professionals not only to respond to the demands of the present, but also to actively contribute to the evolution of the field. This study serves as a valuable model for other institutions aspiring to innovate and enhance their curricula, especially in subspecialties of nursing, reinforcing the need for adaptable, evidence-based teaching methods that respond to contemporary industry demands.

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Herbal medicine *Cissus sicyoides* as a complement to the treatment of type II Diabetes Mellitus

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ABSTRACT

Diabetes Mellitus (DM) has become a public health issue in recent years. The comorbidities that affect its carriers lead to a reduction in daily activities, worsening of quality of life, and increased mortality because of diseases and complications of the disease. The basic health units, together with their health promotion programs and prevention strategies, have been adapting the protocols for comprehensive care of patients with diabetes mellitus, guiding them to a healthier lifestyle. This study showed the benefits of the complementary use of phytotherapy, specifically Cissus sicyoides in patients with diabetes mellitus, demonstrating hypoglycemic effects in 50% of patients submitted to the use of dry extract. As an adjuvant to the treatment of diabetes mellitus II, there is a need to implement strategies that reinforce the use of herbal therapies and research needs to be carried out for this purpose.

Keywords: Phytotherapy, Diabetes Mellitus, *Cissus sicyoides*.

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INTRODUCTION

At an archaeological site in northwestern Spain, dental plaques from extinct Neanderthals (Homo neanderthalensis) have found microfossils of plants including yarrow (Achillea millefolium) and chamomile (Anthemis arvensis). These herbs lack nutritional value and have a bitter and unpleasant taste. However, they are widely used in traditional medicine. These fossilized teeth date back 49,000 years and are possibly the earliest evidence of the use of medicines.1

The use of medicinal plants in the recovery of health has evolved over time from the simplest forms of treatment to the technologically sophisticated forms of industrial manufacturing used by modern man. Although there is a huge difference between the two ways of use, there is a common factor between them: the active ingredient that causes beneficial reactions in the body, capable of resulting in the recovery of health.[2]

Diabetes mellitus (DM) is a metabolic disease caused by the inability of the pancreas to secrete insulin (type I diabetes) or decreased tissue sensitivity to insulin (type II diabetes). It can also be caused by degeneration or inactivation of the beta cells of the islets of Langerhans.[3] It is a syndrome in the metabolism of carbohydrates, proteins and fats, and can be multifactorial.[4.5]

Due to the deficiency of insulin in the tissues, the metabolism will not have enough glucose to generate energy. Therefore, it uses fat as an energy source and consequently blood glucose levels are altered.[3]

Currently, Diabetes has become a major global public health problem and is growing every year. In 2023, this number reaches the mark of 529 million people worldwide. One in every 350 children has type I diabetes, which is caused by the destruction of insulin-producing cells due to an immune system problem in which antibodies attack the cells that produce insulin. Type II, on the other hand, is the resistance or deficiency of insulin secretion. It is the most common, 90% of cases are acquired throughout life.[6]

The increase in diabetes cases in the world is related to several socioeconomic, demographic, genetic and environmental factors. Where there is an increase in risk factors, such as obesity, lack of physical activity and a healthy diet, among other multifactorial causes. Chronic diseases are one of the biggest public health problems in Brazil and in the world, with high economic costs for society, in addition to the impacts on people's quality of life and life expectancy.[5]

In Brazil, diabetes affects about 7.7% of the Brazilian population, occupying the second place among the chronic diseases with the highest incidence and the fourth place in mortality from chronic diseases in Brazil.[5]

As we can see, Diabetes Mellitus is an important pathology with a high number of carriers and requires continuous care, therefore, we seek to evaluate the benefit of the use of an herbal

medication as a complement to the treatment of these patients. Among the numerous species of plants with hypoglycemic characteristics, we choose *Cissus sicyoides*, better known as "INSULIN".

Nome cientifico – Cissus sicyoides.[2,7]

Popular names – Portuguese: Insulina vegetal, cipó-pucá, indigo climber, uva-brava, cortina de pobre, tinta-dos-gentiles. Spanish: cortina del diablo, insulina vegetal. English: princess vine, toad vine.

Part used: Aerial part.

Distribution habitat: It is distributed in tropical and sub-tropical areas of the Americas, starting from the southern United States and Mexico to Brazil and Argentina.[2]

History of the plant: During the nineteenth century it was used as a laxative, against bruises and in blennorrhagia and as anti-virals.[2]

Therapeutic properties: hypoglycemic, antiinflammatory, antibacterial, bronchodilator, anticonvulsant, antiserotonergic, nervous system depressant, gastroprotective, uterine contraction.[7]

Contraindication: It is contraindicated in case of pregnancy due to the action of uterine contraction. Its use is also contraindicated in cases of hypercalcemia and history of lithiasis due to the presence of calcium oxalate. Its use in cases of asthma attacks is inappropriate.

Adverse Effects: To date, no adverse effects have been reported in humans.[2]

Forms of use: The plant is recommended in the form of decoction of the leaf orally (tea).[2] 2 cups (coffee) or 20 grams of dried leaf in a liter of boiling water. Placing the plant in a container and pour boiling water over it, smother and let it rest for at least 10 minutes and strain before use. drinking 1 cup (tea) 3 times/day (30 min after meals).[2.7]

The objective of this research was to evaluate the use of the medicinal plant insulin – *Cissus sicyoides* as a complement to the treatment of patients with type II diabetes mellitus, based on a qualitative analysis, collected from a group of 12 individuals who agreed to participate in the research, who live in the neighborhood of Jardim Eldorado – Palhoça. A semi-structured questionnaire was applied to the selected research subjects and an evolution form was used to collect glycemic levels before and during the use of tea.

METHODOLOGY

This study is characterized as a descriptive field research, of the exploratory type. Qualitative analysis techniques were used, based on the approximation with the interviewed patients.

For Minayo, qualitative research is characterized by being concerned with reality that cannot be quantified and by deepening its knowledge of human actions and reactions.[8]

The study was carried out at the Jardim Eldorado Basic Health Unit, Palhoça/Santa Catarina. The extension area of the Basic Unit comprises the population living in the Jardim Eldorado neighborhood, which makes up 1,000 families. On average, 48 patients with insulin-dependent type I diabetes mellitus and 120 non-insulin-dependent patients with type II diabetes mellitus are followed.

The interview was conducted with 10% of the population, 12 people, all of whom had type II diabetes mellitus and lived in the coverage area. Patients followed by the Health Unit, both sexes, with a mean glycemic score of 150 to 300 mg/dl were selected.

The research took place from July 12 to December 20, 2008. Data collection was divided into three stages:

After a lecture on diabetes, which discussed the objective of the project to be applied to this population, the active participants of the research were selected, a total of twelve patients with type II diabetes mellitus, who fit the previously established standard and requirement. A home visit was made to sign the free and informed consent form and the history was collected. With these data, clinical conditions and the habits of the individuals in relation to their pathology were evaluated, thus being able to prepare a health education activity. A folder was delivered explaining the pathology (diabetes mellitus) and guiding care regarding diet and physical activity.

2nd moment: For a period of 49 days, weekly, the glycemic rate was evaluated along with eating habits and the practice of physical activities.

3rd moment: After the end of the 49 days, checking the glycemic rate, we make a new home visit to give them the medicinal plant for daily consumption. Delivered properly packaged and dosed, advising on the preparation and therapeutic use of tea through dialogue and an educational folder.

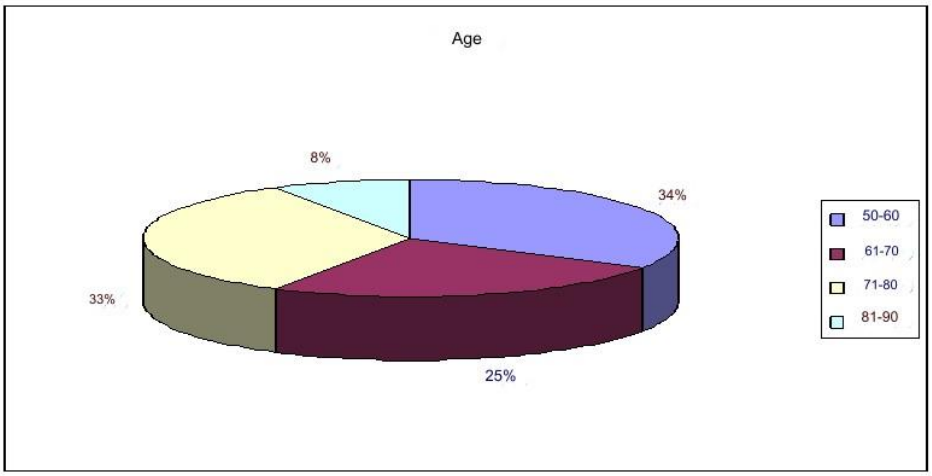
We advise that the use of tea should take place for the next 58 consecutive days, from this we carry out weekly home visits to assess the glycemic rate and eating activities and physical activities, clarifying doubts and verifying the correct use of the tea.

For the development of this research, the recommendations of Opinion 404/2008 of the National Research Ethics Commission were adopted, which determines that the objective of the Research Ethics Committees is to protect the human being in his dignity and integrity and to contribute to scientific development and to be approved by the Ethics Committee of the University of Southern Santa Catarina – UNISUL.[9.10]

RESULTS AND DISCUSSION

Regarding the age of the research participants, it can be seen in graph 01 that 4 (four) were aged between 50 and 60 years representing 34%, 4 (four) between 61 and 70 years (33%), 3 (three) between 71 and 80 years (25%) and 1 (one) between 81 and 90 years (8%), we observed that most of the research subjects have an elderly age group 66% (over 61 years).

Graph 01 – Age range of the research subjects.



Source: The Authors

Diabetes is common and has an increasing incidence. It is estimated that in 1995 it reached 4.0% of the world's adult population and that by 2025 it will reach 5.4%. Most of this increase will occur in developing countries, accentuating the current pattern of concentration of cases in the 45-64 age group. In Brazil, at the end of the 1980s, it was estimated that diabetes occurred in about 8% of the population, aged 30 to 69 years, living in Brazilian metropolitan areas. This prevalence ranged from 3% to 17% between the 30-39 and 60-69 age groups. The prevalence of impaired glucose tolerance was also 8%, ranging from 6 to 11% among the same age groups. Today, it is estimated that 11% of the population is 40 years of age or older, which represents about 5 and a half million carriers.[11]

Regarding the participants' schooling, 9 (nine) 75% had not completed elementary school, 2 (two) 17% were illiterate and 1 (one) 8% had completed high school.

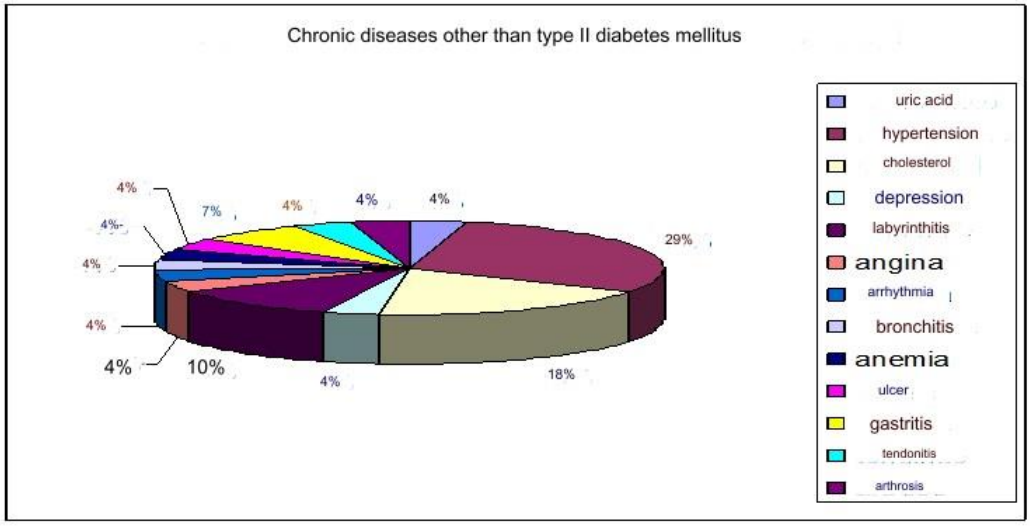
We can see that most of the interviewees had incomplete elementary schooling, based on these data we directed our dialogue in a way that was accessible to them.

Regarding the marital status of the participants, 4 (four) 33% were widowed and 8 (eight) 67% were married.

Due to their advanced age, we noticed that some participants, without a partner, could have this factor related to difficulty in care or lack of family support.

As for chronic diseases, in addition to type II diabetes mellitus, we can see in graph 04 that among the 12 (twelve) participants, most of them had systemic arterial hypertension (SAH) and hypercholesterolemia. (Chart 02)

Graph 02 – Chronic diseases that the research subject has, in addition to type II DM.



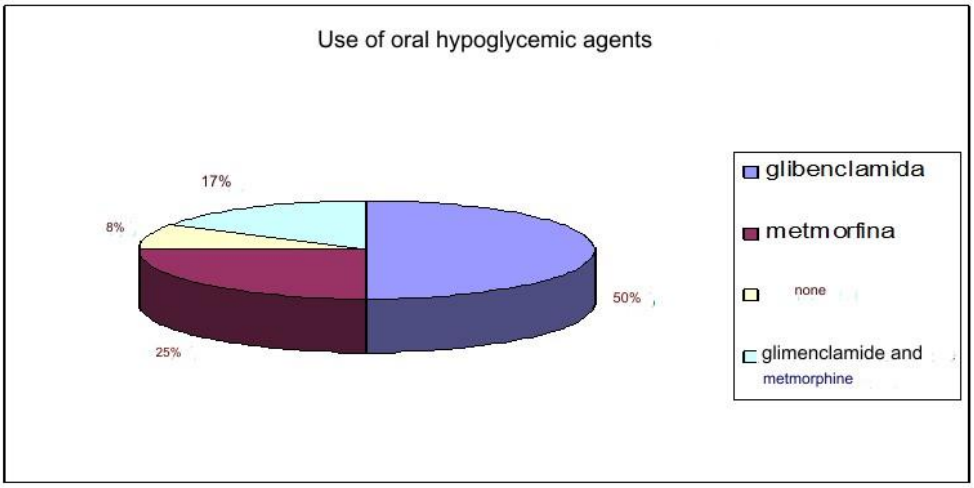
Source: The Authors

The natural history of diabetes is marked by the appearance of chronic complications, generally classified as microvascular – retinopathy, nephropathy, and neuropathy – and macrovascular – coronary artery disease, cerebrovascular disease (CVA) and peripheral vascular disease. All of them are responsible for significant morbidity, with rates of cardiovascular and renal mortality, blindness, limb amputation, loss of function, and quality of life much higher than individuals without diabetes. Ischemic cardiovascular diseases are more frequent and earlier in individuals with diabetes compared to others. In women with diabetes, the protective effect typically recognized for the female gender disappears. The symptomatology of the three major cardiovascular manifestations – coronary heart disease, cerebrovascular disease and peripheral vascular disease. Systemic arterial hypertension affects the majority of patients with diabetes. It is an important risk factor for coronary heart disease and microvascular complications such as retinopathy and nephropathy.[11]

Patients with type II diabetes have a higher prevalence of lipid abnormalities that contribute to higher rates of coronary artery disease (CAD). Therefore, every patient with a risk of coronary artery disease above 20% should receive a statin, regardless of LDL cholesterol level. Monitoring of control (LDL cholesterol, triglycerides, and HDL cholesterol).[11]

Regarding the use of oral hypoglycemic agents, we can see in graph 05, 2 (two) 17% used oral hypoglycemic agents glibenclamide and metformin, 3 (three) 25% used only metformin, which represents 6 (six) 50% used only glibenclamide, which represents and only 1 (one) 8% did not use hypoglycemic medications.

Graph 03 – Oral hypoglycemic agents used by the research subjects.



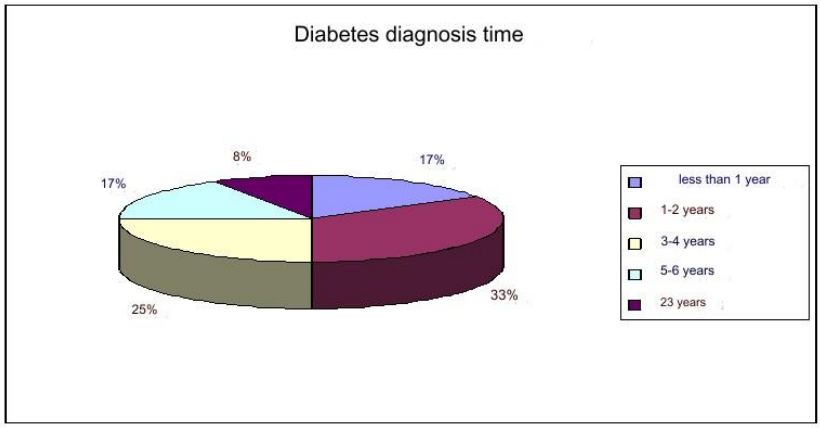
Source: The Authors

Glibenclamide is an oral hypoglycemic agent widely used in type II diabetes mellitus, some pharmacokinetic parameters of glibenclamide are well known: they are rapidly and adequately absorbed by the intestine, distribute in the extracellular fluid, partially bind to plasma proteins; The speed and mode of degradation of these drugs vary. The differences in the duration of action depend on the course of metabolism and the rate of excretion of each.

According to information from the Glibenclamide Leaflet, 45 to 84% are absorbed by the intestines. Of the five metabolites, one is only partially active: the two hydroxylated metabolites are not hypoglycemic and are rapidly and completely eliminated.

Regarding the time of diagnosis of type II diabetes mellitus, we can observe in graph 06 that only 2 (two) 17% had diabetes diagnosed less than 1 (one) year ago, 1 (one) 8% diagnosed 23 years ago, another 2 (two) 17% discovered that they had diabetes mellitus between 5 and 6 years, 3 (three) knew that they were diabetic between 3 and 4 years representing 25%, and 4 (four) had diabetes diagnosed 1 to 2 years ago, representing 33%. (Chart 04)

Graph 04 – Time of diagnosis of diabetes in the research subjects.



Source: The Authors

About 50% of the population with diabetes does not know that they have the disease, sometimes remaining undiagnosed until signs of complications appear. Therefore, screening tests are indicated in asymptomatic individuals who are at higher risk of the disease, although there are no clinical trials documenting the resulting benefit and the cost-effectiveness is questionable. Factors indicative of higher risk are: Age >45 years; Overweight (Body Mass Index, BMI >25); Central obesity (abdominal girdle >102 cm for men and >88 cm for women, measured at the height of the iliac crests); Family history (mother or father) of diabetes; Hypertension (> 140/90 mmHg); HDL cholesterol >35 mg/dL and/or triglycerides >150 mg/dL; Defined cardiovascular, cerebrovascular, or peripheral vascular disease.[11]

Regarding the practice of physical exercises, we can observe in graph 7 that only 3 (three) 25% practiced physical exercise such as walking and dancing, another 9 (nine) equivalent to 75% did not practice any type of physical exercise.

Physical activity and exercise are crucial for preventing complications and managing blood glucose in people with diabetes. They improve glycemic control, reduce cardiovascular risks, promote well-being, and can help with weight loss. Even without weight loss, eight weeks of exercise reduces HbA1c by 0.66 percent. People with diabetes should avoid a sedentary lifestyle by incorporating light activities such as standing or walking.[12th]

The regular practice of physical activity is indicated for all patients with diabetes, as it improves metabolic control, reduces the need for hypoglycemic agents, helps promote weight loss in obese patients, decreases the risks of cardiovascular disease and improves quality of life. Thus, the promotion of physical activity is considered a priority.[11]

Environmental, social and psychological factors may play an important role in the development of type ll diabetes mellitus, and its prevalence is higher in overweight patients than in normal weight patients aged 20 to 75 years. In patients in the age group of 20 to 45 years, the risk is 3.8 times higher. resistance exercise 3 times a week, in the main muscle groups. [G3] Physical

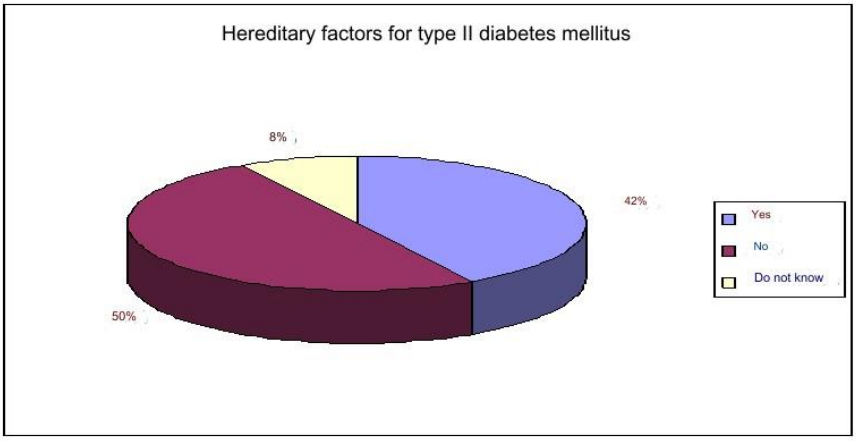
inactivity, in particular, reduces glucose tolerance and favors obesity. With regard to stress, it is stated that it can lead to changes in hormone and neuroregulatory levels, causing deviation from normal blood glucose levels.[14th]

Regarding the use of alternative treatment, among the 12 (twelve) research participants, 7 (seven) equivalent to 58% do not use alternative treatments, another 5 (five) 42% use alternative treatments to help control diabetes mellitus, this treatment being the use of medicinal plants such as Jambolão, Pata de Vaca, Insulina, Espinheira Santa, Sete Sangrias, plants indicated by family or friends or known by people of advanced age.

Although oral antidiabetic drugs and insulin have effective effects in the treatment of DM, they have side effects that hinder their use, in addition to their high cost, even when offered free of charge by the SUS because the government also buys the drug for distribution. The search for plants or natural compounds with antidiabetic activity comes to meet the need for new active compounds, less toxic and possibly more accessible to the population. There are several plants with antidiabetic potential used since ancient times, some of which have proven their effects in the control of DM. More research, including toxicological control, is needed in order to offer the population more accessible medicines, with quality, safety and proven efficacy. There are several plants with potential antidiabetic action in the world, which shows a great chance of discovering new therapeutic possibilities.

As for the hereditary factors for diabetes mellitus Graph 05, 5 (five) 42% subjects had a hereditary factor that would predispose them to develop type II diabetes mellitus, 6 (six) participants equivalent to 50% did not have genetic inheritance and 1 (one) did not know if they had a hereditary factor representing 8%. (Chart 05)

Graph 05 – Participants with hereditary factors for DM.



Source: The Authors

We know that the genetic component is strong, because a patient with a family history is likely to develop the disease in a proportion of 5 to 10 times more than in the general population.

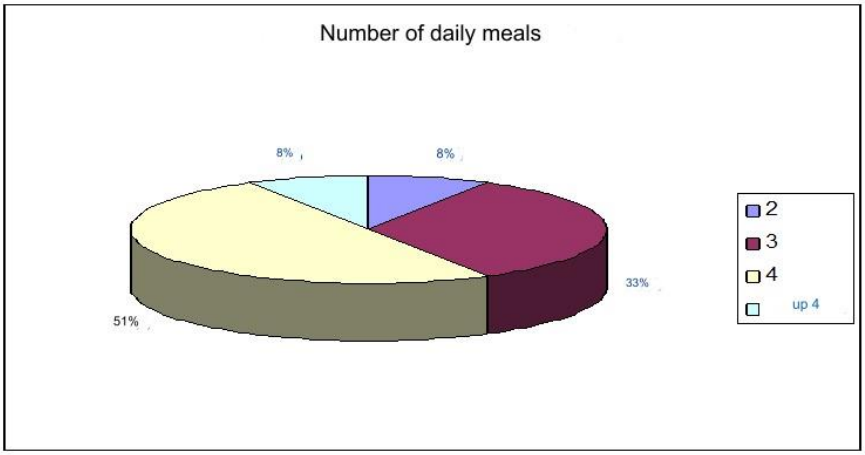
According to Brasil (2024), first-degree relatives of type ll diabetics are several times more likely to develop diabetes than controls without a family history.

Regarding heredity, 50.5% reported having family members with diabetes. The population consisted of 142 people and 49.5% did not report it. Among the former, 20.2% reported having first-degree relatives with the disease. We know that first-degree relatives of type II diabetics are two to six times more likely to develop diabetes than controls without a family history. Also in type II diabetes, the genetic component is strong, which is demonstrated by the five to ten times greater possibility of a patient with a family history developing the disease in relation to the general population, with 90% agreement in identical twins.[11]

Thus, the environmental factors that lead to obesity and sedentary lifestyle have an important interaction with genetic susceptibility, increasing insulin resistance and causing a higher risk for the development of diabetes, which intensifies with advancing age. If the genetic component alone is a relevant factor for the triggering of diabetes mellitus, the situation is more worrying when it is associated with physical inactivity and stress.[11.15 AM]

As for the number of daily meals (graph 06), we have 3 (three), 43% eating an average of three meals a day, the other 4 (four), that is, 57%, had an average of four meals a day, and what we could observe is that many of these meals are rich in carbohydrates, helping to increase their blood glucose rate and, consequently, decompensating diabetes and aggravating clinical conditions.

Graph 06 – Number of daily meals eaten by the research subjects.



Source: The Authors

Nutritional therapy is a fundamental part of the diabetes treatment plan, and can reduce glycated hemoglobin by 1-2%. It is based on the same basic principles of healthy eating.[11.16]

Diabetes mellitus is currently considered one of the main chronic diseases that affect contemporary man and its importance has been growing as a result of several factors. Among these we highlight changes from traditional to modern lifestyles, physical inactivity and obesity. In this direction, mental and physiological anxiety can decrease glucose tolerance, as well as precipitate

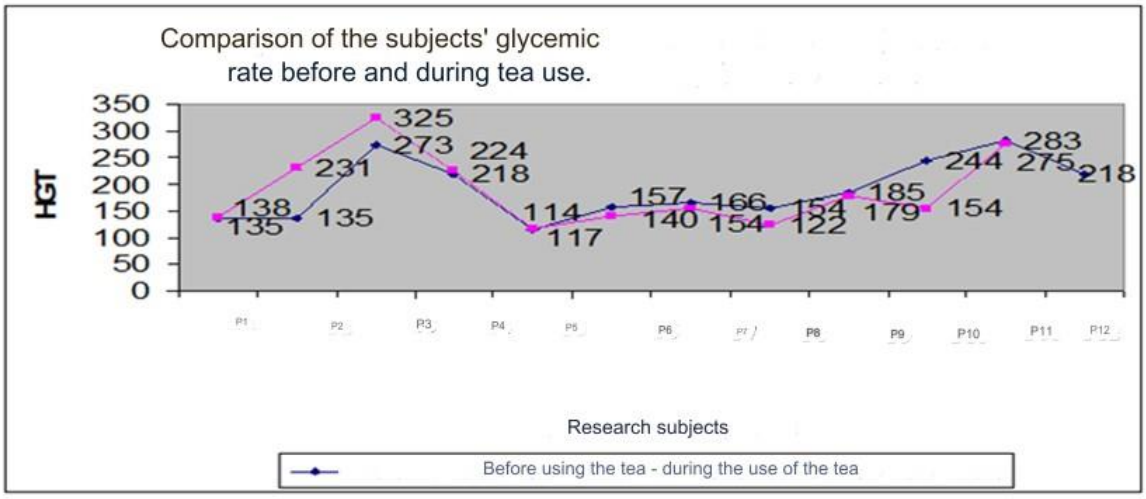
diabetes in people whose tolerance is already declining. Thus, stress in the work environment can contribute to the onset of this disease, requiring institutions to review the guidelines that guide work.[11.16]

When analyzing the most frequent risk factors, it is found that physical inactivity, stress and obesity (BMI) deserve to be highlighted.

ANALYSIS OF SURVEY GLYCEMIC RATE RECORDS

Analyzing graph 07 we can see that among the twelve research patients, six showed a decrease in the glycemic rate with the use of "Insulin" tea and six research patients showed an increase in the glycemic rate, among these five there were factors that may have influenced not to achieve a positive result, such as diseases associated with the administration of unusual medications, stress factors, change of diet during the use of tea, among others.

Graph 07 - Comparison between the glycemic rates of the research subjects before and during the use of tea.



Source: the authors

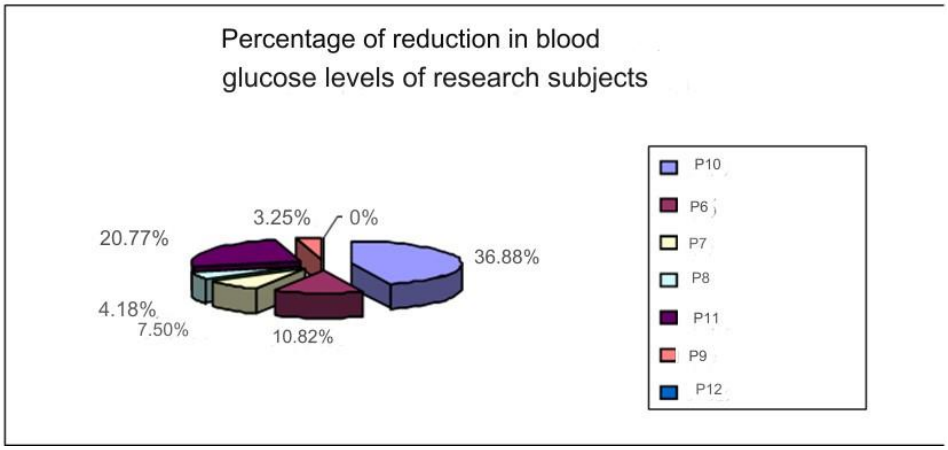
It can be seen in the graph below that the patients submitted to the use of the herbal medicine had a significant reduction in the glycemic rate after use, if compared to the previous rate. However, some factors may have contributed to this result not being even more efficient. For example, stress, anxiety, personal problems, among other problems, including health problems.

According to the Guidelines of the Brazilian Diabetes Society, Environmental, social, and psychological factors may play an important role in the development or worsening of type L diabetes mellitus.

We observed that participant 10 (P10) had the highest glycemic reduction index. This was 38% less when compared to their glycemic level prior to treatment. This can be the result of a balanced routine, with the correct use of herbal treatment.

Therefore, it is believed that this result could also be expanded to others, if the number of participants was more expressive, because taking into account personal issues, the final result suffers interference.

Graph 08 – Percentage of reduction in glycemic levels of the research subjects during the use of tea.



Source: the authors

Phytotherapy has proven to be a great ally of the health and quality of life of the population, promoting health and helping as an adjuvant in various treatments. According to Alonso (2021)[7], the herbal medicine Cissus sicyoide is a plant with hypoglycemic power, capable of helping to reduce blood glucose. It is believed that this effect in the medium term is even more efficient and capable of proving its effects.

The World Health Organization has been increasingly implementing national policies for integrative and complementary practices, and among them, phytotherapy has gained a prominent place, due to the strong evidence and the various training and studies that have been carried out. Since 2006, it has been part of the therapies offered by the SUS. However, their scientific knowledge is still little explored by primary care units and family health strategies. According to Lacerda *et al* (2020), phytotherapy is the most used practice in PHC, and has been accepted by users, promoting a new health paradigm.[18.19]

These herbal medicines, which have been used in primary health care units, have shown beneficial effects. And even though they are medicinal plants, they need to be used carefully and well guided their use, so that the maximum potential of the plant can be used safely.

They are used for various situations, for example, the standardized extract of B. Fortificata (cow's foot), has already proven its hypoglycemic effects, improving metabolic control, in addition to being considered to be understood as drug measures as well.[18th]

Approximately 25% of medicines are derived from plants and produced using modern drug technology, albeit naturalG1. This shows us the great potential that medicinal plants can have in the face of the most diverse diseases of today.

However, these treatments have shown promise. Plants that are still little studied, such as Cissus Sicyoide, having their hypoglycemic effects proven by an experimental study in patients with type II diabetes mellitus, is the beginning of new and future studies in the line of complementary therapies, especially phytotherapy, which has been growing and is already a complementary therapy recognized by the Ministry of Health.

CONCLUSION

In view of this study, it can be concluded that the Cissus Sicyoide plant demonstrated hypoglycemic effects in 50% of the patients submitted to the use of the dry extract. Being an adjuvant to the treatment of diabetes mellitus II, there is still a need to implement strategies that reinforce the use of herbal therapies and research needs to be carried out for this purpose. Since the herbal medicine Cissus Sicyoide has been shown to be a viable option in adjuvant or complementary treatment for patients with Diabetes Mellitus.

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Characterization of suicides in the Seridó region of the state of Rio Grande do Sul: A time series study

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ABSTRACT

Objective: To analyze suicide cases from 2000 to 2015 in the seridó region of Rio Grande do Norte, Rio Grande do Norte, Brazil. Methods: This is an epidemiological, ecological and time-series study, developed in the 4th health region of the state of Rio Grande do Norte. The study population consisted of suicide cases that occurred in the region in the time series. In the researched databases, information was collected regarding: socio-demographic characteristics, number of deaths due to suicide, number of inhabitants per municipality, and the human development index. The data were analyzed using descriptive statistics by reading the absolute (n) and relative (%) frequencies, as well as the suicide mortality rate. Results: A total of 397 cases of suicide were identified in the period, with a mean age of 43.7± 18.9 years; most were male (82.1%); young adults (38.48%); white skin color (48%); single people (48%) and farmers (30.27%), in addition to hanging as the most used method (79%). Conclusion: The profile of suicides in the Seridó region of Rio Grande do Sul is very similar to what is already known in the national and international literature. However, the figure of the single male farmer as the main actor identified points to the importance of further studies on the phenomenon, in order to support regional public policies in suicide prevention, directed to these workers and inserting them in psychosocial care networks.

Keywords: Suicide, Mental health, Preventive psychiatry, Epidemiology.

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INTRODUCTION

Suicide refers to the deliberate act, performed by the individual himself/herself, whose intention is to die, in a conscious, intentional, even ambivalent way, using a means that he/she believes to be lethal[1]). It is among the major public health problems, and its attempt is associated with a considerable reduction in the life expectancy of the general population[1].

According to estimates by the World Health Organization (WHO), suicide is responsible for at least 800,000 deaths annually, corresponding to one death every 45 seconds, or more than two thousand people who end their own lives every day somewhere on the planet[2]. Young people and young adults are among the most affected – being the second most frequent cause of death among those aged 19 to 25 years[2].

The mental disorders most commonly associated with suicide are: depression, bipolar mood disorder, and dependence on alcohol and other psychoactive drugs. Schizophrenia and certain personality traits are also important risk factors. According to Bertolote & Fleischmann (2002)[3], the risk situation is aggravated when more than one of these conditions are combined, such as depression and alcoholism, or even the coexistence of depression, anxiety and agitation.

In Brazil, the average mortality rate by suicide is 5.5 per 100,000 inhabitants over the course of a year, which can be considered relatively low when compared to other countries, although this rate has been increasing over the last ten years[2].In spite of this, because it is a populous country, Brazil occupies the eighth place among those with the highest absolute numbers of deaths by suicide[2]).

In the last epidemiological bulletin, released by the Ministry of Health in 2017, the suicide mortality rate in the country in the period studied, although twice as low as the world rate in 2012, showed a similar pattern of behavior regarding sex and marital status. On the other hand, the highest mortality rates in adults and the elderly were highlighted, contrary to what was observed in world data[2]. Considering the 1993 WHO classification, Brazil has an average level of suicide mortality rate (between 5 and 15/100,000 inhabitants) in males. In this group, the highest rates were observed in the elderly population over 70 years of age; in people with low schooling; single, widowed or divorced; and that they used hanging as the primary means to commit suicide.

It is known, however, that in Brazil there is an unequal distribution of suicide cases in the different regions of the country[4].In certain localities, as well as in some population groups, such as: indigenous people from the Midwest and North, and farmers from the interior of Rio Grande do Sul, the mortality rates are close to those of Eastern European countries and Scandinavia, in the range of 15-30 per 100,000/year. Several sociocultural and economic factors seem to be associated with these high rates, as well as a high frequency of mental distress and alcohol abuse[5].

In Brazil, the highest rates of death by suicide were recorded in the states of Rio Grande do Sul, Santa Catarina and Mato Grosso do Sul, respectively[6]. The region of Seridó Potiguar, in the interior of the Northeast, in turn, appears as a *suicide cluster* in Rio Grande do Norte, with several municipalities presenting suicide mortality rates well above the national average, in the Northeast and in the state itself[7,8]. The municipality of Caicó, specifically, located in the aforementioned region, has already occupied the 3rd place among the 20 Brazilian cities, with at least 50,000 inhabitants, with the highest suicide rates between the years 2005 and 2007 [9].

Several sociocultural and economic factors seem to be associated with these high rates, as well as a high frequency of mental distress and alcohol abuse[5]. According to Meleiro (2018)[1], the main vulnerability factors for suicidal ideation can be divided into four broad categories: demographic, diagnostic, psychiatric history, and psychological. Of the demographic characteristics, male gender, being single or divorced, and being unemployed are known risk factors.

In this context, the present study sought to obtain a broader understanding of the phenomenon of suicide and its particularities in the *locoregional context, with the objective of analyzing suicide cases in the region of Seridó Potiguar, in the period from 2000 to 2015, with the characterization of the sociodemographic profile and the means used to do so.*

Developed within the scope of a professional master's degree, the perspective of action research employed in this study also assumed the commitment that its product could assist in a proposal for intervention in the local reality, contributing to teaching-service-community integration and directing actions to prevent and reduce mortality by suicide in the region.

METHODS

This is an epidemiological study, of the ecological type and time series, referring to the period from 2000 to 2015. The research setting was the 4th health region of the state of Rio Grande do Norte, located in the Seridó Potiguar region.The study population consisted of suicide cases that occurred in the IV URSAP (Regional Public Health Unit) in the period referring to the time series.

According to IBGE data, the Seridó Potiguar is a geographical and cultural region belonging to the state of Rio Grande do Norte, covering an area of 9,374.063 km², and an estimated population of 311,531 inhabitants, corresponding to 9.1% of the total population of the state[10]. It consists of 25 municipalities: Acari, Bodó, Caicó, Carnaúba dos Dantas, Cerro Corá, Cruzeta, Currais Novos, Equador, Florânia, Ipueira, Jardim de Piranhas, Jardim do Seridó, Jucurutu, Lagoa Nova, Ouro Branco, Parelhas, Santana do Matos, Santana do Seridó, São Fernando, São João do Sabugi, São José do Seridó, São Vicente, Serra Negra do Norte, Tenente Laurentino Cruz and Timbaúba dos Batistas, presenting the highest concentration of municipalities with high or medium-high human development index (HDI) in the North and Northeast regions of the country[10].

Data collection was carried out between August and October 2017, using a standardized questionnaire for the study. The ITEP/Caicó – RN databases were consulted to obtain information regarding: sociodemographic characteristics and number of deaths by suicide between January 1, 2000 and December 31, 2015, in the Seridó region of Rio Grande do Sul.In the IBGE, information was collected on the population of the municipalities and the human development indices (HDI).

Among the variables investigated are the independent variables: gender, age, occupation, place of residence; and the dependent variable: death certificate by suicide, considered as deaths resulting from intentional self-harm (X60-X84), of the International Statistical Classification of Diseases, in its tenth edition (ICD-10)[11][11].

The data were analyzed using descriptive statistics by reading the absolute (N) and relative (%) frequencies, as well as the suicide mortality coefficient, in the quadrennials from 2000 to 2015, according to quantitative variables. To calculate the Suicide Mortality Coefficient , the following formula was used: *number of suicides x 100 thousand/number of inhabitants*. In addition, the data and information were analyzed based on the theoretical conceptual framework of collective health, with references and authors who reflect on the interface between collective health and mental health and, in particular, on the phenomenon of suicide in its various determinations.

The research was evaluated and approved by the Research Ethics Committee of the Faculty of Health Sciences of Trairi – Federal University of Rio Grande do Norte (FACISA-UFRN), under CAAE No. 56201616.2.0000.5568, Opinion Number: 1.707.504.

RESULTS

According to the information obtained from the ITEP/Caicó database, during the period from 2000 to 2015, there were 397 cases of suicide in the Seridó region, with the municipalities of Caicó (29.47%), Currais Novos (9.57%) and Jucurutu (7.30%), with the highest number of cases in the period studied, and the municipality of Timbaúba dos Batistas with no cases recorded for the period (Table 01).

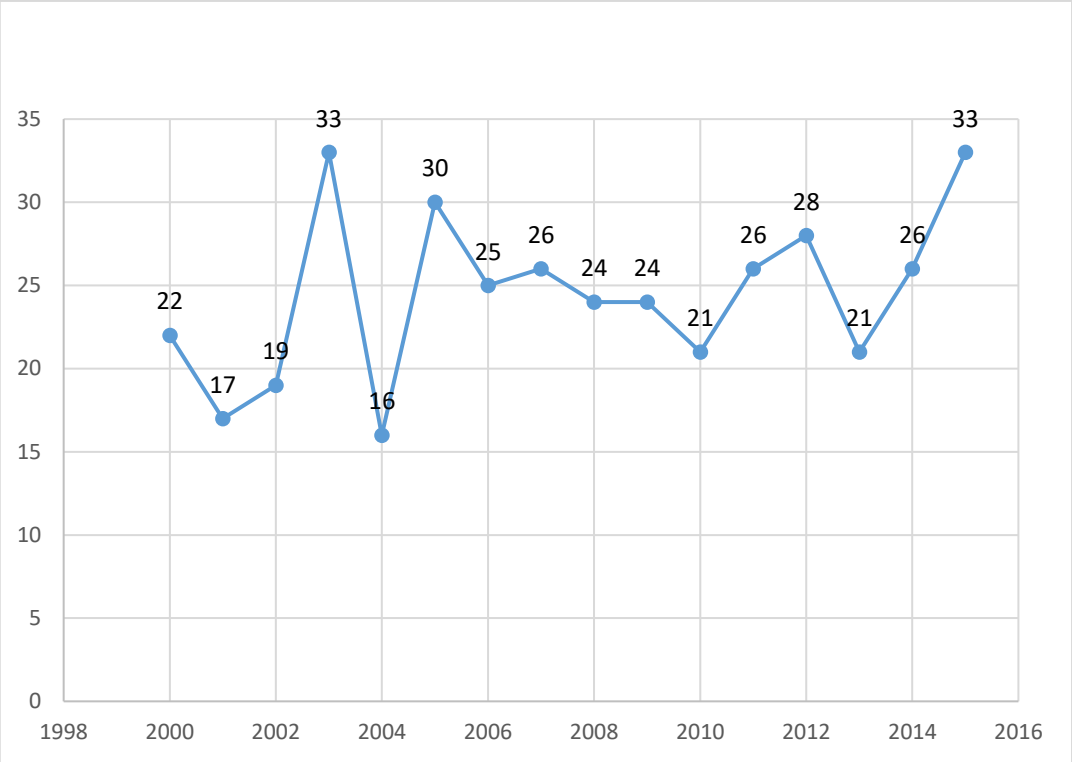
Table 01: Occurrence of suicide in the Seridó region of Rio Grande do Norte, by city and micro-region, from 2000 to 2015

Microregion/Municipality	Human development index (HDI)	Absolute Frequency (n)	Relative Frequency (%)	Mortality Coefficient
Seridó Ocidental				
Caicó		**117**	**29,47%**	
Jardim de Piranhas		24	6,05%	
Serra Negra do Norte		3	0,76%	
São João do Sabugi		12	3,02%	
São Fernando		6	1,51%	
Timbaúba dos Batistas		0	0,00%	
Ipueira		4	1,01%	
Seridó Oriental				
Acari		11	2,77%	
Carnaúba dos Dantas		Human Development Index (HDI)	Absolute Frequency (n)	
Mortality Coefficient		10	2,52%	
Currais Novos		**38**	**117**	
Equador		3	24	
Parelhas		9	3	
Jardim do Seridó		22	12	
São José do Seridó		11	6	
Santana do Seridó		2	0	
Ouro Branco		15	4	
Serra de Santana				
Bodó		5	11	
Cerro Corá		15	8	
Florânia		14	10	
Lagoa Nova		15	38	
Santana dos Matos		12	3	
São Vicente		10	9	
Tenente Laurentino Cruz		2	22	
Vale do Açu				
Jucurutu		29	2	
Total		**397**	**15**	

Source: Survey data

Graph 01 shows the absolute distribution of the number of suicide cases in the period studied, highlighting the years 2003 and 2015 with the highest frequency (n=33).

Graph 01: Number of suicides by year of occurrence, from 2000 to 2015



Source: Survey data

Among the 397 cases of suicide in the Seridó region of Rio Grande do Sul, in the period from 2000 to 2015, the average age was 43.7± 18.9 years. According to the socio-demographic characteristics presented in Table 02, suicide was characterized as having a predominance of males (82.1%), young adults (38.48%), whites (48%), singles (48%) and farmers (30.27%).

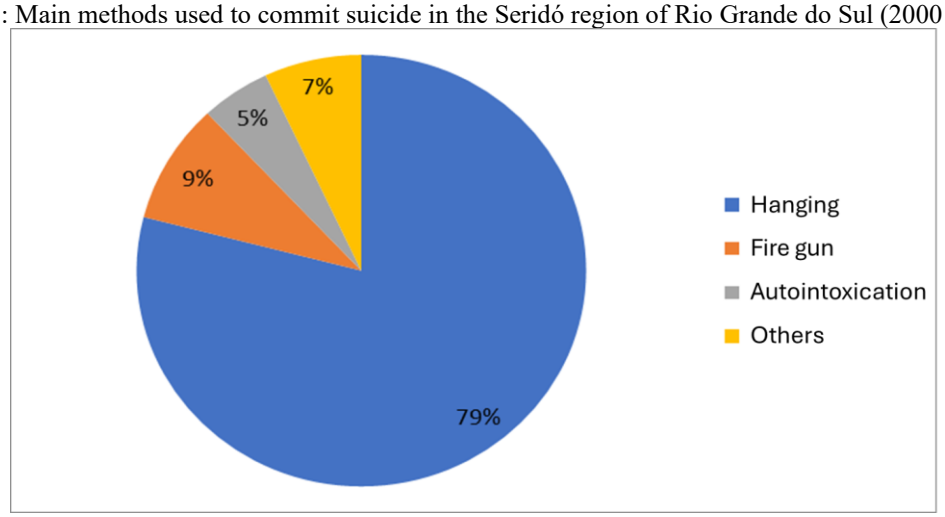
Table 2: Sociodemographic characterization of suicides in the Seridó region / RN, according to gender, age group, ethnicity and marital status, from 2000 to 2015.

VARIABLES	2000-2003 N = 94	2004-2007 N = 95	2008-2011 N = 101	2012-2015 N = 107	**TOTAL N = 397**
	%	%	%	%	%
GENDER					
Masculine	78,72	82,10	87,13	80,37	**82,08**
Feminine	21,28	17,90	12,87	19,63	**17,92**
AGE GROUP					
< 18	6,38	5,26	8,91	1,88	**5,6**
18 a 40	50,00	34,74	33,66	35,51	**38,48**
41 a 64	31,91	36,84	43,56	35,51	**36,96**
65 or +	11,71	23,16	13,87	27,10	**18,96**
ETHNICITY					
Black	5,32	4,21	8,92	7,48	**6,49**
Brown	39,36	32,63	37,62	49,53	**39,78**
White	55,32	63,16	53,46	42,99	**53,73**
MARITAL STATUS					
Single	44,68	47,37	57,42	43,92	**48,35**
Married/Stable union	37,23	43,16	38,61	45,78	**41,95**
Divorced	4,25	1,05	1,00	2,80	**2,27**
Widower	5,32	7,37	2,97	6,54	**5,55**
Not assessable	8,52	1,05	0	0,96	**1,88**

Source: Survey data

Among the methods used for the event (suicide), the following stood out: hanging, firearms and self-intoxication, with hanging being the most used method (79%) (Graph 02).

Graph 2: Main methods used to commit suicide in the Seridó region of Rio Grande do Sul (2000 to 2015)



Source: Survey data

DISCUSSION

According to the information obtained from the ITEP/Caicó database, during the period from 2000 to 2015, there were 397 cases of suicide in the Seridó region, highlighting the cities of Caicó, Currais Novos and Jucurutu, showing, proportionally, a higher number of suicide cases in the larger municipalities of the Seridó region. This result is corroborated by other studies, when Caicó assumed

a prominent position in the regional context, occupying the 3rd position in the ranking in the country's suicide rate in municipalities with up to 50 thousand inhabitants, in the period from 2005 to 2007[9], and the Seridó region of Potiguar presented high suicide mortality rates in the period from 2010 to 2014[7].

In the present study, only the municipality of Timbaúba dos Batistas did not present cases of suicide during the period studied. However, this reveals the difficulty regarding the statistical treatment of indicators that use the base of 100,000 inhabitants in the calculation of the coefficient, with emphasis on small municipalities such as São José do Seridó and Ouro Branco, which, proportionally, presented higher mortality coefficients than those of Caicó and Currais Novos, which had more cases in absolute number.

In addition, it is noteworthy that the municipalities of Caicó and Currais Novos have the largest regionalized hospitals, as well as the most complex mental health services in the region. In view of this, the importance of deepening knowledge about the degree and circuit of notification of cases in the regional context is considered, as well as the attribution of the event to their place of residence or where they actually died.

As of MS Ordinance No. 1,271/2014, suicide attempts became a mandatory and immediate notifiable disease, and the notification must be made to the Municipal Health Department within 24 hours. The start of care for the person should also be immediate, and they should receive the necessary emergency follow-up, as well as psychosocial follow-up in the Health Network[12].

It is estimated that for every case of suicide there are at least ten attempts of sufficient severity to require medical attention and that these behaviors are up to 40 times more frequent than completed suicides. It is also considered that, for each documented attempt, there are four others that were not recorded[13]. It is likely that many of these attempts do not reach hospital care because they are of minor severity. Even when patients arrive at the care units, the records prepared in the emergency services usually indicate only the injury or trauma resulting from the attempts that required medical care[14].

In relation to the period studied, it was observed that mortality by suicide in the seridó potiguar was not distributed homogeneously and/or equitably over the years. There were peak periods, seen in 2003, 2005, 2012 and 2015, as well as sharp declines in the number of cases, seen in 2004 and 2013. According to the study by Santos (2017)[7] on suicide cases in RN, there was a cluster of suicide in the Seridó region, mainly in rural areas. In this scenario, we point to the importance of further studies and reflections on these indicators, seeking new correlations with historical, economic, social, environmental and cultural factors, which could be having a seasonal impact on the occurrence of cases.

Regarding the socio-demographic profile of the cases, the results presented corroborate the existing scientific literature on the subject, which frame the profile of the suicidal person, historically marked by the predominance of male, white, single, middle-aged men[15,16].

In addition, regarding the occupation of individuals who committed suicide, it was observed that 30.2% of the cases were farmers. If, on the one hand, the region has a large contingent of farmers, due to economic activity, evidencing a probable selection bias, recent studies in several countries, such as India, China, Japan and Australia, have also shown concern about the increase in the number of suicides in this category of workers[17-20]. This is because prolonged or acute exposure to organophosphate pesticides is characterized as one of the causes of aggressiveness, impulsivity and increased risk of suicide among farmers[20]. On the other hand, a qualitative study with family members of suicidal farmers in the interior of Rio Grande do Norte found that the lack of opportunities for work and leisure, as well as drought, appear as possible causes for suicide in this class of workers, demonstrating a multifaceted phenomenon that also reverberates in other psychosocial dimensions[21].

In this context, it is observed that men from Serido, single and of working age had the highest proportion of suicide cases. It is noteworthy that, historically, women commit three times more suicide attempts than men, but using less lethal methods[4].Therefore, it is recognized that, when it comes to suicidal behavior, men idealize, plan and execute attempts with more lethal and forceful means, with little chance of survival, such as suicide by firearms and hangings[4].

Regarding the method used, the findings of our study are also similar to those found in the national reality, in which hanging appears as the main method adopted for suicide in men[6]. Also according to the epidemiological bulletin of the Ministry of Health, hanging, exogenous intoxication and firearms were, in that order, the most used means to commit suicide([6]. Although it is known that this is an inexpensive and easily accessible method, especially in rural communities, this finding gains even greater contours when observing the main occupation of the individuals who committed suicide investigated here, namely, farmers.

According to the WHO, strategies to restrict the means of committing suicide, such as controlling the use of pesticides and firearms, reduce the incidence of suicide and are recommended as universal prevention tools, i.e., for the general population[22]. However, it is known that suicide is a multifactorial phenomenon and that prevention goes beyond restricting the means of committing it. It is necessary to have a network of care and teams constantly prepared to welcome the individual who suffers, whether in PHC settings, health services in general and emergency care units.

Considering that the gateway for patients with suicidal ideation or attempt may be primary care or clinical emergency, it is of fundamental importance to train general practitioners and an integrated health network for attention and care in cases of suicide. The identification and

assessment of suicide risk is the responsibility of the entire health network, and permanent training is of paramount importance, as it is a serious global public health problem[23].

FINAL THOUGHTS

The present study characterized the cases of suicide in the region of Seridó Potiguar, in the interior of northeastern Brazil, giving visibility to the main individual involved who frames the characteristics and profile of suicidal behavior in the region. It was observed that the highest proportion of suicides were men, single, farmers and in the economically active age group; Hanging was identified as the most frequent form.

It is concluded that suicide in the Seridó Potiguar is a major public health problem, with repercussions and consequences that go far beyond the individual who committed the act itself, bringing consequences to the family, social, economic and cultural context of its people.

It is worth noting some limitations of the present study, such as the fact that this study was based on secondary data, making it impossible to draw greater statistical inferences. However, it points to the importance of this work in arousing new discussions in the various social segments, as well as in pointing out the need to produce new studies to investigate possible associations with socioeconomic factors and exposure to pesticides.

In addition to the above, the present study also supported a proposal for intervention in the psychosocial care network in the Seridó region of Rio Grande do Sul as a contribution to teaching-service-community integration in the context of the approach to suicide.

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Depression and its relationship with food consumption and body image

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ABSTRACT

Depression is a mental disorder that compromises the physical and psychological health of the individual, and can affect people of any age, about 300 million people and when this disorder remains for a long time, it can lead to suicide. The increase in the prevalence of depression is related to the adoption of a modern lifestyle, represented by a sedentary lifestyle, dietary changes and sleep deprivation, a stressful environment, fast pace and low quality of the diet consumed. Body image can be defined as a wide range of psychological experiences. It encompasses not only the concept of physical appearance, but attitudes towards the body, encompassing thoughts, behaviors, convictions, emotions and actions and over the years, society has promoted an aesthetic standard that privileges thin or muscular and defined bodies associated with beauty and success, and this is promoted mainly through the media. In some mood changes, food consumption may increase, with greater interest in consuming high-calorie foods, such as ultra-processed foods. These foods increase the production of serotonin in the body, providing a feeling of immediate pleasure and, consequently, it becomes a vicious cycle. Therefore, the promotion of healthy eating, with foods that are a source of antioxidant nutrients, is important in the prevention and treatment of depression, in addition to humanized care, with a multidisciplinary team.

Keywords: Depression, Eating disorders, Food consumption, Body image.

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INTRODUCTION

Depression is a mental disorder that compromises the physical and psychological health of the individual, and can affect people of any age, whose symptoms are sadness for a long period, low self-esteem, chronic fatigue, discouragement, insomnia, irritability and appetite alteration (MS, 2005). Worldwide, more than 300 million people, of all ages, suffer from depression and when this disorder remains for a long time, it can lead to suicide, about 800 thousand deaths per year (PAHO, 2018).

A healthy diet is of paramount importance for the balance of the body, as it needs all the nutrients and vitamins for proper functioning. Deficiency of some nutrients such as zinc, magnesium, vitamins A, C, D, E and B complex is associated with depression. The benefits of these micronutrients are intrinsic in the development and regulation of appetite, transmission of nerve impulses, improvement in the immune system, and production of neurotransmitters such as serotonin, whose function is to regulate mood, sleep, and appetite (Rocha et al., 2020).

The increase in the prevalence of depression is related to the adoption of a modern lifestyle, represented by a sedentary lifestyle, dietary changes and sleep deprivation, a stressful environment, fast pace, and low quality of the diet consumed (Sousa et al., 2024).

In today's society, there is an intense appreciation of the body and an incessant search for thin beauty and the media has been an important vehicle for the dissemination and formation of idealized body image, influencing how the individual should mold himself to the standards of beauty considered acceptable in the social environment. In this way, there is dissatisfaction with the body, a constant desire to be and be thin, with negative repercussions on the subject's mental health, acquiring psychological disorders such as depression and eating disorders (Barros, 2019).

According to Lacerda and Assumpção, (2018), body image is formed from childhood, with children's self-perception of recognizing their own body, maturing their behaviors and appearance according to the social parameters that are presented to them, over time. When this occurs in a distorted way, the child develops dissatisfaction with their own body, low self-esteem and propensity to some psychic disorders due to the established beauty standards.

LITERATURE REVIEW

DEPRESSION

Depression is classified as a mood disorder, and is often confused with sadness, but it is characterized by a loss of interest and pleasure; energy and reduced activity; marked tiredness after light exertion, especially when of long duration and with moderate or severe intensity. Depression can become a critical health condition. Other associated symptoms are: decreased appetite, disturbed sleep, ideas of guilt, and reduced: self-esteem, concentration and attention (WHO, 1993; WHO, 2015).

According to the Pan American Health Organization (PAHO), it is estimated that more than 300 million people suffer from depressive disorders, which can result in problems in family relationships, friendships, as well as performance at work and in studies. In extreme cases, this disorder can lead to suicide. Statistics indicate that more than 800 thousand people take their lives each year (ALBUQUERQUE, 2021).

There are several fields in neuroscience that seek to explain this disease. From a neurochemical point of view, research focuses on monoamine neurotransmitters (dopamine, serotonin, epinephrine). From a neuroanatomical point of view of the brain, structural abnormalities are observed in areas such as the hippocampus and different cortical regions of the brain. When depression is looked at from a neurocognitive point of view, it is observed that it is associated with changes in information processing, attention, and memory (ALBUQUERQUE, 2021).

Depressive disorder is a growing phenomenon, affecting various social groups without distinction between gender, economic class or age group. In addition, it is associated as a comorbidity with other diseases, and is often referred to as "the disease of the twenty-first century" (WHO, 2001). It is a disorder resulting from multiple factors, and is related to maladaptive thoughts, which can manifest themselves in situations of complex understanding. Maladaptive thoughts influence the interpretation of thoughts in relation to oneself, others, and the future, often triggering situations that are difficult to cope with (SILVA, GONÇALVES, SILVA, 2017).

With regard to depressive thoughts about oneself, many of them are related to the inability to solve problems, thoughts of rejection and loss; based on the use of instruments, it becomes possible to plan interventions that are based on the prevention not only of depression, but also of suicide, before the symptoms worsen (SILVA, GONÇALVES, SILVA, 2017).

It is known that thoughts are considered by cognitive therapy as a fundamental part of the treatment of depression, and it presupposes that the negative perception that the subject has of himself, others and the future directly interferes in his cognitive vulnerability, and the more dysfunctional the thoughts, the greater the severity of the episode (CARNEIRO E BAPTISTA, 2012).

BODY IMAGE-ASSOCIATED DEPRESSION

Body Image (CI) can be defined as a wide range of psychological experiences. It encompasses not only the concept of physical appearance, but also attitudes towards the body, encompassing thoughts, behaviors, convictions, emotions, and actions (SANTOS, 2021).

According to Yazdani *et al* (2018), Body image can involve three dimensions: the perceptual dimension, which refers to the subject's perception of their physical appearance; the subjective dimension, which involves emotional and affective aspects of the individual, including their level of satisfaction with their physical appearance; and the behavioral dimension, which relates to the

behaviors adopted by the person as a result of their body perception, how to avoid situations that require exposure of the body due to the discomfort felt in relation to it (SANTOS, 2021; CASH, 2003).

Over the years, society has promoted an aesthetic standard that privileges lean or muscular and defined bodies associated with beauty and success, and this is mainly promoted through the media. As a result, there has been an excessive preoccupation with appearance, as well as feelings of inferiority in individuals who do not fit this pattern. This aesthetic pressure considerably increases the risk of depression, anxiety, and food-related problems (CARDOSO et al., 2020).

The study by Fernandes (2019), conducted with 647 undergraduate students at the Federal University of Ouro Preto (UFOP), with the aim of evaluating the impacts of social media on body dissatisfaction and the risks of eating disorders and symptoms of depression, found a positive correlation between body dissatisfaction and levels of stress, anxiety, depression, and risks of eating disorders. with the female public being the most affected.

This fact is more evident in courses where Body Image is an essential sight for the professional future. The study by Lima et al. (2018), carried out at the Federal University of Piauí/Brazil with university students of Physical Education, found that 70% of the students had body dissatisfaction. It is assumed that this high dissatisfaction is attributed to the demands of the course profession itself, to the physical and aesthetic demands and appearance, seen as essential for success. It is worth noting that no statistically significant relationship was found between body dissatisfaction and depression. However, feeling dissatisfied with one's own body can start a negative cycle of thoughts and emotions, significantly harming emotional and mental well-being. And when not treated properly, it can trigger a host of emotional issues, depression being one of them. ´

DEPRESSION AND FOOD CONSUMPTION

Food is considered an environmental determinant that plays an important role in an individual's health. A healthy diet can play a protective role in the development, progression, and treatment of some mental disorders, and its adherence is inversely related to depressive symptoms and their severity, because when a nutritional deficiency occurs, it can cause serum changes in inflammatory markers (Costa et al., 2020).

In some mood changes, food consumption may increase, with greater interest in consuming high-calorie foods, such as ultra-processed foods. These foods increase the production of serotonin in the body, providing a feeling of immediate pleasure and, consequently, it becomes a vicious cycle, these cravings are directly associated with a decrease in the response of neurotransmitters (Araújo, 2017; Franco et al., 2023).

Some nutrients, such as polyunsaturated fatty acids, exert a modulating function, such as omega 3, which has an anti-inflammatory action to improve depression. Among the minerals, magnesium should be highlighted, as it is involved in the reactions of neurotransmitters, hormones and neuronal membrane. In addition, its intake is associated with lower levels of inflammation markers that impact the development of the disease (Rocha et al, 2020).

Vitamin D is related to the synthesis of some neurotransmitters and plays a crucial role in sleep and circadian rhythms, which, when unbalanced, can be associated with depression. B vitamins play an important role in the synthesis of neurotransmitters of the Central Nervous System (CNS), helping to rebuild brain and nervous system tissues (Angels; Martin; Costa, 2020).

Excessive consumption of carbohydrates, saturated fats, sodium, and alcohol increases the prevalence of depressive symptoms and, in addition, can trigger inflammatory processes, free radical formation, neurotransmitter imbalance, and can cause changes in the intestinal microbiota and, consequently, induce the worsening of the clinical condition of depressed patients (Neres et al., 2022).

The quality of the diet positively affects the individual's health and contributes in an impactful way to the improvement of the depressive condition. Therefore, the promotion of healthy eating, with foods that are a source of antioxidant nutrients, is important in the prevention and treatment of depression, in addition to humanized care, with a multidisciplinary team to improve the individual's quality of life.

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Covid-19 pandemic and the impacts on occupational health and quality of life of professionals working in primary care

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ABSTRACT

This study aimed to analyze the impacts of the Covid-19 pandemic on the occupational health and quality of life of professionals working in primary health care. To this end, a literature review was conducted, where it was possible to verify that the Covid-19 pandemic overloaded primary care professionals with an intense workload, exposure to the virus, physical and emotional exhaustion, lack of resources and adequate training,

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in addition to impacts on mental health. Despite the challenges, these professionals have demonstrated unwavering dedication to providing essential care to the population. Rapid adaptation to new working practices and the implementation of safety measures were crucial to ensure the continuity of primary health services. The results highlight the importance of effective measures to protect and support primary care professionals, including the adequate provision of personal protective equipment, access to psychological support and mental health services, continuous training, and recognition of the work of these professionals. In addition, the pandemic has highlighted the need for investments in public health and strengthening of primary care systems to prevent and face future health crises, thus promoting the health and quality of life not only of professionals, but of the entire population served by primary health services.

Keywords: Occupational Health, Quality of Life at Work, Pandemic, Health Professionals, Primary Care.

INTRODUCTION

The Covid-19 pandemic has brought significant challenges to the occupational health and quality of life of professionals working in primary care. Since the emergence of the new coronavirus, these professionals have faced an intense workload, dealing with the increased demand for health services, the fear of contamination, the shortage of adequate protective equipment, and the emotional burden of dealing with infected patients and severe cases of the disease (LANA et al., 2020).

In the context of primary care, where direct contact with the community is essential, health professionals have faced additional challenges, such as the need to quickly adapt to new care protocols, perform screening and tests for Covid-19, monitor patients in quarantine, and cope with the increase in cases of mental illnesses related to stress and social isolation (CARVALHO et al., 2020).

In addition, the pandemic has exacerbated existing health and social inequalities, disproportionately affecting health professionals who were already in vulnerable situations, such as informal workers, those with precarious contracts, or those who face difficulties in accessing adequate health services (BARBOSA et al., 2021).

Given this scenario, it is essential that effective measures are implemented to protect and support frontline health workers. This includes providing adequate personal protective equipment, ensuring safe working conditions, providing psychological support and access to mental health services, promoting training and continuing education programs, and recognizing the work and effort of these professionals through incentives and appreciation.

This literature review seeks to analyze the impacts of the Covid-19 pandemic on the occupational health and quality of life of professionals working in primary care, identifying the main challenges faced by these professionals, the coping strategies adopted, and the gaps in knowledge that require future research. Through a critical analysis of the existing literature, it is intended to contribute to the development of policies and practices that promote the well-being and safety of these essential workers.

DEVELOPMENT

COVID-19 PANDEMIC

The Covid-19 pandemic, caused by the SARS-CoV-2 coronavirus, is one of the most impactful and significant events of the 21st century. Initially identified in the city of Wuhan, China, in December 2019, the virus has spread rapidly around the world, resulting in a global public health crisis that has affected millions of people on all continents (LIMA; DOMINGUES JUNIOR; SILVA, 2024).

The novel coronavirus belongs to the family of coronaviruses, which includes a number of viruses that can cause anything from common colds to more serious illnesses such as Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS). However, SARS-CoV-2 has been shown to be highly contagious and capable of causing a wide range of symptoms, from mild flu to severe forms of pneumonia and respiratory failure (LIMA et al., 2023).

Transmission of the virus occurs primarily through respiratory droplets expelled when an infected person coughs, sneezes, or talks, and can also occur through contact with contaminated surfaces. The resulting disease, known as Covid-19, can affect people of all ages, but is most severe in older adults and individuals with underlying health conditions such as heart disease, diabetes, and obesity (BITTENCOURT, 2020).

Since the start of the pandemic, healthcare systems around the world have faced unprecedented challenges, including shortages of hospital beds, personal protective equipment (PPE), mechanical ventilators, and medicines. In addition, the burden on health services has led to the postponement of non-urgent medical procedures, cancellation of elective appointments, and challenges in providing health care for conditions other than Covid-19 (ISER et al., 2020).

To contain the spread of the virus, a range of public health measures have been implemented, including social distancing, wearing face masks, hand hygiene, quarantines and lockdowns. However, the effectiveness of these measures has varied according to the population's adherence, government policies, and the capacity of health systems to deal with the crisis (BITTENCOURT, 2020).

In addition to the physical health impacts, the pandemic has also had significant consequences for the mental, economic, and social health of communities around the world. Social isolation, fear of illness, job loss, and uncertainty about the future have contributed to the increase in anxiety, depression, and other mental disorders (LIMA; DOMINGUES JUNIOR; SILVA, 2024).

PRIMARY HEALTH CARE

Primary health care is the first level of care in the health system, and is considered the gateway to health services. It is responsible for providing accessible, continuous, coordinated, and comprehensive primary health care to the population. This means that primary care aims to address the most common and basic health needs of individuals and communities by promoting disease prevention, treatment of common health conditions, and promotion of overall well-being (GAMA et al., 2021).

Primary care services are usually provided by a multidisciplinary team of health professionals, which may include general practitioners, nurses, nursing technicians, community health agents, among others. This team works in basic health units, such as health centers, health

centers, and family health units, and works in an integrated manner with other levels of health care, such as specialized and hospital care (SILVA et al., 2017).

Among the main activities of primary care are: health promotion and disease prevention, through vaccination campaigns, guidance on healthy habits and early detection of diseases; the follow-up of chronic diseases, such as hypertension and diabetes, through regular consultations and monitoring; the care of uncomplicated urgencies and emergencies; the performance of basic examinations and procedures; guidance and referral to other health services when necessary; and the development of community health actions, aiming at the active participation of the population in the promotion of their own health (CORDIOLI et al., 2019).

Primary care is essential to ensure equitable and universal access to health services, contributing to the improvement of health indicators and quality of life of the population (GAMA et al., 2021).

COVID-19 PANDEMIC AND THE IMPACTS ON PRIMARY CARE HEALTH PROFESSIONALS

The Covid-19 pandemic has brought with it a series of challenges for health professionals working in primary care. These professionals, including family doctors, nurses, nursing technicians, and community health workers, play a key role on the front lines of the fight against the disease, dealing directly with the population and facing unique conditions during this critical period (LIMA et al., 2020).

One of the main challenges faced by these professionals was exposure to the virus. Working in close contact with infected or suspected patients, they were subject to a higher risk of contagion, often facing this reality with limited protective resources (FABRI et al., 2022).

In addition, the pandemic has burdened these professionals with an increased workload. With the increase in the number of Covid-19 cases, they had to deal not only with the treatment of these patients, but also with maintaining routine care for other health conditions, such as chronic diseases and medical emergencies (BRANDÃO et al., 2021).

Physical and emotional exhaustion has also become a significant concern. The constant fear of contagion, work overload, stressful conditions, and exposure to traumatic situations contributed to high levels of stress, anxiety, and exhaustion among these professionals (GALARÇA et al., 2022).

The lack of resources and adequate training was another challenge faced by the primary care team. Shortages of personal protective equipment, limited access to diagnostic tests, insufficient training in prevention measures, and lack of psychological support were recurrent issues (PINTO et al., 2022).

Faced with these challenges, primary care health professionals have had to adapt to new work practices to ensure the safety of patients and themselves. This included implementing patient triage,

telemedicine, social distancing measures, and educating the community on preventive measures (LIMA; GOMES; BARBOSA, 2020).

Finally, the pandemic has had a significant impact on the mental health of these professionals, leading to symptoms of post-traumatic stress, burnout, depression, and anxiety. Despite all the challenges, the dedication and commitment of these professionals were instrumental in providing essential care to the population during this unprecedented period (LIMA et al., 2020).

FINAL THOUGHTS

In view of the analysis of the impacts of the Covid-19 pandemic on the occupational health and quality of life of primary health care professionals, it is possible to conclude that these workers faced a series of unprecedented challenges during this critical period. Exposure to the virus, intensified workload, physical and emotional exhaustion, lack of resources and adequate training, and impacts on mental health were some of the main obstacles faced by these professionals.

The pandemic required rapid adaptation on the part of primary care professionals, who needed to implement new work practices to ensure the safety of patients and themselves. Despite the difficulties faced, these professionals demonstrated an unwavering dedication to providing essential care to the population, standing out as true heroes on the front lines of the fight against the disease.

However, it is essential to recognize that the pandemic has had a significant impact on the physical and mental health of these professionals, highlighting the importance of effective protection and support measures. Policies and strategies should be implemented to ensure adequate provision of personal protective equipment, access to psychological support and mental health services, ongoing training, and recognition of the work and effort of these professionals.

In addition, the pandemic has highlighted the need for investments in public health and strengthening of primary care systems as a way to prevent and address future health crises. By recognizing and valuing the fundamental role of primary care professionals, it is possible to promote the health and quality of life not only of these workers, but of the entire population that depends on primary health services.

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Occupational health: The effects of the pandemic on the quality of life of Primary Health Care (PHC) professionals

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ABSTRACT

The present research aimed to analyze the main effects of the COVID-19 pandemic on the quality of life at work of health professionals in Primary Health Care (PHC). The research consisted of an integrative literature review, using Google Scholar and Scielo to search for scientific articles on quality of life at work of PHC health professionals during the COVID-19 pandemic. Strict inclusion criteria were applied, resulting in the selection of a sample of three articles for detailed analysis. The studies present a comprehensive analysis of the effects of the COVID-19 pandemic on the quality of work life and mental health of health workers, especially those on frontline and primary care. In addition to highlighting the social and labor dimension of the crisis triggered by the pandemic, the studies highlight the neglect of the care and respect needs of these professionals, who are often perceived only as caregivers. The lack of adequate social protection and exposure

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to the risk of contamination contributed to feelings of anguish and insecurity, aggravated by the intensification of occupational stress. Integrative and Complementary Health Practices (ICPs) have emerged as a relevant alternative for professionals' self-care and health promotion, highlighting the need for holistic approaches that consider both physical and mental health. The implementation of policies and strategies to prevent mental illness and promote the well-being of professionals is crucial, requiring a sensitive look at their experiences during the pandemic. In summary, the studies underline the importance of an integrated approach to address the impacts of the pandemic on the health of health workers and ensure that they are supported to face future challenges.

Keywords: Occupational health, Quality of Life at Work, Primary Health Care (PHC), Pandemic, Covid-19.

INTRODUCTION

Occupational health is a fundamental field that aims to promote the physical, mental, and social well-being of workers in the workplace. Occupational health involves the prevention of work-related diseases, the control of occupational hazards, and the promotion of safe and healthy work environments. Occupational health practices are essential to ensure the safety and health of workers, as well as contributing to the productivity and quality of services provided by organizations. It encompasses a series of preventive measures, such as ergonomic assessments, accident prevention programs, and monitoring of exposure to harmful agents, in order to protect the physical and mental integrity of workers (LIMA; DOMINGUES JUNIOR; GOMES, 2024).

The COVID-19 pandemic has brought unprecedented challenges to occupational health, significantly impacting the way organizations and professionals deal with occupational health and safety. The rapid spread of the virus necessitated the implementation of emergency measures such as social distancing, the use of personal protective equipment (PPE), and strict hygiene protocols. Healthcare workers faced extremely challenging working conditions, dealing with high levels of stress, risks of contamination, and emotional burden due to the nature of the pandemic. Rapid and effective adaptation of occupational health practices has become essential to protect workers and ensure the continuity of health services (OLIVEIRA et al., 2023).

The quality of life at work of health professionals has become a central concern during the pandemic, given the intensity and complexity of the demands faced by these workers. In addition to the physical challenges associated with exposure to the virus, health care workers dealt with a significant emotional burden, including the anguish of dealing with critically ill patients and grief over the loss of life (ASUNÇÃO; CORRÊA; UEHARA, 2022).

In primary health care, practitioners face specific challenges related to providing community-based health care. During the pandemic, these professionals were called upon to play a crucial role in identifying, screening, and referring suspected cases of COVID-19, while continuing to provide essential care for other health conditions. Work overload, lack of resources, and exposure to the risk of infection were amplified issues in primary care during this period (PEIXOTO et al., 2021).

Thus, the present research aimed to analyze the main effects of the COVID-19 pandemic on the quality of life at work of health professionals in Primary Health Care (PHC). It is hoped that the results of this research will provide theoretical and practical subsidies to understand how the COVID-19 pandemic has affected the quality of life at work of health professionals working in Primary Health Care.

METHODOLOGY

The methodology adopted for this research consisted of an integrative literature review, an approach that allows synthesizing and critically analyzing pre-existing studies on quality of life at work. This methodological choice is justified by the need to compile and examine a variety of information sources to obtain a comprehensive understanding of the main effects of the COVID-19 pandemic on the quality of life at work of Primary Health Care (PHC) health professionals.

Data collection was carried out in the Google Scholar and Scielo databases, using specific keywords and search descriptors related to quality of life at work, pandemic and PHC health professionals. Strict inclusion criteria were applied, which included the exclusive selection of scientific articles published between 2020 and 2023, written in Portuguese and available free of charge and in full. The research focused specifically on studies that addressed the effects of the pandemic on the quality of life at work of PHC professionals, excluding other types of documents, such as theses, abstracts, and reports, to ensure the quality and relevance of the data.

Data analysis was conducted in two distinct stages. In the first stage, the abstracts and titles of the articles were reviewed to identify those that met the inclusion criteria and were aligned with the research objective. In the second stage, the selected articles were read in full and submitted to a detailed analysis to extract relevant information on the effects of the COVID-19 pandemic on the quality of life at work of PHC professionals. At the end of the process, a sample of three scientific articles was chosen to compose the basis of analysis and discussion of this research.

RESULTS AND DATA ANALYSIS

Based on the integrative literature review, it was possible to obtain a sample of three scientific articles, as shown in Chart 1.

The study revealed that the pandemic has had a significant impact on the mental health of frontline health workers, highlighting the lack of appreciation of this dimension and the urgent need for worker care. The changes imposed by the pandemic, such as the increase in patients, complexity of cases, and reorganization of services, have intensified the challenges faced by professionals. In the face of these changes, demands have emerged for mental health programs and new forms of communication to support the care process. The study also highlighted the phenomenon of scientific denialism, which has led to practices that have not been scientifically proven and had negative repercussions for health teams. In addition, the intensification of occupational stress during the pandemic was observed, especially among professionals who dealt directly with COVID-19 patients. The need for programs and actions aimed at the mental health of health professionals has become evident, emphasizing the importance of policies and strategies to prevent mental illness in the workplace. The study recognizes its limitations, such as the specific focus on the reality of certain professionals during the peak of the pandemic, but highlights the relevance of considering the experiences of these professionals for the development of effective mental health care measures.

Authors	Objective	Methodology	Conclusion
Martins et al. (2020)	Systematize the knowledge acquired from workshops held with Primary Care professionals in the city of Guaiuba-CE, seeking to understand the effects of the pandemic on their mental health	Experience report	The Covid-19 pandemic has had significant impacts on the quality of work life of primary care health professionals. While the media focus turned to the spread of the virus, it was important to highlight that the consequences went beyond the biological aspect, also affecting the social aspect. In this context, health professionals were often perceived only as caregivers, ignoring their own needs for care and respect. The precariousness of work in the health sector became evident, especially given the lack of adequate social protection and constant exposure to the risk of contamination. This led to feelings of anguish and insecurity, directly affecting the mental health of these professionals.
Pereira et al. (2022)	Identify the possible repercussions of the COVID-19 pandemic on workers' health, the care strategies used and the offer of Integrative and Complementary Practices	Descriptive study, with a qualitative approach AND Qualitative approach	This study revealed the impact of the pandemic on workers' health, with an emphasis on mental health, leading to the search for care strategies that included Integrative and Complementary Health Practices (PICS). Faced with the interruption in the provision of these practices to the population due to the COVID-19 pandemic, professionals with training in PICS began to make them available to their co-workers. The pandemic has brought several challenges to healthcare workers, highlighting the importance of self-care and worker health. One strategy mentioned was the resumption of PICS, initially offered to workers and later to the general population. In addition to adapting services to ensure the health and safety of workers during the pandemic, the creation of support networks and the systematic provision of PICS during the workday can contribute to mental health care and health promotion.
Reiser e Mattos (2023)	Understanding the repercussions on the mental health status of health professionals in Primary Health Care	Qualitative, exploratory and descriptive study	The study revealed that the pandemic had a significant impact on the mental health of frontline healthcare professionals, highlighting the lack of appreciation for this dimension and the urgent need for worker care. The changes imposed by the pandemic, such as the increase in patients, complexity of cases and reorganization of services, intensified the challenges faced by professionals. Faced with these changes, demands for mental health programs and new forms of communication to support the care process emerged. The study also highlighted the phenomenon of scientific denialism, which led to scientifically unproven practices and had negative repercussions for healthcare teams. Furthermore, the intensification of occupational stress during the pandemic was observed, especially among professionals who dealt directly with patients with COVID-19. The need for programs and actions aimed at the mental health of healthcare professionals has become evident, highlighting the importance of policies and strategies to prevent mental illness in the workplace. The study recognizes its limitations, such as the specific coverage of the reality of certain professionals during the peak of the pandemic, but highlights the relevance of considering the experiences of these professionals for the development of effective mental health care measures.

Source: Survey data (2024).

Based on the above, it is observed that Martins et al. (2020) reveal an impactful portrait of the effects of the Covid-19 pandemic on the quality of life at work of primary care health professionals. By highlighting that the impacts of the pandemic go beyond the biological aspect, also reaching the social aspect, the authors highlight the complexity of this public health crisis. In the midst of the spread of the virus and the widespread concern about physical health, the neglect of health professionals' needs for care and respect is evidenced.

The text highlights the predominant perception of professionals only as caregivers, disregarding their own health and well-being needs. This lack of recognition and support is amplified by the precariousness of work in the health area, evidenced by the lack of adequate social protection and constant exposure to the risk of contamination. As a result, professionals face feelings of distress and insecurity, directly impacting their mental health.

This analysis reveals not only the immediate challenges faced by health workers during the pandemic, but also highlights broader structural issues related to working conditions and professional recognition. The precariousness of work in healthcare is not a new phenomenon, but the pandemic has highlighted and exacerbated these issues, requiring an urgent and comprehensive response. In addition, the analysis underscores the importance of considering not only the physical health but also the mental health of health professionals, highlighting the need for appropriate support and care measures.

The study conducted by Pereira et al. (2022) highlights the significant impact of the pandemic on workers' health, with special emphasis on mental health, highlighting the need to search for care strategies. In this context, Integrative and Complementary Health Practices (ICPs) have emerged as an important alternative, especially considering the interruption in the supply of these practices to the population due to the COVID-19 pandemic. A notable response was the initiative of health professionals trained in ICPs, who began to make these practices available to their co-workers. This highlights the importance of worker self-care and health as fundamental elements during this challenging period.

The challenges faced by health workers during the pandemic are multifaceted, highlighting the pressing need to care for the physical and mental health of these professionals. The resumption of ICPs, initially aimed at workers and later at the general population, is pointed out as a potential strategy to deal with these challenges. In addition to adaptations in services to ensure the health and safety of workers, the creation of support networks and the systematic provision of PICS during the working day emerge as crucial measures to promote the well-being and mental health of professionals.

The study conducted by Reiser and Mattos (2023) offers important insights into the impact of the pandemic on the mental health of frontline health workers. The results revealed a significant

deterioration in this dimension, highlighting the lack of appreciation of the mental health of these workers and the urgent need for care. The changes imposed by the pandemic, such as the increased workload, the complexity of cases, and the reorganization of services, have exacerbated the challenges faced by these professionals.

Faced with this scenario, demands for mental health programs and new communication strategies that could support the care process emerged. The study also draws attention to the phenomenon of scientific denialism, which resulted in practices that were not scientifically based and had negative repercussions for health teams. In addition, an intensification of occupational stress was observed, especially among professionals who dealt directly with patients infected with COVID-19.

The urgent need to implement programs and actions aimed at the mental health of health professionals has become evident, highlighting the importance of policies and strategies to prevent mental illness in the workplace. The study recognizes its limitations, such as the specific focus on the reality of certain professionals during the peak of the pandemic, but emphasizes the relevance of considering the experiences of these professionals for the development of effective mental health care measures.

FINAL THOUGHTS

The panorama outlined by the studies offers a comprehensive analysis of the impacts of the COVID-19 pandemic on the quality of life at work and on the mental health of health professionals, particularly those working on the frontline and in primary care. It is evident that the crisis triggered by the pandemic transcended the limits of the biological aspect, entering the social and work field, where professionals were often perceived only as caregivers, neglecting their own needs for care and respect.

The precariousness of work in the health area was manifested in a glaring way, reflected in the lack of adequate social protection and constant exposure to the risk of contamination, resulting in feelings of anguish and insecurity that directly impacted the mental health of these professionals. In addition, the intensification of occupational stress during the pandemic, exacerbated by the increased workload and the complexity of cases, highlighted the urgency of care and support strategies aimed at the mental health of professionals.

The studies also highlight the importance of Integrative and Complementary Health Practices (ICPs) as a significant alternative for self-care and health promotion of health professionals. The initiative by professionals with PICS training to make them available to their co-workers during the pandemic highlights the need for holistic approaches that consider not only the physical health but also the mental health of workers.

In this context, it is crucial to implement policies and strategies aimed at preventing mental illness and promoting the well-being of health professionals. A close and sensitive look at the experiences of these professionals, especially those who faced frontline challenges during the peak of the pandemic, is needed in order to develop effective mental health care measures in the workplace. In sum, the studies highlight the urgency of an integrated and comprehensive approach to address the health impacts of the pandemic on health workers, recognizing their vital importance and ensuring that they are given the support they need to face future challenges.

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Management of septic shock secondary to pneumonia: Treatment protocols in medical emergencies

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ABSTRACT

This study investigates the effectiveness of treatment procedures for septic shock in patients with pneumonia treated in emergency medical services. The methodological approach involved a descriptive and qualitative literature review, consulting sources such as Scielo, Google Scholar and PubMed, from 1996 to 2024. The specific objectives included the description of the pathophysiological mechanisms, the analysis of the therapeutic protocols, the evaluation of the use of corticosteroids, the investigation of the role of the multidisciplinary team, and the verification of the importance of biomarkers in early diagnosis. The results underscore the need for personalized approaches to treatment, given individual variation in response to therapies. The conclusion highlights that in-depth knowledge and careful management of protocols are essential to improve compliance with therapeutic guidelines and patients' quality of life. Future research should focus on innovative therapies and explore in more depth predictive markers of risk, as well as evaluate the efficacy of complementary therapies such as corticosteroids.

Keywords: Septic shock and pneumonia, Septic shock treatment protocols, Corticosteroids in septic shock, Multidisciplinary team in septic shock, Biomarkers in septic shock.

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INTRODUCTION

The word sepsis refers to the presence of microorganisms or their toxins in the bloodstream[1]. Septic shock should be defined by a systolic blood pressure of less than 90 mmHg or a mean arterial pressure of less than 65 mmHg after a crystalloid fluid challenge, indicating when vasopressor treatment should be initiated and when adjunctive therapy should be considered [2].

Pneumonia is a health condition that commonly results from infections, leading to inflammation and congestion of the lungs, which impairs normal breathing, causing coughing and dyspnea. Although it can affect people of all age groups, it is more common in children and the elderly. [3]. In Pseudomonas aeruginosa pneumonia, septic shock is primarily caused by alveolar epithelial injury, which allows the release of pro-inflammatory mediators into the circulation [4].

Severe sepsis or septic shock is common in patients with gram-negative bacteremia, predicting higher mortality rates, with kidney disease and indwelling urinary catheter being the most significant risk factors [5].

The general objective of this article is to evaluate the efficacy of treatment protocols currently recommended for the management of septic shock in patients with pneumonia in emergency settings. The specific objectives outlined to achieve this goal include: To describe the pathophysiological mechanisms of septic shock in patients with pneumonia; To review the scientific literature on treatment protocols for septic shock secondary to pneumonia used in medical emergencies; To examine the use of corticosteroids in patients with pneumonia-induced septic shock and its effect on clinical outcomes; To analyze the role of the multidisciplinary team in the effective treatment of septic shock in pneumonic patients; To assess the importance of biomarkers in the early diagnosis and management of septic shock secondary to pneumonia.

The article in question is a vital study, as the management of septic shock in patients with pneumonia is crucial, considering the high severity of sepsis and its significant impact on mortality rates when not managed properly. The investigation and application of effective protocols in medical emergencies are key to improving clinical outcomes and reducing mortality, emphasizing the need for constant innovations and updates in treatments.

METHODOLOGY

The current work is an essential research that is based on a detailed literature review, with the aim of exploring in a comprehensive, organized and systematic way the results found in studies related to the theme.

The inclusion criteria for this review are specific and encompass research investigating the pathophysiological mechanisms of septic shock in patients with pneumonia, emergency treatment protocols, the use of corticosteroids and their impacts on clinical outcomes, the evaluation of the role

of the multidisciplinary team in effective treatment, and the importance of biomarkers for early diagnosis. Studies that do not directly address these aspects or that focus on other conditions will be excluded.

The search strategy will involve the use of recognized electronic databases such as Google Scholar, Scielo and PubMed. The keywords aligned with the specific research objectives will be "Septic shock and pneumonia", "Treatment protocols for septic shock", "Corticosteroids in septic shock", "Multidisciplinary team in septic shock" and "Biomarkers in septic shock".

The study selection process will follow a qualitative and descriptive approach, starting with the identification of abstracts that seem to meet the established criteria, followed by a thorough analysis of the full articles to verify their adequacy and relevance.

During data collection, information on the occurrence, diagnosis, treatment, and management of septic shock will be thoroughly gathered. The evaluation of the quality of the included studies will take into account methodological soundness, clinical relevance and timeliness, covering articles published between **1996 and 2024**. This ensures that the information analyzed is fresh and pertinent. Additionally, the analysis will be restricted to the specific terms and languages used in the searches, which may result in the exclusion of relevant studies that are not aligned with the designated keywords.

This methodological approach ensures a concentrated and detailed analysis, which is essential for the effective management of septic shock in patients with pneumonia in medical emergency settings. The goal is to promote continuous improvement in treatment protocols and, consequently, in clinical outcomes.

RESULTS AND DISCUSSION:

Pneumonia is an acute inflammatory condition that can be triggered by various causes, such as bacteria, viruses, fungi, or exposure to toxic substances. This inflammation in the lungs can progress to a body-wide inflammatory response, which can result in septic shock[6][7].

During the process of inflammation throughout the body, several inflammatory mediators are involved. These mediators include pro-inflammatory cytokines such as tumor necrosis factor-α (TNF-α), interleukin-1 (IL-1), and interleukin-6 (IL-6), which are responsible for stimulating the immune response and triggering generalized symptoms. In addition, the release of acute phase proteins, such as C-reactive protein (CRP) and ferritin, is also observed in this process [6][7].

The body-wide inflammatory response triggered by pneumonia can result in a number of systemic effects, including fever, increased heart rate, low blood pressure, and, in severe cases, septic shock. Septic shock is a serious complication of pneumonia characterized by an out-of-control

inflammatory response that leads to decreased blood flow to tissues and consequent multiple organ dysfunction [6][7].

One study showed that severe pneumonia caused by respiratory syncytial virus (RSV) is associated with intense localized viral replication, exacerbated pro-inflammatory response, and high immune cell activation. In addition, the general diagnosis of pneumonia, especially those caused by viruses, is challenging, making it difficult to understand these diseases and their causative agents [8].

It is crucial to prevent pneumonia to avoid such complications. In view of this, vaccination against influenza and pneumonia, hand hygiene, avoiding smoking and crowded places are recommended as preventive measures [9].

Respiratory failure is one of the initial complications of septic shock, resulting in hypoxemia and requiring ventilatory support. Renal failure is another common complication, leading to oliguria or anuria due to dysfunction of the kidneys, requiring close monitoring of kidney function and, in severe cases, renal replacement therapy. Cardiovascular failure is a critical complication, manifesting as refractory hypotension, requiring vasopressors to maintain adequate tissue perfusion [10].

These conditions complicate patient management, as each of them requires specific therapeutic approaches and ongoing monitoring to prevent further harm. Respiratory failure requires adequate ventilatory support and strategies to improve oxygenation. Renal failure requires intensive care to maintain fluid and acid-base balance, and may require dialysis. Cardiovascular failure poses a significant challenge, as refractory hypotension can lead to poor tissue perfusion and multi-organ dysfunction, requiring careful use of vasopressors and close hemodynamic monitoring [10].

These complications in septic shock underscore the importance of a multidisciplinary and personalized approach aimed at stabilizing compromised organ function, preventing further damage, and improving the clinical outcomes of affected patients. Early identification and aggressive treatment of these complications are key to optimizing the management of septic shock and reducing the morbidity and mortality associated with this serious condition [10].

Fluid administration is a critical life support strategy in the treatment of septic shock, as it helps restore vascular volume and perfusive blood pressure. The goal is to maintain an adequate circulating volume to ensure tissue oxygenation and peripheral perfusion. It is recommended to initiate resuscitation with crystalloids, preferably isotonic sodium chloride solutions (0.9%), at an initial dose of 30 mL/kg body weight, within the first 3 hours after the diagnosis of septic shock. If mean arterial pressure (MAP) is less than 65 mmHg, additional fluids should be considered, up to a maximum of 50 mL/kg body weight [11].

Vasopressor support is an important life support strategy in the treatment of septic shock when fluid administration is not sufficient to restore perfuurious blood pressure. The goal is to maintain a mean arterial pressure (MAP) greater than 65 mmHg and an adequate urine output. Norepinephrine is

the vasopressor agent of choice for septic shock, followed by epinephrine, dopamine, and vasopressin. The initial dosage of norepinephrine is 0.05 to 0.1 mcg/kg/min, and can be gradually increased until the desired MAP is reached [11].

Airway management is an important life support strategy in the treatment of septic shock, as it ensures adequate ventilation and tissue oxygenation. The goal is to maintain an inspiratory oxygen fraction (FiO2) of less than 60% and a partial pressure of carbon dioxide (PaCO2) within normal limits. Endotracheal intubation and invasive mechanical ventilation are recommended in patients with septic shock and severe respiratory dysfunction such as refractory hypoxemia or hypercapnia.

Noninvasive mechanical ventilation may be considered in patients with septic shock and mild to moderate respiratory dysfunction, but should be monitored carefully to detect respiratory deterioration [11].

The choice and timing of antibiotics in the treatment of septic shock secondary to pneumonia are crucial for therapeutic success and patient survival. Current guidelines recommend early administration of broad-spectrum antibiotics, such as third-generation cephalosporins or carbapenems, to cover the most common pathogens associated with pneumonia and septic shock. Delays in the proper administration of antibiotics can lead to increased mortality due to spread of infection and worsening of the clinical picture.

The challenges associated with antimicrobial resistance make the choice of antibiotics even more complex. Bacterial resistance limits effective therapeutic options, requiring an individualized approach based on the results of cultures and susceptibility testing. In addition, the indiscriminate use of antibiotics contributes significantly to the development of resistance, highlighting the importance of rational prescription and control of antimicrobial use [12].

The question of the use of corticosteroids in the treatment of septic shock has been widely discussed in the scientific literature, with inconclusive evidence on its benefits and risks. Most of the reviewed studies emphasize the need for further research to clarify the efficacy of adjunctive corticosteroid therapy in patients with septic shock [13][14].

Regarding the risks, the use of corticosteroids may be associated with complications such as secondary infections, hyperglycemia, myopathy, gastrointestinal hemorrhage, and adrenal insufficiency12. Therefore, it is important that the decision to use corticosteroids in the treatment of septic shock be individualized, taking into account the potential benefits and risks for each patient [13][15].

The management and outcomes of septic shock can be significantly influenced by the intervention of a multidisciplinary team, composed of specialists such as intensivists, infectious disease specialists, nurses, and pharmacists. The multidisciplinary approach allows for a more

comprehensive and personalized assessment of the patient, which can result in more effective interventions and an overall better prognosis.

Intensivists are specialists in critical care and play a key role in the management of septic shock, as they can assess the need for ventilatory and hemodynamic support, as well as the possibility of surgical interventions [16]. Infectologists are specialists in infections and play a crucial role in the diagnosis and treatment of septic shock, who are responsible for identifying the etiologic agent of the infection, assessing antibiotic sensitivity, and recommending appropriate antibiotic treatment. In addition, infectious disease physicians can advise on infection control and transmission prevention measures [17].

Nurses are essential healthcare professionals in the day-to-day care of these patients, as they are responsible for assessing the patient's clinical status, administering medications, monitoring vital signs, providing specialized nursing care, and maintaining communication with the multidisciplinary team. In addition, these professionals can identify complications and evaluate the efficacy of therapeutic interventions [18].

Pharmacists play an important role in the management of septic shock by providing guidance on the selection, dosing, and administration of antibiotics and other medications, mitigating the adverse effects of medications, maximizing treatment effectiveness, and preventing antibiotic resistance. In addition, pharmacists can advise on drug interactions and help manage complex medication regimens [19].

In short, collaboration between these professionals allows for a more comprehensive and personalized assessment of the patient, which can result in more effective interventions and an overall better prognosis. However, these results are mixed and more research is needed to confirm this association and better understand the underlying mechanisms.

CONCLUSION

This study underscores the complexity of pneumonia and how it can progress to septic shock, a condition that can result in multi-organ dysfunction due to the body's generalized inflammatory response. It is critical to start treatment with broad-spectrum antibiotics quickly to control the infection. In addition, it is critical to carefully monitor and intervene in the inflammatory response. The study also emphasizes the importance of effective preventive strategies, such as vaccination and hygiene practices, to decrease the risk of pneumonia and its complications. A multidisciplinary approach to the treatment of septic shock, involving intensivists, infectious disease specialists, nurses, and pharmacists, is essential to improve patients' clinical outcomes. Future research should focus on personalized and innovative therapies that can reduce the morbidity and mortality rates associated with septic shock, as well as further investigate the predictive markers of risk and the

efficacy of corticosteroids as an adjunctive treatment. Ongoing research is crucial to develop new therapeutic approaches that can effectively prevent the progression of pneumonia to septic shock and provide a better quality of life for patients.

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Prophylaxis of preeclampsia in low-income adolescents: Protocols and challenges

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ABSTRACT

This paper addresses preeclampsia, a serious gestational complication marked by hypertension and proteinuria, with a focus on low-income adolescents. The research, a literature review, aims to identify risk factors, assess access to treatment, and explore preventive measures appropriate to this demographic. The methodology includes a review of previous studies in the Google Scholar, Scielo, and PubMed databases, covering publications from 2001 to 2024. The results underline the need for a personalized approach to treatment, reflecting individual variability in response to interventions. It is concluded that a deep understanding and careful management are vital to mitigate the risks associated with preeclampsia, improving treatment adherence and quality of life of affected adolescents.

Keywords: Preeclampsia, High-risk prenatal care, Pregnancy in adolescence, Hypocalcemia in pregnancy.

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INTRODUCTION

Preeclampsia is a serious complication of pregnancy characterized by the development of arterial hypertension and organ dysfunction in previously normotensive women[1]. It is defined by the onset of hypertension accompanied by proteinuria, which is the presence of protein in the urine[2] . Its diagnosis is based on the presence of high blood pressure (systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg) and proteinuria (≥300 mg in a 24-hour urine collection or a protein/creatinine ratio ≥0.3). [2]

In adolescents of low socioeconomic status, it is a multifactorial disease associated with biological, socioeconomic and medical-dental factors. In general, adolescent mothers have low socioeconomic status, low educational and cultural status, and are not legally married. The most common complications that affect the baby's health are associated with perinatal death, epilepsy, mental retardation, blindness, deafness, miscarriage, preeclampsia, anemia, infections, complications in childbirth and childcare, and emotional disorders. [3]

This study is a vital study, since preeclampsia is a serious complication in the women's puerperium that significantly affects low-income adolescents, increasing the risks of maternal and neonatal morbidity and mortality. Considering that the incidence of early pregnancy is higher in vulnerable populations, where access to preventive care is limited, it is essential to develop and evaluate prophylaxis protocols tailored to these young women to improve health outcomes and reduce inequalities.

The general objective of this study is to evaluate the impact of specific interventions in reducing the incidence and severity of preeclampsia in adolescents under 15 years of age with low socioeconomic status. The specific objectives outlined to achieve this goal include: To identify the main risk factors associated with the development of preeclampsia in adolescents under 15 years of age of low socioeconomic status. To assess the accessibility and suitability of healthcare facilities that provide treatment for preeclampsia for this demographic. To investigate the influence of nutrition and other behavioral factors on the risk and management of preeclampsia in adolescents. To study the barriers to compliance with prescribed treatments and propose solutions to improve adherence to treatment among adolescents. To propose and evaluate the implementation of a multidisciplinary care model for the treatment of preeclampsia in adolescents and to evaluate the role of family support networks.

METHODOLOGY

The present work consists of a literature review that sought to address results found in research on the theme in question, either in a comprehensive, orderly or systematic way. Focal points include Epidemiology of Preeclampsia in Adolescents, Symptomatology, Risk Factors, Diagnostic

Methods, Access to Maternal Health Care, Nutrition and Preeclampsia, Psychosocial Aspects of Pregnancy in Adolescents, and Multidisciplinary Models of Care.

The inclusion criteria for this view include specifically investigating the Prophylaxis of Preeclampsia in Low-Income Adolescents: Protocols and Challenges. Any studies that do not directly address these aspects will be excluded.

To carry out the search, several electronic databases will be used, such as Google Scholar, Scielo and PubMed. The keywords chosen will align with the specific objectives of the study and will include terms such as "Preeclampsia", "high-risk prenatal care", "Pregnancy in adolescence", "Hypocalcemia in pregnancy" and other pertinent terms.

The study selection process will follow a qualitative and descriptive methodology. Initially, abstracts that seem to meet the inclusion criteria will be identified. Subsequently, the full articles will undergo a thorough review to assess their adequacy and relevance to the objectives of the study. Throughout the data extraction process, information pertaining to preeclampsia prophylaxis will be collected, including documented symptoms, diagnostic approaches, and the effectiveness of various treatment strategies.

When assessing the quality of studies, their methodological rigor, clinical significance, and timeliness will be carefully considered. It is important to note that this review will only cover articles published from 2009 to 2024, which may result in the exclusion of previous research, but ensures that the information analyzed is current and relevant. In addition, the analysis will be limited by the specific terms and languages used in the searches, potentially leading to the omission of pertinent studies that do not align with the designated keywords.

RESULTS AND DISCUSSION

In addition to high blood pressure and proteinuria, symptoms of preeclampsia include generalized edema, oliguria, cyanosis, visual disturbances, headache, epigastric pain, among others. [4] Preeclampsia is a pregnancy-related condition that affects both the mother and the fetus. Prevalence in adolescents varies globally and regionally, with socioeconomic factors playing a significant role. According to a study published in the Journal of Pregnancy, adolescent women in low- and middle-income countries (LMICs) are more likely to develop preeclampsia compared to those in high-income countries (HICs) [5]. The study found that its prevalence in adolescent women in LMICs was 7.5 percent, while in HICs it was only 2.6 percent. The study also found that young people in rural areas of LMICs were at higher risk of developing it than those in urban areas[5]. This difference can be attributed to the lack of access to adequate health services in rural areas, which can lead to delays in the diagnosis and treatment of this condition. In addition, the study found that

pusbecants with low socioeconomic status were more likely to develop preeclampsia than those with high socioeconomic status[5].

Risk factors related to the occurrence of preeclampsia include chronic arterial hypertension, advanced maternal age, obesity, family history of preeclampsia, nulliparity, multiple pregnancy, preexisting diabetes mellitus, and previous history of preeclampsia.[6] Additionally, it is important to note that according to Genivaldo Moura da Silva, women with periodontitis have nine times the risk of developing preeclampsia compared to those with healthy periodontal tissues. [7]

In addition, it is essential to emphasize that preeclampsia can cause maternal complications, such as placental abruption, coagulopathies, renal failure, pericardial effusion, and pulmonary edema.[8] Moreover, it increases the risk of acquiring future cardiovascular diseases in the mother. In addition, in the neonate, it can cause complications, such as low birth weight, preterm, fetal growth restriction, and respiratory problems.[9] In summary, preeclampsia can have both short- and long-term negative effects for both mother and neonate. It is important that pregnant women are accompanied by qualified health professionals to identify and manage the disease as early as possible, minimizing the risks to both mother and baby.

Therefore, it was evidenced that home blood pressure monitoring in pregnant women at high risk of preeclampsia can enable early diagnosis and optimize prenatal care.[10] Therefore, primary care clinicians can effectively diagnose and manage hypertensive diseases of pregnancy, including preeclampsia, in prenatal and postnatal women.[11] Thus, Basic Health Units (BHUs) play an essential role in the early detection and prevention of these conditions, ensuring maternal and fetal health during pregnancy.

Primary prevention strategies include 100 mg of acetylsalicylic acid (ASA), and calcium carbonate supplementation, which should be started at specific gestational ages.[12] In the context of adolescent pregnancy, there is no specific information on the prevention of preeclampsia. However, teenage pregnancy is associated with higher rates of prematurity and low birth weight, which are also complications of preeclampsia.[13] Therefore, it is important for health professionals to consider the increased risk of this condition in these patients and to implement appropriate prevention strategies, such as ASA and calcium, especially for those with other risk factors, as it has been shown that the consumption of these drugs in low doses for 9 weeks during pregnancy significantly reduced serum levels of high-sensitivity C-reactive protein and oxidative stress.[14]

The multidisciplinary approach includes the development of nursing care protocols and the use of specific scales for symptom assessment, such as the Prenatal Follow-up Symptom Scale among pregnant women with preeclampsia (PPSC), which helps predict the worsening of the condition and the appearance of complications.[15] The use of a graphical tool to monitor the care

provided to pregnant women with preeclampsia and eclampsia has also improved the quality of care and documentation.

The importance of understanding the pathophysiology of preeclampsia is also discussed, which contributes to the work of health professionals, especially nurses.[16] In addition, the article highlights the need for high-quality care, including timely prenatal care, regular blood pressure monitoring, and detection of proteinuria, as well as the need for appropriate diagnostic testing and treatment of hypertension.[16] In cases of severe preeclampsia or eclampsia, the use of magnesium sulfate is recommended for prevention and treatment of seizures, and antihypertensive drugs are recommended for treatment.[17]

In summary, the multidisciplinary approach to preeclampsia involves a comprehensive, evidence-based approach to care, including early identification, appropriate nursing care, use of specific scales to assess symptoms, and use of appropriate medications for crisis prevention and treatment. However, these results are mixed and more research is needed to confirm this association and better understand the underlying mechanisms.

CONCLUSION

This study highlights the complexity of preeclampsia, which in addition to the classic symptoms of high blood pressure and proteinuria, includes a number of signs that can complicate the clinical picture and management of the condition. In the context of adolescent pregnancy, regional differences in prevalence and the impact of socioeconomic factors are particularly significant, reflecting inequalities in access to health care that may delay diagnosis and effective treatment. While prevention strategies such as the use of acetylsalicylic acid and calcium supplementation are promising, a more personalized approach that takes into account the individual characteristics of pregnant women, such as their socioeconomic conditions and accessibility to health services, is crucial. In addition, the need for future research to develop more effective methods of prevention and treatment is evident, aiming at a more effective and safer management of preeclampsia.

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Drills physical changes after osteotomies and sterilization

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ABSTRACT

Some research suggest that the good condition of the drills used in osteotomies for dental implants is fundamental to a minimally invasive surgical technique, decreasing the temperature when preparing the surgical area. Objective: Analyze the wear of the drills used in osteotomies for dental implants, comparing the physical changes of the groups and types of coatings after their use, as well as evaluating the difference in these changes with and without sterilization. Ninety-six drills were used, 48 of which were spear-type (24 steel and 24 Diamond like carbon (DLC)) and 48 helical-type (24 steel and 24 DLC), divided into four groups: (G0), (G1), (G2) and (G3), with 0, 45, 90 and 135 osteotomies, with and without sterilization, evaluated by scanning electron microscopy (SEM). In this study, were used bovines ribs, with dimensions of 20cm in length, for osteotomies. Results: Wear of the drills after 90 osteotomies, p-value < 0.001; no evidence was found about the wear related to the sterilization process; and better performance of the steel twist drills in group G2 compared to the DLC twist drills in the same group, analyzed using the Mann-Whitney and Friedman statistical tests, as well as Dunn's post hoc test. Conclusion: Considering the wear and tear on the drills, their reuse is safe for up to 90 osteotomies.

Keywords: Dental Implants, Stainless Steel, Osteotomy, Sterilization.

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INTRODUCTION

The implantology is based on strong pillars, and in 2015, your consolidation will be 50 years, serving as a pivotal tool for oral rehabilitation. Studies conducted on dental instruments used in implants osteotomies describe the direct relationship between damages occurring in them and the increase in surgical trauma, resulting in increase the local heat above 47°C, and this heat is hardly dissipated due to physiological characteristics of the oral cavity bone, short bone with a considerable cortical layer, leading to an increase of tissue necrosis area due to the low thermal conductivity, resulting in greater local fibrosis and reduced initial implant stability (Barbosa, 2009; Carvalho et al., 2011; Chauhan et al., 2018; Eriksson et al., 1996; Iyer et al., 1997; Mendes et al., 2014; Santos et al., 2014; Sartori et al., 2012; Vasconcelos, 2012).

Considering the specific bone characteristics present in the oral cavity, the abundantly irrigate is essencial in all the surgical process of osteotomies, as it has been observed and proven that profuse irrigation tends to reduce the heat production, what is harmful to tissue healing process (Gehrke et al., 2013; Omar et al., 2023; Tur et al., 2020).

However, the research conducted by Santos et al. (2014) and Migliorati et al. (2013) found that even using the appropriate irrigation, the guided surgeries experience a higher temperature elevation during the osteotomies compared to the conventional surgeries. Researchers attribute this phenomenon of thermal elevation to the obstacle provided by the surgical guide, as well as to artifacts or instruments used during the procedure, even with sufficient irrigation.

Strbac et al. (2014a, b) emphasize that irrigation should be done from the tip of the drills, justifying that this is the best option for osteotomies with working lengths greater than 10mm.

Research by Scarano et al. (2011) revealed that another factor influences the increase in temperature during osteotomies, increasing the possibility of tissue necrosis. They point to the shape of the drills as this factor and state that conical-shaped drills promote lower milling temperatures when compared to cylindrical-shaped drills.

There is a consensus that increased tissue necrosis results in longer tissue repair time at the surgical site, and minimizing these negative effects also involves correct instrument maintenance. It is clear that the quality of dental instruments is of paramount importance when aiming for greater success in implant treatments (Bertolete, 2009; Comar, 2006; Cordioli et al., 1997; Junior et al., 2007; Matthews et al., 1972; Paterno et al., 2011; Junior et al., 2007). In this sense, the most frequent finding in the studies carried out is that the deformation of the drills is directly proportional to their use (Chauhan et al., 2018; Mendes et al., 2014; Santos et al., 2014; Sartori et al., 2012).

The coatings of dental drills used in dental implant surgery also interfere in this modification process, since depending on the material used in its composition, it will offer greater resistance to corrosion and deformation resulting from use (Ciuccio et al., 2010).

The aim of seeking high resistance in drills is to reduce wear by minimizing friction with adjacent tissues. Diamond-Like Carbon, commonly known by the acronym DLC, stands out in this universe of drill bit materials. This material has been widely used in medicine and dentistry due to its biocompatibility, hemocompatibility and lack of cytotoxicity (Dearnaley et al., 2005; Roy et al., 2007).

Attention is drawn to important assertions that have been widely discussed in studies on the subject: heating of the bone as a result of osteotomy procedures can lead to necrosis in the cortical area and/or affect the entire tissue region; the extent of necrosis varies according to factors such as irrigation and temperature control; and the repeated use of drills during preparation of the recipient site can increase wear, reducing drilling efficiency (Mendes et al., 2014; Santos et al., 2014; Sartori et al., 2012).

Another important point that deserves consideration, as it is commonly approached empirically, are the guidelines that underpin the surgeon's decision to replace the drills or surgical kit (Sharma et al., 2014), especially in relation to a number of uses greater than 100 times. It is necessary to understand the drill wear process in order to establish disposal parameters that minimize the deleterious effects of inappropriate reuse (Mishra et al., 2014) or the mistaken disposal of still viable instruments, which could increase treatment costs.

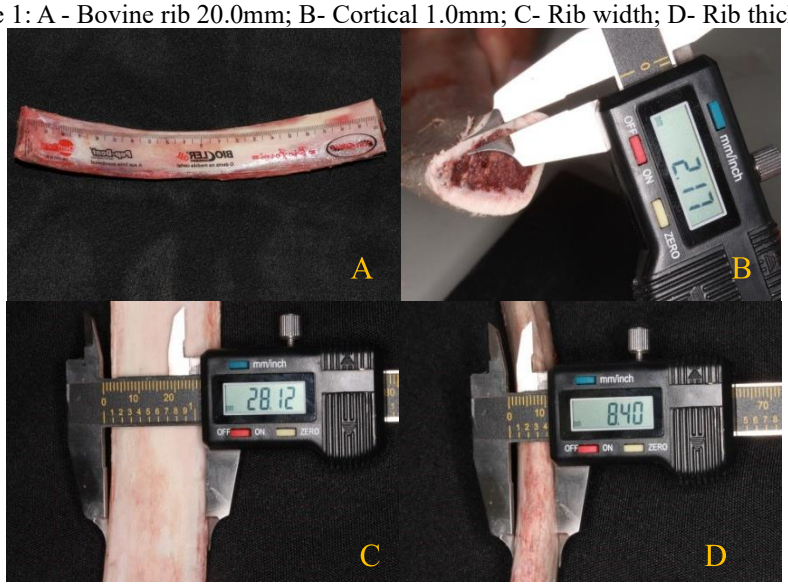
Therefore, in addition to researching the physical alterations of the drills due to use, an investigation was also carried out into the physical alterations of the drills when they were subjected to the cleaning and sterilization process. These reprocessing procedures are necessary to safeguard against biological contamination.

MATERIALS AND METHODS

STUDY DESIGN

This descriptive experimental study used bovine ribs obtained from a butcher's shop, from a previously slaughtered animal (Ercoli et al., 2004; Mendes et al., 2014; Queiroz et al., 2007; Sartori et al., 2012), where 65 units were selected based on the following inclusion criteria: length of at least 20 centimeters, at least 1 millimeter of cortical dimension surrounding the specimen, width over 27 millimeters and thickness greater than 8 millimeters (Figure 1). The measurements were taken using a digital caliper with a precision of 0.01mm (Model 500-144B - Mitutoyo - Brazil), and the ribs that did not meet the inclusion criteria were discarded.

Figure 1: A - Bovine rib 20.0mm; B- Cortical 1.0mm; C- Rib width; D- Rib thickness.



Source: Authors (2024)

This animal model was chosen due to its good bone density and balance between the cortical and medullary portions, similar to the human mandibular bone (Mendes et al., 2014; Sartori et al., 2012). The ribs had the soft tissue and periosteum removed, the epiphyses discarded and were refrigerated at a temperature of 5°C.

It should be noted that the proposed project complies with Resolution No. 196, of October 10, 1996, of the National Research Ethics Council, and before being implemented, it was submitted to the Animal Research Ethics Committee of the Bahiana School of Medicine and Public Health, under number 0001/2014, and obtained unanimous approval for its execution without restrictions on May 22, 2014 (Annex 1).

Before performing the osteotomies, the ribs were thawed by immersion in saline solution (0.9% NaCl) and heated until their temperature was similar to the human body temperature of 37°C.

As a device for irrigation and milling, an electric motor (Surgic XT, Neodent, Curitiba, PR, Brazil) was selected, consisting of an attached peristaltic pump, allowing the use of irrigation at a speed of 1200rpm and a torque of 35N for the surgical preparation of the alveolus (Gehrke et al., 2013), and a 20:1 reduction contra-angle (NSK, Suzano, São Paulo, Brazil). Profuse external irrigation with 0.9% sodium chloride solution (Segmenta, Ribeirão Preto, São Paulo) was carried out throughout the preparation. Osteotomies were performed by a single calibrated operator. The contra-angle was coupled to an adapted mechanical arm with vertical movement (Figure 2), which provided constant guided pressure (Mendes et al., 2014; Sartori et al., 2012).

Figure 2: A- Contra angle attached to the verticalizer; B- Steel and DLC drills; C- Drilling length 7.0mm.



Source: Authors (2024)

Ninety-six TitaniumFix drills (São José dos Campos, São Paulo, Brazil) were used, 24 of which were steel spear drills, 24 steel spear drills with Diamond-Like Carbon (DLC) coating, 24 steel twist drills and 24 twist drills with DLC coating (Figure 2). The steel drills are characterized by a steel structure and titanium nitride (TiN) coating, and the DLC drills have a stainless steel structure and diamond-like carbon coating, both types of drill have a diameter of 2.0 mm and were used for bone drilling at a constant depth of 7.0 mm (Figure 2).

As an evaluation methodology, the set of drills was divided into four groups:

Group G0 (control), made up of 24 drills with a diameter of 2.0mm (06 Titanium Nitride (NiT) coated steel spear drills, 06 DLC carbon coated steel spear drills, 06 steel twist drills with Titanium Nitride coating and 06 steel twist drills with carbon DLC coating, which had never been used in osteotomies, subdivided into subgroups G0A and G0B respectively without sterilization, only cleaned with gauze and sterilized.

Group G1, similar to the previous group, represented 45 osteotomies subdivided into subgroups (G1A and G1B), where the drills in the subgroup (G1A) were subjected to 90 perforations without being sterilized, and those in the second subgroup (G1B) were sterilized.

Group G2 consisted of the same group of drills as the previous ones, which were used 90 times in osteotomies, also subdivided into subgroups (G3A and G3B), where the drills in subgroup (G3A) underwent 90 perforations without being sterilized, and the second subgroup (G2B) was sterilized.

Group G3, similar to the previous groups, was used 135 times in osteotomies, also subdivided into subgroups (G3A and G3B), where the drills of subgroup (G3A) were subjected to 135 perforations without being sterilized and the second subgroup (G2B) sterilized.

The colors were assigned to the groups according to Table 1.

Table 1: Colors referring to the groups worked on.

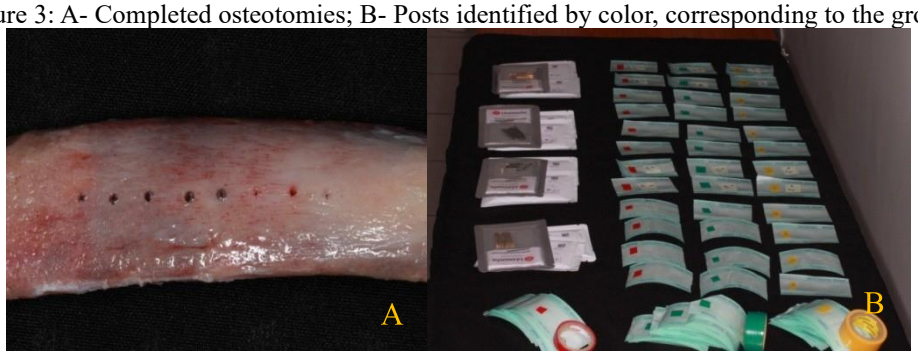
G1	
G2	
G3	

It is worth noting that the common characteristics between the groups were initially evaluated using the control group (G0) as a reference, without any mechanical stress, and at the end of using all the samples from the three groups, they were compared.

LABORATORY PROCEDURES

As a laboratory procedure, a sequence of milling groups was followed with simple randomization, following the sequence of: first, a spear drill preceding all the milling, and then the use of a twist drill. The spear drill aimed to traverse the external cortical bone to a pre-established depth of 7.0mm in milling length, followed by a 2.0mm twist drill to a depth of 7.0mm, completing the osteotomy (Figure 3). All the drills were subjected to microphotography.

Figure 3: A- Completed osteotomies; B- Posts identified by color, corresponding to the group.



Source: Authors (2024)

After milling, each drill used was placed in a "post" and, after all the milling, they were redistributed into their specific groups; in relation to the corresponding groups to be sterilized, they were subjected to chemical processing and a specific sterilization step, completing the pre-established sequence for each of the groups (Figure 3).

STERILIZATION PROCEDURES

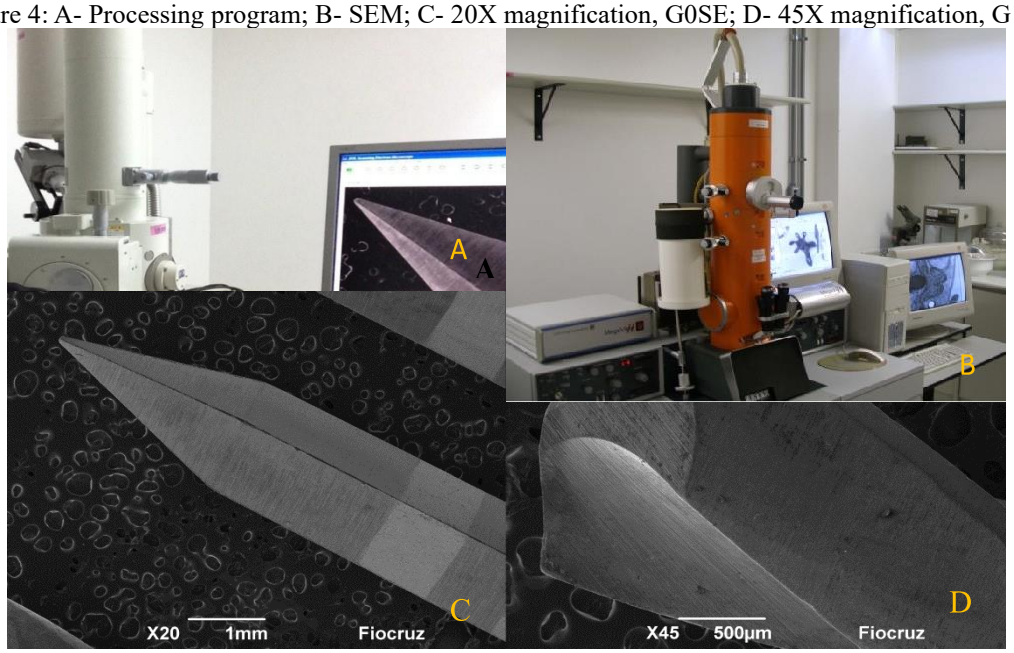
With regard to the disinfection and sterilization process, according to the guidelines adopted by the Bahian School of Medicine and Public Health (EBMSP), the instruments first go through a pre-washing, decontamination and rinsing process. Pre-washing is initially carried out by manual cleaning, which consists of immersing the material in a basket inside a container containing the enzymatic detergent Liquizime-Ruhof (Mineola, New York, USA) for a period of 3 minutes. The material is then washed with Atol neutral liquid detergent (Amparo, São Paulo, Brazil) using brushes.

The material is then rinsed and dried with clean cloths. At the end of these stages, the material is placed for sterilization in individual packages, envelopes of surgical grade paper associated with laminated polypropylene films (post). For the sterilization process, a moist heat autoclave (Cristófoli, Campos Mourão, Brazil) was used at a temperature of 127ºC, with sterilization cycles of 40 minutes and 15 minutes of drying.

MICROSCOPY PROCEDURES

The drills of the control group, G0A and G0B, were submitted to microscopy, and the other groups, after reaching the pre-established limit of osteotomies for each group and sterilization, were sent to the Electron Microscopy Service of the Oswaldo Cruz Foundation (FIOCRUZ), Gonçalo Moniz Research Center. The drills were stabilized with double-sided carbon tape on the sample evaluation table for analysis by scanning electron microscopy (SEM), JOEL JSM-6390LV, 3 nm resolution at 30 Kv (high vacuum mode) and 4nm at 30Kv (low vacuum mode), with a microanalysis system (Figure 4).

Figure 4: A- Processing program; B- SEM; C- 20X magnification, G0SE; D- 45X magnification, G1SE.



Source: Authors (2024)

Word Distance (WD) = 38, Spot Size (exit from the column tip to the sample) = 40, and Acceleration voltage = 8 were used as references, and 45x and 20x magnifications were made using the Sem Main Menu program and photomicrographs of the respective images were taken (Figure 4).

The drills were analyzed and compared with the parameters extracted from the control group (G0). The qualitative damage parameters were established according to the table 2 below:

Table 2: Qualitative damage parameters.

SCORE	TYPE OF CHANGE	CODE
0	No change	AA (No Change)
1	Presence of grooves, cracks and delamination	AI (Initial Change)
2	Presence of a crater	AM (Media Change)
3	Shape Deformation	AMX (Maximum Change)

STATISTICAL METHODS USED

The statistical analysis of the results obtained was carried out using the so-called "non-parametric statistical tests", Mann-Whitney and Friedman for paired samples, which are tests to define the level of similarity or difference between two moments in the same sample or population, and Dunn's test was used for significant differences between pairs. This last test studies the differences between two situations in the same population to assess significance.

The database was created in Excel 2003 and analyzed in R Software (version 3.1.2). A descriptive analysis (median and quartiles) was carried out to identify the general and specific characteristics of the sample studied.

RESULTS

Evaluating the overall level of wear of the drills after use, Friedman's statistical analysis and the evaluation of significant differences between pairs using Dunn's post-hoc test showed that there was physical alteration of the drills in group G3. A p-value < 0.001 was obtained for the association between group G3 and the other groups, determining that the drills in this group had suffered significant wear (Table 3).

The table below shows the statistical significance of the physical changes suffered, both for the G3A group drills used up to 135 times without being sterilized, and for those that underwent the sterilization process (G3B), $p < 0.001$ comparing them with the other groups. However, no significant changes were observed between the G0, G1 and G2 groups (Table 4).

The superscript letters a and b in Tables 3 and 4 indicate that there was no statistically significant difference between the groups with similar letters, but between the groups with different letters, there was a difference characterized by a p-value < 0.001.

Table 3 - Correlation between drill wear and number of uses.

	Variables	Median	Q1-Q3
	Control	0^a	0-0
Osteotomy 45	0^a	0-0	
Osteotomy 90	0^a	0-1,0	
	Osteotomy 135	$2,5^b$	1-3
	p-valor	**<0,001**	

a,b Different letters indicate significant differences between pairs by Dunn's test.

Table 4 - Correlation between drill wear, number of uses and influence of sterilization

Sterilization					
	No		**Yes**		**p-value**
Variables	**Median[1]**	**Q1-Q3**	**Median[2]**	**Q1-Q3**	
Control	0^a	0 – 0	0^a	0 - 0	**1,000**
Osteotomy 45	0^a	0 – 0	0^a	0 - 0,75	**0,514**
Osteotomy 90	0^a	0 - 0,75	$0,5^a$	0 - 2,5	**0,242**
Osteotomy135	2^b	1 – 3	$2,5^b$	2,0 - 3,0	**0,514**
p-value	**<0,001**		**<0,001**		

[1,]2 Different letters in the columns indicate significant differences between the pairs using Dunn's test.

[a,b] Different letters indicate significant differences between pairs according to Dunn's test.

Analysis of the SEM images showed that after 45 osteotomies there was little wear on the drills; however, the LC drills showed signs of geometric deformation at the active tip, but this was not statistically significant. Analysis of the microphotographs of the steel drills showed a more regular surface image compared to the carbon drills. However, there were no statistically significant differences.

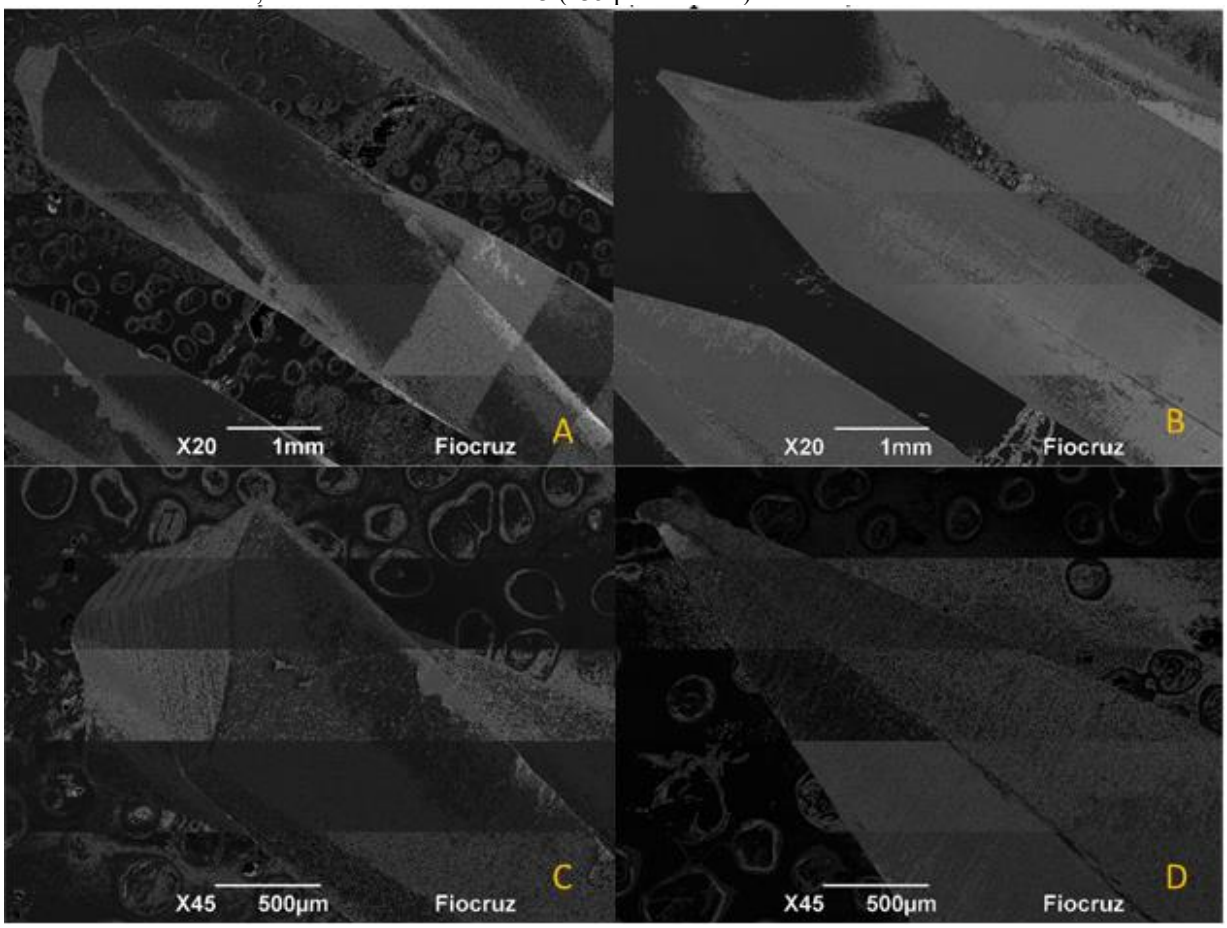
The existence of physical change in the groups was confirmed after SEM analysis. This loss occurred gradually after 45 osteotomies and was directly proportional to the number of perforations made.

No wear was seen in the G1 group, while that seen in G2 was recorded mainly as cracks and grooves. There were also no significant changes between the sterilization subgroups compared to the non-sterilization subgroups. Cracks and grooves were observed in scanning electron microscopy by checking for the presence of deformation zones in the samples. Substrate loss or delamination was more strongly confirmed in the DLC twist drills of Group G3.

Further analysis of Table 2 allows comparisons to be made between drills from the same group, evaluating their subgroups with the p-value of this comparison represented in the rows of the table, and in the columns, a comparison between the times, also with the p-value recorded.

Some deformations were evident in the SEM, such as the deformation suffered by an LA drill from G3, which revealed an active tip with maximum change in shape; and a carbon twist drill showing craters, suggesting it was contraindicated for reuse (Figure 5).

Figure 5: A- Carbon helical drill with crater-type wear; B- Steel spear drill with no wear; C- LA, G3 without sterilization and with AMx deformation; D- Carbon helical drill G3 (135 perforations).



Source: Authors (2024)

Between the steel and carbon twist drills after milling, regardless of sterilization, there was a significant difference after the osteotomies applied in Group G2, where the HC showed evidence of wear, and this obtained a $p = 0.015$ and $p < 0.05$. (Tables 5 and 6).

Table 5 - Correlation between helical drills and number of uses.

	Type of drill				
	HA		**HC**		**p-value**
Variables	**Median**	**Q1-Q3**	**Median**	**Q1-Q3**	
Control	0	0 – 0	0	0 - 0	**1,000**
Osteotomy 45	0	0 – 0	0	0 - 0	**1,000**
Osteotomy 90	0	0 – 0	1	0,75 – 1	**0,015**
Osteotomy135	1,5	1 – 2,25	1,5	1- 2,25	**1,000**

Table 6 - Correlation between helical drills and the number of uses without sterilization.

Type of drill					
	HA		HC		p-value
Variables	Median	Q1-Q3	Median	Q1-Q3	
Control	0	0 – 0	0	0 - 0	1,000
Osteotomy 45	0	0 – 0	0	0 - 0	1,000
Osteotomy 90	0	0 – 0	1	0 - 1	0,200
Osteotomy135	1	1 – 3	1	1- 3	1,000

In the images of Group G2 (90 osteotomies), although there was no significant difference ($p > 0.05$) in most of the evaluations, there were areas where there was a process of delamination, which is the physical separation of part of the metal of an instrument (Sastry et al., 2014) from the coating on the surface of the HC drill, as well as signs of changes in the cutting edge of the HC drills when compared to the HA, $p < 0.05$.

Evaluating the twist drill groups after milling without sterilization, in the table above, it can be seen that there was no significant difference between the twist drills. However, there was a specific change in the HC group after 90 osteotomies and sterilization, as shown in Table 7.

Table 7 - Correlation between helical drill coatings, number of uses and sterilization.

Type of drill					
	HA		HC		p-value
Variables	Median	Q1-Q3	Median	Q1-Q3	
Control	0	0 – 0	0	0 - 0	1,000
Osteotomy 45	0	0 – 0	0	0 - 0	1,000
Osteotomy 90	0	0 – 0	1	1 - 1	0,100
Osteotomy135	2	1 – 2	2	1- 2	1,000

Comparing the coatings of the lanced drills of the proposed groups, no difference was found between these types of drills, even after evaluation of the experiment with sterilization and statistical analysis (Table 8).

Table 8 - Correlation between spear drills and number of uses.

Type of drill					
	HA		HC		p-value
Variables	Median	Q1-Q3	Median	Q1-Q3	
Control	0	0 – 0	0	0 - 0	1,000
Osteotomy 45	0	0 – 0	2	0 - 2	0,065
Osteotomy 90	0	0 – 0	2,5	0 - 3	0,065
Osteotomy135	3	3 – 3	3	1- 3	0,394

With regard to the wear caused by the sterilization process, the DLC lance drills in G2 showed deformation of the cutting region and small areas with signs of coating loss on the active tip, although this was not statistically significant ($p > 0.05$). (Tables 9 and 10).

Table 9 - Correlation between lance drills, number of uses and sterilizations.

Type of drill					
	HA		HC		p-value
Variables	Median	Q1-Q3	Median	Q1-Q3	
Control	0	0 – 0	0	0 - 0	**1,000**
Osteotomy 45	0	0 – 0	3	1 - 3	**0,100**
Osteotomy 90	0	0 – 0	3	3 - 3	**0,100**
Osteotomy135	3	3 – 3	3	3- 3	**1,000**

Table 10 - Correlation between spear drill coatings, number of uses without sterilization.

Type of drill					
	HA		HC		p-value
Variables	Median	Q1-Q3	Median	Q1-Q3	
Control	0	0 – 0	0	0 - 0	**1,000**
Osteotomy 45	0	0 – 0	0	0 - 3	**0,700**
Osteotomy 90	0	0 – 0	0	0 - 2	**0,700**
Osteotomy135	3	3 – 3	1	1- 3	**0,200**

DISCUSSION

In a study similar to this one, carried out by Sartori et al. (2012), which aimed to comparatively evaluate the deformation, roughness and loss of mass of three types of dental drills made of different materials, all used in osteotomies for the installation of osseointegratable implants, structural loss occurred from the initial group onwards, which differs from this one in that it was visualized from G2 onwards.

The studies by Sartori et al. (2012), Mendes et al. (2014) and Santos et al. (2014) concur with the statement that there is a correlation coefficient between the reuse of drills and their deformation.

With regard to the study by Sartori et al. (2012), they carried out visual verification tests using SEM, which revealed areas of deformation in all the 2.0mm samples and irregular deformation in the 3.0mm samples.

Sartori et al. (2012) concluded that in all groups there was a loss of cutting power after the 40th drill for 2.0mm drills; there were wear marks in all groups of 2.0mm drills when compared to 3.0mm drills, similar to the present study which observed initial wear from the 45th drill, in carbon-coated drills, but without significance. Similarly, Chauhan et al. (2018) observed in their systematic review that drills should not be used for more than 40 osteotomies, recommending the use of sharp drills to minimize surgical trauma.

It can be seen that this maximum limit of drills varies greatly between studies, as cited by Oliveira et al. (2012), Carvalho et al. (2011) and Allsobrook et al. (2011), where the limit is raised to more than 50 drills, as they state that before this, there is no production of temperatures harmful to bone tissue or even serious signs of wear and deformation of the drills.

Mendes et al. (2014) evaluated the influences on implants resulting from the wear, deformation and roughness of the drills after repeated drilling and sterilization processes. For this purpose, they used drills made of three different materials, which were grouped as follows: G1 -

stainless steel; G2 - DLCoated (diamond-like carbon coated); and G3 - zirconia. These groups were further subdivided into five subgroups 1, 2, 3, 4 and 5, which corresponded, respectively, to the minimum use of drills 0 (not used), 10, 20, 30 and 40 times.

Subsequently, in the study by Mendes et al. (2014), the drills were washed with water, dried with compressed air jets and sterilized in an autoclave at 127°C for 40 minutes. It is worth noting that mass, SEM and roughness measurements were taken before and after the drilling procedure and sterilization cycles in each of the groups and subgroups. The results of the study revealed that the drills of the three groups, with their respective subgroups, did not show significant differences in mass, however, in this study, the sterilization process took place after a series of five osteotomies.

Although greater wear processes were observed in the carbon twist drills than with the same type of steel drill, this result contradicts what was found in a study by Allsobrook et al. (2011), where the drills made with tungsten carbide coating obtained the following performance: lower drilling temperatures, less plastic deformation and surface corrosion.

However, Mendes et al. (2014), in the SEM analysis, observed that all the drills showed signs of wear characterized by damage to the cutting surface. At the end of the experiment, the author concluded that, collectively, no significant differences were detected in relation to the mass and roughness of the drills; however, repeated use of the drills increases wear, reducing cutting efficiency and, consequently, increasing the heat of friction, similar to the present experiment.

With regard to the comparative analysis of the drills used in the preparation of the surgical socket, the sterilization method proposed in this study is in line with the work of Ciuccio et al. (2010) and Fais et al. (2011), who state, respectively, that the heat treatment applied to dental drills gave them resistance to autoclaving and corrosion, and that the method proposed for cleaning and disinfecting the instruments, studied and employed here, causes little damage to the cutting efficiency compared to other methods.

According to Alevizakos et al. (2021), the sterilization process can affect the main cutting edges of the drill; however, in order to gain a better understanding of the relationship between implant holder preparation and the influence of sterilization on drill performance and wear, further studies are required.

It was also evident in this study that there is greater change in spear drills compared to twist drills. The same can also be confirmed in the study by Carvalho et al. (2011), where the greatest thermal change was seen in the preparation of the surgical bed with the spear-type drill due to its association with the wear suffered.

The research by Santos et al. (2014), which aimed to evaluate and compare bone heating, drill deformation and changes in roughness after osteotomies for dental implants, used 20 rabbit tibias, divided into two groups: CG - control group and GG - guided surgery. This GG group was

subdivided into five subgroups called GO, G1, G2, G3 and G4, corresponding respectively to the number of times the drill was used: 0, 10, 20, 30 and 40. In the study in question, after using the drills, the thermal changes were evaluated and it was observed that there was a significant change in temperature in GG and that the deformation of the drill was progressive, proportional to use.

At the end of the study, Santos et al. (2014) made the following extremely relevant comments: they stated that the bone heating generated during osteotomy procedures can cause necrosis in the cortical area and/or affect the entire tissue region; they stated that the extent of necrosis varies according to factors such as the osteotomy, and that irrigation directly controls the temperature; stated that the repeated use of drills during the preparation of the recipient bed can increase wear, reducing the effectiveness of drilling and causing more friction; emphasized that the guidelines that support the dentist's decision to replace the drill are still very empirical; and, finally, concluded that guided surgery can limit irrigation within the active point of the drill.

CONCLUSIONS

Within the limitations of this study and based on the methodology followed, it can be concluded that: The physical changes of the drills were significant after 90 osteotomies. The TiN-coated steel twist drills in G2 showed lower levels of wear than the DLC-coated drills in the same group. The sterilization process did not generate statistically significant changes in the groups studied.

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ANNEX

ANNEX 1

Ethics Committee Approval

BAHIANA
ESCOLA DE MEDICINA E SAÚDE PÚBLICA
COMISSÃO DE ÉTICA NO DE USO DE ANIMAIS

Ofício 03/2014.
Salvador, 22 de maio de 2014.

A **Comissão de Ética no Uso de Animais – CEUA** da Escola Bahiana de Medicina Saúde Pública, após recebimento do protocolo de pesquisa 001/2014, intitulado "**Avaliação da alteração física das fresas após osteotomias e esterilização**", sob a responsabilidade da Profª. Drª. Lívia Prates Soares Zerbinatti, defere pela abstenção do julgamento fundamentado nas orientações fornecidas pelo CONCEA (*vide* em anexo), visto que, até o momento, inexiste uma normativa que regulamente a utilização de peças oriundas de animais criados para fins alimentícios, com finalidade secundária de pesquisa.

PARECER FINAL:
Legitimamos o registro das informações fornecidas e deferimos positivamente quanto a realização do presente projeto.

Prof. Dr. Diego Menezes
Presidente da Comissão de Ética no Uso de animais Escola Bahiana de Medicina e Saúde Pública (CEUA-EBMSP)

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Use of the essential oils of *Lavandula angustifolia* Mill. in the treatment of anxiety: Systematic review of the literature

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ABSTRACT

Traditional knowledge about the use of medicinal plants is fundamental, but it is equally important to highlight scientific research based on academic tools. This article is a systematic review of the literature on the effects of lavender essential oil (EO) in the treatment of anxiety. The methodology used was the search for scientific articles using keywords Lavender, herbal medicines, aromatherapy, anxiety, alone or together in the Google Scholar, Lilacs, PubMed and Scielo databases, without a determined period, including complete studies with conclusive results that addressed the theme directly and excluding inconclusive articles, reviews or articles that did not directly address the proposed theme. We describe here the results presented by the authors and their conclusions about the benefits of this essential oil from a clinical and therapeutic point of view.

Keywords: Alternative medicine, Medicinal plants, Anxiety, Aromatherapy.

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INTRODUCTION

The human species has used plants as tools in natural therapy methods since ancient times [1]. With the advance of industrialization, products extracted from plant matter have gained prominence in the medicinal area, with the intention of assisting in human health.

Alternative medicine has been using essential oils for several decades to relieve the symptoms of various mental health-related problems [2]. The enormous advance of therapeutic practices that use natural resources in the treatment of diseases is visible, arousing the interest of professionals in this area of science [3][4].

Traditional science has collaborated in the formulation of pharmaceutical medicines, using medicinal plants and their therapeutic properties as material. According to the World Health Organization (WHO), medicinal plants with characteristics considered beneficial to human health are used by 80% of the population, seeking to relieve injuries or negative symptoms in the body, since these natural medicines are easily accessible and less expensive [5].

Also according to the WHO, medicinal plants are understood as any native or cultivated plant organism used for phytotherapeutic purposes, due to active ingredients, which, when applied correctly, act with the purpose of medicating human health [5].

The use of medicinal plants is a common practice among people as a way to improve their quality of life, but there is still a huge gap between the use and scientifically proven information about different properties of plants, considering that knowledge about this type of organism is still precarious for the population in general. The dissemination of knowledge about different properties of plants and how to identify them is extremely important for the preservation and conservation not only of traditional knowledge, but also of biodiversity [1][6].

Anxiety is characterized as a disease of the 21st century, and together with depression it is considered a serious health problem, affecting a large part of the population [7]. Anxiety is an emotional state that comprises both psychological and physiological components, constituting a set of different human experiences and responsible for stimulating performance [8].

A disorder is understood when the affected individual is unable to develop skills or activities, interfering with their daily life [9]. Anxiety is an adjunct problem of various degrees of discomfort, which can cause personal problems such as racing thinking, insomnia, difficulty concentrating, among other health problems [10].

In Brazil, about 9% of the population suffers from anxiety disorder, and on average 3% of the world's population has some degree of this disorder [11].

In this scenario, there is an increase in treatments for anxiety by alternative medicine, such as medicinal plants, widely used and known for their role in therapy, as the active ingredients found in plants allow the treatment and cure of various diseases [12][13]. Integrative and Complementary

Health Practices have been included in the Unified Health System (SUS) since 2006, having been approved by Ordinance No. 971, of May 3, 2006 [5], and aromatherapy inserted in the Unified Health System through Ordinance No. 702, on March 21, 2018 [14]. Aromatherapy stands out because it aims to promote the health and well-being of the body, mind, and emotions, through the therapeutic use of the natural aroma of plants through their essential oils. Aromatherapy can be defined as an integrative practice capable of stimulating the central nervous system through the use of aromas present in essential oils, which can be used olfactory or dermal [15][16].

In general, lavender originates in the Mediterranean basin, in regions of rocky and limestone soil. Its occurrence is recorded throughout North Africa, the Mediterranean, Western Europe, and India [17]. The species belonging to the genus are erect, aromatic shrubs or subshrubs with stems, most often woody. The leaves are opposite, single, whole, toothed, pinnate or bipinnate. The trichomes of the leaves are usually branched connected to glands. The inflorescence is a terminal spike, single or branched, dense and compact or long and wide with a rectangular or square peduncle. They can be green, red, purple, white. The fertile bracts are opposite, alternating or spiral, intertwined or arranged in vertical rows. The sterile bracts form a large plume or similar structure above the spike, present in the subgenus Stoechas. In *the Lavandula section* there is the presence of bracteoles. The flowers are sessile or have short pedicels. The corolla of the flowers is tubular, and the outermost part of the tube is dilated, with five short lobes or two larger lobes and the others smaller. The color of the corolla varies from violet, white, purple to dark blue. The calyxes are also tubular forming an appendage over the corolla before opening in some sections, such as the *dentata* [18][19].

The plants popularly known as lavender follow the following taxonomic classification: Reino Plantae; Phylum Magnoliophyta; Class Eudicots; Subclass Asteridae; Order Lamiales; Family Lamiaceae; Genus *Lavandula* [20], according to the current classification of the APG System.

As general characteristics within the genus *Lavandula*, it has a shrubby or subshrub habit, opposite leaves, single, whole or scalloped and trichomate. The flowers are pentamerous, sessile or pedicillate, corolla joined and bilabiate, with the color varying between violet, white, purple or blue and the calyx is also joined and usually green [18][19]. The genus *Lavandula* comprises forty-seven species [21] whose common name is "Lavender".

The species *Lavandula angustifolia* Mill., popularly known as French lavender, is the species with the greatest economic importance for the production of essential oil, used as a natural remedy, since studies have already proven the reduction of anxiety from its essential oil, in addition to its sedative and antibacterial properties [22][23]. According to Maier (2021)[24], the European Pharmacopoeia describes linalool, linalyl acetate and terpine-4-ol as major constituents of lavender

essential oil, with other components found in lower concentrations being α-pinene, camphene, α-pinene, β-pinene, p-cymene, limonene, terpinen-4-ol and cryptone.

It is important to note that some lavenders do not have a sedative effect, but a stimulating effect due to the presence of camphor in their composition, as is the case of Brazilian lavender or *Lavandula dentata* L, popularly known as lavender [25]. This species has distinct characteristics, such as a leaf with a scalloped margin, the presence of bracteoles at the base of the inflorescence, the stem has a grayish green color, the plant can reach 0.9 to 1 meter in height, and its inflorescence reaches 30 centimeters [18][19][26], so it is important to characterize the species to be used in treatments for anxiety.

The objective of this study was to develop a systematic literature review on the use of Lavandula *angustifolia Mill essential oils* in the treatment of anxiety.

METHODOLOGY

This article is a systematic review of the literature carried out through the definition of criteria that ranged from the analysis of these articles to the presentation of the results obtained through the research.

When studying a topic, we should rely only on the best quality studies on the subject. According to Galvão and Pereira (2014) [27], based on the principle of searching for and analyzing these studies, a systematic review of the literature "emerges". It is a type of investigation focused on well-defined questions, which aims to identify, select, evaluate and synthesize the relevant evidence available on the proposed topic. Also according to these authors:

> Systematic reviews should be comprehensive and unbiased in their preparation. The criteria adopted are disseminated so that other researchers can repeat the procedure. Good quality systematic reviews are considered the best level of evidence for decision-making. Because it follows an explicit scientific method and presents new results, the systematic review is classified as an original contribution in most clinical research journals [27].

Systematic reviews differ from narrative or traditional reviews, the latter are broad and provide general information about the topic in question, being common in textbooks. They are also different from integrative reviews, in which different designs are used in the same investigation, in addition to expressing the author's own opinion [27].

The bibliographic research was carried out using different databases such as *Google Scholar, Lilacs, PubMed and Scielo.* The scientific articles selected were articles in English, Portuguese or Spanish, with the use of keywords (*Lavandula angustifolia*, essential oils, anxiety, alone or combined).

The research was carried out with the inclusion of complete studies with conclusive results without a determined period that address the theme directly and any inconclusive article or that did not directly address the proposed theme was excluded from the elaboration of this work.

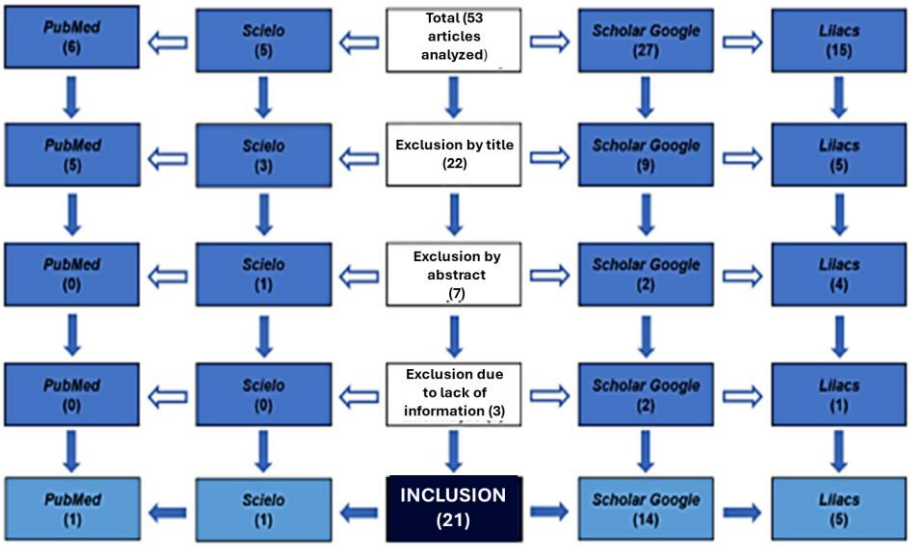
The criteria for the exclusion of articles in this review were: literature review articles, books, simple or expanded abstracts published in congresses and/or conferences, incomplete articles without text presentation, authors or/and full title.

The criteria for inclusion of articles were: information about lavender essential oils associated with anxiety in the title, abstract or text.

RESULTS AND DISCUSSION

Based on the criteria defined in the methodology, 53 articles were analyzed, and of these, 21 were selected and read in full, and only nine were used for the preparation of the systematic review, following the inclusion/exclusion criteria (Figure 1).

Fig. 1. Flowchart of the results obtained in the search for articles



The nine selected articles presented studies on the use of EO to control anxiety and its action potential, in isolation or comparatively, which is the object of this review and are described in Table 1.

Table 1 - Potential action of the essential oil of *Lavandula angustifolia* Mill. in the treatment of anxiety according to the literature consulted.

N.	Título	Autores	Tipo de pesquisa	Objetivo
1	Massagem com aromaterapia: efetividade sobre a ansiedade de usuários com transtornos de personalidade em internação psiquiátrica	Domingos e Braga 2015 [28]	Exploratória	Investigar a efetividade da massagem com aromaterapia utilizando óleos essenciais de Lavandula angustifolia e Pelargonium graveolens (0,5%) para diminuição da ansiedade de pacientes com Transtornos de Personalidade durante a internação psiquiátrica
2	Lavender and the Nervous System	Kouviladet al. 2013 [29]	Descritiva	Fazer um levantamento do estado atual do conhecimento experimental e clínico sobre o efeito da lavanda no sistema nervoso.
3	O Uso do Óleo Essencial de Lavanda Para Crianças com TEA: Estudo de Caso Sobre o Impacto na Qualidade do Sono e Ansiedade	Velez 2023 [30]	Qualitativa	Aplicar o Protocolo de Uso do Óleo Essencial de Lavanda para Crianças com TEA, e Identificar o efeito da aplicação do protocolo no sono e comportamento de duas crianças no município de Currais Novos/RN.
4	Uso de Óleos Essenciais No Tratamento Para Ansiedade	Morais e Vilete 2022 [31]	Exploratória	Analisar o uso de óleo essencial de lavanda no tratamento da ansiedade a partir de uma pesquisa de campo.
5	Exploring Pharmacological Mechanisms of Lavender (Lavandula angustifolia) Essential Oil on Central Nervous System Target	López etal. 2017 [32]	Exploratória	Avaliar os efeitos do óleo essencial de lavanda (Lavandula angustifolia) no sistema nervoso central
6	Óleos Essenciais: Aspectos Gerais e usos em Terapias Naturais	Machado e Fernandes 2011 [33]	Descritiva	Relatar aspectos gerais sobre os óleos essenciais bem como sua utilização em terapias naturais como a aromaterapia.
7	Aromaterapia Para a Ansiedade e Estresse de Professores de Enfermagem	Dias et al. 2019 [34]	Quantitativo, exploratório-descritivo	Investigar a efetividade do uso da aromaterapia com os óleos essenciais de lavanda (Lavandula angustifolia) ou ylang-ylang (Cananga odorata), associada à massagem, para o alívio da ansiedade e do estresse.
8	Efeitos do Óleo Essencial de Lavandula angustifolia Associado a Massagem com Auxílio de Pedras Quentes na Redução de Ansiedade e Perda de Peso em Mulheres Obesas	Nunes et al. 2021 [35]	Qualitativa, quantitativa	Investigar a relação do uso do óleo essencial de Lavandula angustifolia na redução do escore de ansiedade e perda de peso em mulheres obesas.
9	Efeitos da Aromaterapia Com Óleos Essenciais de Lavanda e Bergamota sobre a Qualidade do Sono, Ansiedade e Estresse em Profissionais da Enfermagem Frente à Pandemia da COVID-19	Maier 2021 [24]	Exploratória, quantitativa, qualitativa	Demonstrar os benefícios da massagem relaxante associada a aromaterapia para auxiliar no combate da ansiedade.

Source: the authors 2024.

In their work, Domingos and Braga (2015) [28] aimed to investigate the effectiveness of aromatherapy associated with massage on the anxiety of patients diagnosed with personality disorder. The study was presented as an uncontrolled clinical trial, carried out in a psychiatric clinic in São Paulo. Essential oils of *Lavandula angustifolia* (lavender) and *Pelargonium graveolens*

(geranium) were used to characterize calming and tranquilizing actions, both indicated for anxious situations.

The efficacy analysis of the intervention was carried out in two stages, first measuring the heart rate and then the respiratory rate before and after each aromatherapy massage session. The results indicated that there was a statistically significant decrease ($p<0.001$) in the mean heart and respiratory rates after each intervention session, as well as in the inventory score.

Kouviland et al. (2013) [29] reported an increase in the popularity of alternative medicine and the use of natural products, generating interest in the use of *Lavandula angustifolia essential oils.* The author demonstrated that although lavender may have a significant clinical potency as a therapy for different disorders, there is a lack of research and information necessary to confirm the beneficial effect of this plant on neurological disorders, even though many compounds found in lavender oil have demonstrated therapeutic potential, there is still a search for new treatments for different diseases.

Velez (2023)[30] in their research, carried out a qualitative study in order to apply the use of lavender essential oils for the purpose of relieving the symptoms of people with autism spectrum disorder (ASD), such as difficulty in communication and social interaction, since the core symptoms of ASD interfere with the resistance to fall asleep, anxiety and drowsiness.

For data collection, a field diary was made, where the testimony of the mothers of the children with ASD indicated for the project was described, performing a quantitative and qualitative analysis. The results obtained took into account the description of the field diaries, where the protocols for the use of lavender essential oil for the treatment of children with ASD were applied.

Morais and Vilete (2022) [31] addressed in their study an exploratory research, applying questions about the daily routine and knowledge about essential oils through a questionnaire. Through the answers obtained to the questionnaire, the author came to the conclusion about the positive efficacy of the use of lavender essential oil aromatherapy in the treatment of anxiety, as well as how it can be used to prevent other crises, diseases and to reduce stress. The results of the research also show that the use of aromatherapy is almost non-existent in popular daily life, as well as its benefits are unknown.

López et al. (2017) [32] demonstrated that lavender exerts an action on receptor binding affinity with N-methyl D-Aspartate (NMDA) activity. The study also states that lavender's calming and antidepressant effects may be related to at least part of the NMDA receptor. Another aspect observed was that lavender essential oil protected the neuroblast cell lines of human nervous tissue (SH-SY5Y) from hydrogen peroxide-induced neurotoxicity.

Machado and Fernandes (2011)[33] explored in their article the use of essential oils, presenting their wide variety of biological actions, as well as their application in different areas of

use. The author demonstrates new possibilities for research and use of essential oils in the treatment and prevention of diseases, thus highlighting aromatherapy as an option with a better therapeutic potential.

Dias et al. (2019)[34] developed their work in a public institution of higher education in the interior of the State of São Paulo, where they performed six aromatherapy massage sessions. Essential oils of *Lavandula angustifolia* and *Cananga odorata were used in this study*, both used with 3% in their concentration. The effectiveness of the massages was verified using psychological and biophysiological parameters as a reference.

Aromatherapy has shown partial effectiveness in reducing stress and anxiety, as it was considered to decrease blood pressure in isolated massage sessions with aromatherapy, but analyzing the heart rate did not decrease enough to obtain significant results.

Nunes et al. (2021)[35] addressed in their article an intervention study without a control group, composed of obese women, in the region of Santa Maria, RS. The study used sociodemographic data such as age, occupation, and marital status in its assessment.

There was a significant reduction in anxiety levels, as well as a reduction in weight, but there was no reduction in body mass index. The study shows that the reduction in anxiety in obese women can be complemented with the use of lavender EO, as it decreased binge eating caused as an anxiety condition.

The study by Maier (2021)[24] was conducted in a private hospital in the city of Ponta Grossa, where there were 18 beds for COVID-19 patients. The project participants were selected based on an authorial questionnaire, applied online. The volunteers were divided into three groups, where the essential oils of lavender, bergamot and the control group that used almond oil would be applied.

It was verified within this project that the professionals who presented signs of sleep disorder, anxiety and stress, when receiving these essential oils of lavender or bergamot demonstrated reductions in symptoms, and it was verified that the bergamot EO demonstrated greater efficiency in helping sleep in terms of quality in the criteria of sleep duration and latency, However, lavender showed a higher percentage of reduction in sleep disturbances in relation to sleep interruption, as well as health factors such as stress, depression, anxiety and insomnia.

CONCLUSION

The literature review is of paramount importance in the formation of any study involving research, focusing on scientific articles with studies based on serious experiences that cover a range of topics on the subject.

Scientific studies indicate that lavender EO has positive effects when used with the intention of preventing or mitigating anxiety and other emotional disorders.

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Clinical manifestations and complications of acute appendicitis in pediatrics: An analysis

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ABSTRACT

Childhood appendicitis can result in several serious complications that disable immediate medical attention and specialized care. Among them, the rupture of the appendix stands out, which can lead to peritonitis; the formation of abdominal abscesses; the possibility of sepsis, an environmentally fatal condition; the formation of abdominal adhesions after appendectomy; and postoperative complications such as bleeding and infection. Not only do these complications have a significant physical impact, but they can also affect the child's psychological and emotional well-being, causing anxiety and stress. Therefore, it is essential to consider the symptoms of appendicitis early and seek prompt medical attention to avoid serious complications and ensure proper recovery.

Keywords: Appendicitis, Childhood, Complications, Pediatric Surgery.

INTRODUCTION

Childhood appendicitis is a medical condition that affects the appendix, a small organ located in the cecum, part of the large intestine. This condition occurs when the appendix becomes obstructed, causing inflammation and infection in the organ.

The most common symptoms of appendicitis in children include sharp, severe abdominal pain, especially in the lower right side of the abdomen, fever, loss of appetite, nausea, and vomiting. However, it is important to note that younger children may have less specific symptoms, such as irritability and diffuse abdominal discomfort.

Diagnosing childhood appendicitis usually involves a thorough medical evaluation, including physical exams, laboratory tests such as a blood count, and imaging tests such as abdominal ultrasound. Early identification of the condition is crucial for proper treatment and to avoid serious complications.

The standard treatment for appendicitis is surgery to remove the inflamed appendix, known as an appendectomy. This procedure is performed to prevent rupture of the appendix and prevent further complications such as peritonitis, which is a serious infection in the abdominal cavity.

METHODOLOGY

This integrative literature review was conducted from January to March 2024 to analyze the main complications of appendicitis in pediatrics. The search for scientific articles was carried out in the databases of the journals SciELO and PubMed, as well as the Brazilian Society of Pediatrics. Descriptors such as "Childhood Appendicitis", "Complications" and "Pediatric Surgery" were used. The search covered the mentioned period, in order to address relevant studies published during this time interval.

The inclusion criteria defined for the selection of primary studies included articles published in Portuguese and English, available in full online, and directly related to the theme of appendicitis in childhood. The synthesis of the results of the integrative review will provide a comprehensive view of the prevalence of appendicitis in children and its complications.

RESULTS AND DISCUSSIONS

During surgery to treat childhood appendicitis, complications can arise that require medical attention and appropriate intervention. Some complications include:

Surgical incision infection: After surgery, the incision made to remove the appendix may become infected, manifesting as lesions, pain, swelling, and increased temperature in the operated area.

Intra-abdominal abscess: A collection of pus may form inside the abdominal cavity, called an intra-abdominal abscess, during or after surgery. In some cases, it is necessary to drain the abscess to treat the infection.

Intestinal obstruction: After the appendix is removed, internal adhesions can form in the abdomen, causing intestinal interference. This can lead to symptoms such as abdominal pain, bloating, vomiting, and difficulty having a bowel movement.

Postoperative peritonitis: Although rare, peritonitis can occur as a complication after appendicitis surgery. It is a serious infection in the abdominal cavity that requires immediate treatment to prevent serious complications.

Anesthetic complications: During surgery, anesthesia-related complications may arise, such as allergic responses, breathing problems, or a drop in blood pressure.

It is critical that healthcare providers are prepared to identify and treat these complications effectively, ensuring a safe recovery for children undergoing appendicitis surgery. Careful postoperative follow-up is essential to monitor any adverse developments and ensure a full recovery.

FINAL THOUGHTS

In the final considerations, it is crucial to highlight the importance of early diagnosis and proper treatment of childhood appendicitis to prevent surgical complications and promote a quick and safe recovery. The surgical complications mentioned, such as incision technique, abscess formation, intestinal interference, peritonitis, and anesthetic complications, can be serious but are usually preventable with a careful approach and diligent medical follow-up.

Healthcare professionals should be aware of the signs and symptoms of appendicitis in children and act promptly to make the correct diagnosis. In addition, proper postoperative follow-up is essential to monitor the progress of recovery and identify any complications that may arise early.

It is also important to emphasize the importance of educating and raising awareness among parents and guardians about the symptoms of appendicitis and the need to seek immediate medical attention when suspecting this condition. Knowledge and early attention can make a difference in preventing complications and promoting children's health.

In summary, when facing appendicitis in childhood, readiness for diagnosis, timely surgical treatment, and careful follow-up are critical to ensure a successful recovery and minimize the risks of surgical complications. Integrated, multidisciplinary care is essential for the well-being and safety of children affected by this condition.

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The science of happiness as a health strategy

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ABSTRACT

Since time immemorial, the pursuit of happiness has fascinated minds and hearts, challenging us to plumb the abysses of human subjectivity. In a world permeated by nuances and complexities, understanding this elusive state continues to push the boundaries of our understanding, inviting us on an intellectual journey towards its essence. As we move forward in time, happiness has increasingly been the subject of scientific scrutiny, driving the emergence of disciplines such as psychology and neuroscience. In this context, the quest to understand the mechanisms underlying happiness transcends the boundaries of philosophy and enters the territory of empirical research, promoting a multidisciplinary approach that seeks to decipher the enigmas of the human mind and unveil the secrets of a full and satisfying life. Today, the emergence of the science of happiness represents an innovative approach in the field of healthcare, recognizing its impact on the emotional and mental well-being of patients. Thus, this study investigates the integration of psychology in the context of health care, aiming to promote the well-being and quality of life of patients. The research comprises a critical review of relevant contents, seeking to synthesize the existing knowledge on the subject. The humanization of health care emerges as a central issue, valuing both professionals and users of the health system. Despite the advances in the discussion and restructuring of health services, there is still a lack of studies that explore the theoretical and philosophical bases of these transformations.

Keywords: Happiness, Science of Happiness, Emotional Well-being, Positive Psychology, Humanization of Health, Health Care.

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INTRODUCTION

Happiness transcends mere conceptual definition, encompassing a multitude of factors that have been explored and debated throughout human history. From the dawn of philosophical thought to the advances of contemporary science, the quest to understand and cultivate happiness has been a multi-track journey, but at the same time rooted deeply in the essence of the human experience.

For a long time, happiness was treated only as a subjective and difficult-to-measure state of mind that depended on individual personality and circumstances. There was little attention to understanding how happiness could be increased or how it could develop effective interventions to help people be happier (Rozeira, 2024).

In the common sense created, happiness was seen as something that simply happened, or not, in people's lives and that reached a common limit, which could only be raised through the external circumstances of our life such as financial success, our relationships, our physical health, among others. For this reason, when we are in this "ordinary" state, we forget about mental health and go in search of these tangible goals (Rozeira, 2024).

It is true that people live in pursuit of happiness. In literature, music, and the fine arts, the feeling is often portrayed as a state of fulfillment achieved on the basis of external achievements: a great love, a job, or a dream trip. But what is the way to happiness? Is it possible to live "happily ever after"?

The perception and pursuit of happiness can be influenced by a range of cultural, social, religious, and philosophical factors, which can result in distinct perspectives between the Western and Eastern world. For example, in the West, happiness is often associated with personal fulfillment, the pursuit of individual goals, freedom, and autonomy. Meanwhile, in the East, especially in some Buddhist and Confucian traditions, happiness can be seen in a more collective way, linked to social harmony, duty, and communal interdependence. Yet, in the Western world, happiness is often expressed in an extroverted way, as a leap into life, accompanied by a wide smile, outstretched arms and legs, seeking to overflow joy and personal fulfillment. On the other hand, in Eastern countries, there is a tendency to seek happiness through peace of mind, contact with nature and introspection, where inner tranquility and harmony with the world around are valued as fundamental pillars of well-being. Despite these differences, there are common elements in the concept of happiness that transcend cultural boundaries. For example, the pursuit of meaningful relationships, a sense of purpose in life, physical and mental health, and a sense of personal fulfillment are all aspects valued in many cultures around the world (Rozeira, 2024).

According to Ekman (1992), fundamental emotions are accompanied by specific facial expressions, universal in different cultures, and correlate with physiological and behavioral changes, also observed in primates, which suggests that happiness can be considered a basic emotion. A wide

range of experiences can evoke feelings of happiness, such as love, joy, health, satiety, sexual pleasure, contentment, security, and serenity. On the other hand, emotions such as sadness, fear, anger, disgust, and affective states such as anxiety, anguish, pain, and suffering tend to decrease the feeling of happiness.

Cloninger (2004) emphasizes that "happiness" reflects a coherent and lucid understanding of the world, requiring a consistent approach to life that integrates sexual, material, emotional, intellectual and spiritual aspects. He suggests that the adaptability of these aspects—such as gender, material possessions, power, and interpersonal relationships—depends on the degree of awareness people have of their goals and values. In addition, Cloninger points out that the degree of coherence in human thoughts and relationships can be evaluated by their ability to promote harmony and happiness.

One of the most discussed questions in the science of happiness today concerns living in the present, that is, in the only concrete time we have. We observe that many people live according to a happiness that has not yet arrived or that which is already gone. They motivate comments such as: "When I graduate, I will be happy"; "When I buy my own house, I will be happy"; "When I get the job of my dreams, I'll be happy" or even "I was happy and I didn't know it...". Living in function of the past or future is almost a sentence to unhappiness, because, as the Stoics remind us, it is only possible to experience satisfaction with life in the only real time we have: the present moment.

According to the Houaiss Dictionary of the Portuguese language, happiness is defined as "the quality or state of being happy, a state of fully satisfied consciousness, contentment and well-being" (Houaiss, 2004). This positive emotional state is associated with the perception of success and a lucid understanding of the world.

Various states and experiences can awaken feelings of happiness, such as love, joy, health, and security. On the other hand, negative emotions and affective states, such as sadness, fear and anxiety, tend to decrease the feeling of happiness (Ferraz; Tavares; Zilberman, 2007).

One of the most intriguing aspects about happiness is the need to experience it in the present. Many people tend to postpone the pursuit of happiness, setting future conditions to achieve it, such as graduating, buying a house, or getting a dream job. However, this mindset of living for the future or regretting the past can be a barrier to experiencing true satisfaction in the present moment (Rozeira, 2024).

Stefan Klein, in the book "The Happiness Formula," suggests that happiness is both a life goal and a path to a better existence. It is an ongoing journey of self-discovery and personal growth (Rozeira, 2024).

When discussing happiness, we encounter a variety of perspectives, including matters of faith, personal opinions, and controversies. Some people believe that happiness is determined by divine

will, while others argue that it is impossible to be happy in today's world or that happiness is directly related to one's financial situation (Rozeira, 2024).

However, beyond subjective beliefs and opinions, there is a more objective and grounded approach to understanding happiness: the science of happiness. This emerging field of study utilizes rigorous research methods to investigate the determinants of happiness, identify effective strategies to increase well-being, and provide valuable insights into how to live a fuller and more meaningful life (Rozeira, 2024).

The science of happiness has gained prominence as an innovative strategy in the field of healthcare, recognizing the importance of emotional and mental well-being in the treatment and recovery process of patients. This approach not only focuses on physical healing, but also considers the positive impact that the relationship between healthcare providers and patients can have on the effectiveness of treatment (Rozeira, 2024).

The success of a healthcare treatment often depends on the quality of interaction between healthcare professionals and patients. A relationship based on empathy, trust, and mutual understanding can significantly improve treatment adherence, recovery, and quality of life for the patient. When patients feel heard, respected, and supported, they tend to be more actively involved in their own care, which can lead to better health outcomes (Rozeira, 2024).

The science of happiness emphasizes the importance of cultivating positive emotions, such as gratitude, optimism, and hope, which can strengthen emotional resilience and help patients face health challenges with a more positive outlook. In addition, strategies based on positive psychology, such as focusing on the patient's strengths and promoting healthy behaviors, can complement traditional medical approaches, contributing to a more holistic and integrated treatment (Lyubomirsky, 2011, Stewart, 2017).

Healthcare professionals can use specific techniques and interventions to promote patient well-being. These approaches not only help patients cope with physical and emotional symptoms, but also develop coping and self-care skills that are critical to maintaining long-term health (Rozeira, 2024).

Incorporating hope and positive expectations into patient care is key to improving their experience and happiness. Positive communication, highlighting strengths and possibilities for improvement in treatment plans, can strengthen patients' optimistic outlook. Informing them about the potential benefits of treatment and expected outcomes can motivate them to follow the care plan and maintain a positive outlook on recovery (Stewart, 2017).

Offering emotional and psychological support is equally important. Helping patients cope with the stress, anxiety, and emotions related to diagnosis and treatment can increase their hope and

confidence in recovery. Sharing success stories of patients who have overcome similar situations can inspire hope and show that recovery is possible (Stewart, 2017).

Encouraging patients' active involvement in their care by setting realistic goals and celebrating progress made can strengthen hope and motivation to continue treatment. Keeping patients informed of their progress and next steps in treatment through regular updates helps maintain a positive and hopeful outlook on recovery (Stewart, 2017; Rozeira, 2024).

A multidisciplinary approach to patient care, working together with other healthcare professionals to address all dimensions of physical, emotional, and psychological well-being, is essential to providing holistic and integrated care (Stewart, 2017).

The role of the health professional should be to pay attention to the well-being and happiness of patients. Showing empathy and understanding, maintaining clear and transparent communication, and treating all patients with respect and dignity are key aspects of improving their experience. Being available to answer their questions and concerns, providing educational information about disease prevention and health care, and creating a welcoming and comfortable environment in your office or clinic are also important (Stewart, 2017; Rozeira, 2024).

Recognizing the uniqueness of each patient and tailoring care to their individual needs, following up regularly to monitor their progress and adjusting the treatment plan as needed, and collaborating with other healthcare professionals to provide an integrated and coordinated approach to patient care are all practices that contribute to improving the patient experience (Stewart, 2017; Rozeira, 2024).

Finally, encouraging patients to provide feedback on your services can help you identify areas of improvement and enhance the quality of care provided, thereby promoting a more positive and satisfying experience for patients (Stewart, 2017; Rozeira, 2024).

The purpose of this study is to investigate how happiness science can be employed as an effective healthcare strategy in a variety of professional fields, including medicine, nursing, psychology, social work, dentistry, and other health disciplines. We aim to explore how positive psychology principles and interventions can be integrated into different health care contexts to promote patient happiness, well-being, and health. In addition, we seek to understand the potential benefits of this approach for the humanization of health care, focusing not only on the treatment of diseases but also on the promotion of human flourishing and quality of life. By examining the scientific evidence and best practices in these diverse areas, we aim to provide insights and guidance to healthcare professionals interested in implementing happiness science-based strategies in their clinical practices, regardless of their area of expertise.

METHODOLOGY

Based on the guidelines of Cervo, Bervian and Silva (2007), the present study can be characterized as a basic and theoretical investigation, whose objective is to deepen scientific knowledge about the application of positive psychology in the context of health, especially in the context of medical care and in the promotion of happiness as a health strategy. This is an exploratory research with a qualitative approach, based on concepts and information extracted from the scientific literature.

As highlighted by Mancini and Sampaio (2007), this research involves a critical and synthetic review of relevant studies published on the topic in question, with the purpose of synthesizing existing knowledge and offering substantial conclusions on how positive psychology can be integrated in the context of medical care to promote patient well-being and the humanization of health.

To conduct this literature review, strategies were adopted using academic and scientific electronic platforms. Specific terms were used in the search, delimiting the parameters that guided the careful selection of studies and the comprehensive understanding of the existing panorama on the subject. Thus, the search engines Google Scholar, Scopus and Web of Science were explored to select relevant articles, using pertinent descriptors such as "positive psychology", "medical care", "patient well-being", "happiness" and "mental health".

Prominent authors in the field of positive psychology include Martin Seligman, recognized as the pioneer of the discipline, and Mihaly Csikszentmihalyi, known for his contributions to the concept of flow. Other relevant researchers include Barbara Fredrickson, Ed Diener, and Sonja Lyubomirsky, whose studies have significantly advanced the understanding of the determinants of human happiness and well-being.

To clarify complex issues addressed in the text, specific searches were carried out using the Google search engine. This approach allowed access to new sources of knowledge, following a methodology based on scientific and epistemological principles. As highlighted by Rozeira et al. (2023), this methodology reveals the beauty of unpredictability, the wit of complexity, and the truth in the journey of discovery. Each new concept assimilated represents a unique piece in the constant search for discernment, strengthening the structure of this scientific study.

LEVELS OF HAPPINESS IN DIFFERENT SOCIAL AND CULTURAL CONTEXTS

The search for understanding happiness has been a topic of growing interest in several areas of knowledge. Comparative studies between populations in different countries reveal marked and consistent differences in happiness levels, shedding light on the various factors that influence this emotional state.

An extensive study conducted in European Union countries between 1973 and 1998, led by Ingleman and Klingemann (2000), highlighted that Danish citizens were significantly more likely to declare themselves "very satisfied" with their lives compared to Italians, French and Portuguese. This finding highlights the influence of culture and social context on an individual's perception of happiness.

In addition, there is a general tendency for richer nations to report higher levels of happiness compared to poorer nations, as indicated by Ingleman and Klingemann (2000). However, this relationship is not uniform, as evidenced by many Latin American countries, which exhibit happiness indices comparable to those of developed nations such as Australia and Japan (Veenhoven, 1991).

The World Values Surveys (WVS), a comprehensive international survey of human values in more than 60 countries, identified the countries with the highest happiness scores, highlighting Puerto Rico, Mexico, Denmark, and Colombia as the most prominent. However, it is interesting to note that Brazil was ranked 32nd, while the United States ranks 15th (Ferraz; Tavares; Zilberman, 2007), highlighting the complexity in understanding the determinants of happiness in different cultural contexts.

While increased purchasing power is associated with a better quality of life, research suggests that once an adequate livelihood threshold is crossed, increased wealth does not significantly correlate with higher levels of happiness. Studies have shown that people with above-average purchasing power are not necessarily happier than the general population and tend to devote less time to pleasurable activities (Kahneman et al., 2006).

Other sociodemographic factors, such as age, gender, marital status, and the presence of children, have been shown to have limited influence on happiness levels, contributing little to the variation in reported happiness indices (Ferraz; Tavares; Zilberman, 2007). However, studies on the relationship between mental health and religiosity or spirituality suggest a positive association between religious involvement and better mental health, with a lower incidence of psychiatric disorders and higher rates of psychological well-being (Moreira-Almeida et al., 2006; Ferraz; Tavares; Zilberman, 2007).

These studies indicate that happiness levels can be influenced by a variety of factors, including socioeconomic, cultural, and individual aspects, and highlight the complexity in understanding this phenomenon, reinforcing the importance of a complex approach to happiness analysis.

LET'S THINK FOR A MOMENT: WHAT DOES IT MEAN TO BE HAPPY?

In the dictionary definition, the concept of happiness is practically unique: the state of being happy, a feeling of well-being and contentment. Philosophers associate happiness with pleasure, with

feelings and emotions. According to Aristotle, happiness would be balance and harmony, and the practice of good. For Epicurus, happiness occurs through the satisfaction of desires. For Pyrrhus of Aelia happiness came through tranquility. For the Indian philosopher Mahavira, non-violence was an important ally to achieve full happiness. For the Chinese philosopher Lao Tzu, happiness could be achieved by taking nature as a model. Confucius, on the other hand, believed in happiness due to harmony between people. In Buddhism, happiness occurs through the release of suffering and the overcoming of desire, through mental training (Roitman, 2022).

For Immanuel Kant, happiness is the condition of the rational being in the world, for whom, throughout life, everything happens according to his desire and will. For Friedrich Nietzsche, happiness is fragile and volatile. And he added, the best way to start the day is, when we wake up, imagine if on that day we can't give joy to at least one person. According to Albert Einstein, a calm and modest life brings more happiness than the pursuit of success combined with constant restlessness. On the other hand, Hannah Arendt introduced the concept of public happiness with public participation in political issues, the possibility of assembly, the joy of speech, the possibility of persuading and being persuaded, the public freedom to act together (Roitman, 2022).

The psychiatrist and psychoanalyst Sigmund Freud argued that every individual is driven by the search for happiness, but this search would be a utopian thing, since for it to exist, it could not depend on the real world, where the person can have experiences such as failure, therefore, the most that the human being could achieve would be a partial happiness (Roitman, 2022).

Beck (1996), a pioneer of Cognitive-Behavioral Therapy (CBT), argues that happiness is an emotional state resulting from healthy patterns of thought and behavior. In CBT, happiness is seen as a natural consequence of adaptive mental processes and positive behaviors. To experience and learn happiness from the perspective of CBT, it is essential to identify and modify distorted thought patterns that contribute to negative feelings, such as excessive self-criticism, rumination about negative past events, or excessive worry about the future. This can be done through the application of specific techniques, such as cognitive restructuring, which involves challenging and replacing negative automatic thoughts with more realistic and positive thoughts. Additionally, learning how to live happily in CBT involves practicing healthy behaviors and effective coping skills. This includes developing problem-solving strategies, the ability to deal with emotions constructively, and engaging in activities that provide pleasure and satisfaction. CBT also emphasizes the importance of cultivating healthy and fulfilling interpersonal relationships, as social support and connection with others play a key role in promoting emotional well-being and experiencing happiness (Beck, 1996), as we will see later when discussing positive psychology.

For many centuries, reflections on happiness have predominantly been under the domain of philosophy, offering deep insights and philosophical perspectives on what it means to live a good and

meaningful life. However, with the advancement of science and the development of psychology as an academic discipline, the focus has begun to shift to the scientific understanding of human happiness and well-being (Roitman, 2022).

Although psychology has had as its primary mission to alleviate human suffering, especially after traumatic events such as World War II, a crucial question has arisen: is it enough to just treat symptoms and alleviate suffering, or should we look for ways to promote human flourishing and genuine happiness (Rozeira, 2024)?

These questions led to the rise of Positive Psychology, focusing on the study of human strengths, virtues, and capabilities that contribute to well-being and happiness. Instead of focusing exclusively on problems and pathologies, Positive Psychology seeks to understand what makes people thrive and achieve a meaningful life (Rozeira, 2024).

Abraham Maslow, known for his Hierarchy of Needs Theory, was one of the pioneers in this area, emphasizing the importance of tapping into human potential and positive aspirations. He believed that psychology had much to learn about human capabilities and the "psychological peak" beyond simply diagnosing diseases and problems (Maslow, 1943).

Maslow's Hierarchy of Needs Theory proposes a hierarchical structure that organizes human needs into five distinct levels, representing the different stages of human development. At the most basic level are physiological needs, such as food and shelter, that are fundamental for survival and physical well-being. Next are security needs, which involve emotional stability and protection. The third level addresses social or belonging needs, related to the search for interpersonal connections and meaningful relationships. On the fourth level are the needs of esteem, which include personal recognition and appreciation, both internally and externally. Finally, at the top of the hierarchy are the needs for self-actualization, which represent the intrinsic desire to develop one's fullest potential and find purpose and meaning in life. This pyramid suggests that as needs at a lower level are met, the individual is motivated to seek the fulfillment of needs at the next level, guiding the process of personal growth and self-discovery throughout life (Maslow, 1943).

In 1954, Maslow introduced the term "Positive Psychology," laying the foundation for a new era of research and practice focused on the scientific study of happiness, well-being, and human flourishing. Since then, Positive Psychology has grown and developed, providing valuable insights and practical tools to promote a fuller, happier, and more productive life (Maslow, 1954).

AND FOR SCIENCE, WHAT IS HAPPINESS?

Psychology and psychiatry have directed their attention to the study of happiness, marking a significant paradigm shift. For much of the twentieth century, the focus of research remained predominantly on pathological affective states. Psychiatrists have extensive knowledge about the

biomedical characteristics of people who suffer from unhappy states, but often have a limited understanding of the characteristics of happy people.

The transformation of happiness into a field of scientific study is a relatively recent development in the history of science and psychology. For a long time, happiness was seen primarily as a subjective state, difficult to quantify and measure objectively, which put it in contrast to the traditional scientific method, which values objectivity, measurement, and replicability (Rozeira, 2024).

Historically, science has predominantly focused on tangible and measurable aspects of human life, such as physical illnesses, biological processes, and observable behaviors. Happiness, on the other hand, was often considered a personal and subjective issue, influenced by complex cultural, social, economic, and psychological factors, making it a challenging topic to study scientifically (Rozeira, 2024).

The field of happiness has been called "subjective well-being" for a long time, it seemed to have a fear of expounding the term "happiness", but today it has experienced a remarkable recent growth in psychology, encompassing a wide range of studies that explore various terminologies such as happiness, satisfaction, state of mind and positive affect. Broadly speaking, this domain focuses on how people evaluate their lives. More precisely, it investigates how and why people experience objective and positive aspects of their lives, as well as considering the subjective assessment of quality of life (Giacomoni, 2004).

Western scholars have long explored the concept of "Happiness" (Diener, 1994), regarding it as the supreme good and the primary motivation for human actions. However, until recently, psychologists have paid little attention to the study of subjective well-being, focusing more on investigating unhappiness and human suffering. Nowadays, this construct is widely used in areas such as quality of life, mental health, and social gerontology. After 1970, behavioral and social scientists began to explore and develop theories on the topic. The term "happiness" was included in the Psychological Abstracts in 1973 and in the Social Indicators Research, founded in 1974, publishing a significant number of articles on the subject (Diener, 1984).

Diener (1984) categorizes the meanings of subjective well-being and happiness into three distinct groups. The first approach conceptualizes well-being in terms of external criteria, such as virtue or holiness. In such normative definitions, which describe what constitutes desirable, happiness is not understood as a subjective state, but as the possession of any desirable quality. Another strand in the definition of well-being arises from research conducted by social scientists, who are dedicated to understanding the factors that lead people to evaluate their lives in a positive way. In this context, the concept of life satisfaction emerges, which is based on the individual's own criteria and standards to determine what constitutes a happy life. This approach values each person's unique perspective on

their own well-being and happiness. In addition, a third category of definition of well-being considers it as a state in which positive emotions predominate over negative ones, emphasizing the importance of the emotional experience of satisfaction and pleasure. This approach assesses the balance between positive and negative emotions over a specific period of time, providing insights into the subjective experience of well-being (Bradburn, 1969).

Over the past three decades, research on subjective well-being has experienced significant momentum, driven by two distinct perspectives of positive functioning. The first, derived from the work of Bradburn (1969), distinguishes between positive and negative affect, considering happiness as a balance between the two. On the other hand, a second conception, increasingly prominent among sociologists, emphasizes life satisfaction as the main indicator of well-being. Life satisfaction is seen as the cognitive aspect that complements the affective dimension of happiness (Ryff and Keyes, 1995).

Subjective well-being, or happiness, is an attitude that has at least two fundamental components: affect and cognition (Ostrom, 1969). The cognitive component refers to the rational and intellectual aspects, while the affective component refers to the emotional aspects. In addition to this distinction, the affective component can be subdivided into positive and negative affect. Andrews and Withey (1976) structured the elements of subjective well-being as the judgment of life satisfaction and positive and negative affect. The definition of well-being is complex, as it can be influenced by variables such as age, gender, socioeconomic status, and culture. It is suggested, in general terms, that a person with a high level of well-being has life satisfaction, frequent experience of positive affect, and relative absence of negative affect. The relative predominance of positive affect over negative affect is called the hedonic balance (Diener, 1996).

According to Diener (1984) there are three fundamental aspects of subjective well-being: firstly, its subjective nature - well-being resides in each person's individual experience; secondly, the understanding that it is not limited to the mere absence of negative factors, but also to the presence of positive aspects; and, finally, that well-being is a global measure that encompasses several aspects of life, rather than being limited to just one.

Since Bradburn's 1960 study, which revealed the relative independence between positive and negative affect, the relationship between these two components has been the subject of controversy. However, there is now ample evidence demonstrating that the proportional levels of negative and positive affect are independent, even when different measurement instruments are employed (Diener, 1984; Giacomoni, 2004).

Ryff and Keyes (1995) proposed a multidimensional model of well-being, composed of six distinct components of positive psychological functioning: positive evaluation of oneself and the previous period of life (self-acceptance), a sense of continuous personal growth and development

(personal growth), the conviction that life has purpose and meaning (meaning of life), satisfying relationships with others (positive relationships with others), ability to cope effectively with the challenges of life and the environment (mastery of the environment) and a sense of self-determination (autonomy).

However, after the 2,000s, there was a growing interest in the scientific understanding of human happiness and well-being. Advances in positive psychology, a subfield of psychology that focuses on the study of the strengths, virtues, and factors that contribute to human flourishing, have played an important role in this process. Researchers such as Martin Seligman and Mihaly Csikszentmihalyi have been exploring concepts such as gratitude, resilience, flow, and engagement, providing a theoretical and empirical basis for the scientific study of happiness.

Additionally, the development of more sophisticated research methods and advanced statistical tools has allowed scientists to address complex questions related to happiness with greater rigor and precision. Longitudinal studies, controlled experiments, and interdisciplinary research have contributed to a deeper understanding of the determinants of happiness, including genetic, environmental, psychological, and social factors (Rozeira, 2024).

As scientific evidence on the importance of happiness for health, well-being, and quality of life has accumulated, academic and public interest in the topic has increased significantly. Consequently, happiness has gained recognition as a legitimate and vital field of scientific study, leading to the formation of dedicated research institutions, academic programs, and specialized publications (Rozeira, 2024).

Martin Seligman is a prominent figure in the field of Positive Psychology, an approach that focuses on the study of human strengths, virtues, and abilities that contribute to well-being and happiness. In contrast to traditional approaches to psychology, which often focus on problems and pathologies, Seligman advocates a more holistic and positive view of the human being (Seligman; Csikszentmihalyi, 2000).

For Seligman, psychology should not only be limited to the study of weaknesses and harms, but should also explore human qualities and virtues. Treating someone is not only about correcting what is wrong, but also about cultivating and strengthening the best in each individual. He argues that by focusing only on reducing our negative aspects, we can achieve average, but we will never achieve excellence or become truly extraordinary people. Instead, Seligman proposes that we should direct our efforts toward developing and nurturing our unique strengths and virtues, striving for a full and meaningful life (Seligman; Csikszentmihalyi, 2000).

As for the concept of happiness, Seligman defines it as the "experience of joy, contentment, or well-being, combined with a sense that life is good, meaningful, and valuable." This definition reflects a broad and integrated perspective of happiness, which goes beyond mere momentary

pleasure, encompassing a deeper sense of purpose, meaning, and satisfaction in life (Seligman; 2011).

Seligman (2004) presented the 5 pillars that support his theory of happiness and serve to measure and support a "flourishing life", that is, full of well-being. The set was called the PERMA Model. Check it out below:

1. **Positive Emotions:** This component highlights the importance of experiencing positive emotions such as joy, gratitude, hope, and love. For example, happy moments with dear friends, such as sharing laughter in a relaxed gathering, can heighten our positive emotions and promote a healthy state of mind.
2. **Engagement:** This refers to engaging in activities that provide us with a state of flow, where we are completely immersed and absorbed in what we are doing. For example, when we engage in a hobby we love, such as painting or playing a sport, we lose track of time and feel deeply satisfied with the activity.
3. **Relationships:** Social and emotional bonds play a crucial role in promoting happiness and well-being. For example, cultivating meaningful relationships, such as spending time with family or having deep conversations with friends, provides us with a sense of belonging, connection, and emotional support.
4. **Meaning:** This component involves finding a purpose or meaning in life. For example, dedicating yourself to altruistic causes, such as volunteering at a charity or working to protect the environment, can provide a deep sense of accomplishment and personal meaning.
5. **Accomplishment:** This refers to the sense of achievement and progress toward personal and professional goals. For example, achieving a challenging goal, such as completing a marathon or receiving a promotion at work, can boost our self-esteem and provide us with a sense of accomplishment and satisfaction.

Mihaly Csikszentmihalyi's theory, known as the Flow theory, explores the mental states of deep involvement and total immersion in an activity. According to Csikszentmihalyi, the flow state occurs when a person is fully absorbed in a challenging task that requires specific skills. During this state, the person loses track of time and space, experiencing a feeling of complete concentration and satisfaction (Seligman; Csikszentmihalyi, 2000).

Csikszentmihalyi identifies several characteristics of the flow state, including a clear goal of the activity, immediate feedback, a balance between challenge and skill, a sense of control over the situation, and a loss of self-awareness. He argues that flow is a key source of motivation and fulfillment, and that finding activities that provide this state is essential for well-being and happiness (Seligman; Csikszentmihalyi, 2000).

Happiness is not euphoria. It's not smiling and hugging the trees all the time. It's not something superficial. "Happiness is an experience of joy, contentment, or positive well-being combined with a sense that life is good, meaningful, and valuable," says Sonja Lyubomirsky, PhD, a Stanford researcher (Lyubomirsky, 2011).

Sonja Lyubomirsky, is one of the leading figures present in the field of happiness science. It has played a role in popularizing and advancing the scientific study of happiness, contributing significantly to academic and public understanding of the determinants and benefits of happiness (Rozeira, 2024).

Lyubomirsky is the author of several influential books on the topic, including "The How of Happiness," in which she presents practical strategies based on scientific research for increasing happiness and well-being in everyday life. She advocates for an evidence-based approach to cultivating happiness, combining insights from positive psychology, cognitive science, and neuroscience (Rozeira, 2024).

Her work addresses important issues such as the influence of genes and environment on happiness, the effectiveness of different practices and interventions to improve well-being, and the relationship between happiness and personal and professional success. Lyubomirsky also explores the concept of the "happiness set point," suggesting that while there is a genetic predisposition to happiness, it is possible to increase and sustain higher levels of well-being through intentional behaviors and attitudes (Rozeira, 2024).

Sonja Lyubomirsky's theory of the composition of happiness, derived from sound and serious research, often referred to as the "happiness formula," suggests that our happiness is influenced by three main components: genetic factors, life circumstances, and intentional activities or behaviors (Lyubomirsky, 2011). According to this theory:

1. **Genetic Factors** (approximately 50%): About 50% of our ability to be happy is determined by genetic factors. This means that some people may have a genetic predisposition to being happier than others. However, it is important to note that genetics is not a fixed, immutable destiny; It establishes a starting point, but it does not determine our final destination in terms of happiness.
2. **Life Circumstances** (approximately 10%): Approximately 10% of our happiness is influenced by the external circumstances of our life, such as income, social status, work, and significant events. While these factors may have a temporary impact on our well-being, they tend to have a limited and short-lived effect on our long-term happiness.
3. **Intentional Activities or Behaviors** (approximately 40%): About 40% of our happiness is determined by intentional activities or behaviors that we can control, such as practicing gratitude, fostering positive social relationships, engaging in meaningful

activities, and developing effective coping skills. These are areas where we can make a significant impact on our well-being through conscious choices and deliberate actions.

Lyubomirsky argues that while we can't change our genetics or completely control our life circumstances, we do have the power to influence a significant portion of our happiness through our choices and behaviors. By adopting practices and habits that promote well-being and cultivating a positive mindset, we can increase and sustain higher levels of happiness and life satisfaction (Fredrickson, 2009).

Sonja Lyubomirsky explains the seriousness of her research into the happiness formula by taking a rigorous scientific approach to her studies. She conducts her research based on established scientific methods such as controlled experiments, robust statistical analyses, and peer review in respected academic publications. In addition, Lyubomirsky has published several articles in prestigious scientific journals, presenting empirical evidence to support his theories and conclusions about happiness. Her research is internationally recognized and contributes significantly to the academic and practical understanding of happiness, which solidifies her position as a serious and respected scientist in the field of positive psychology (Rozeira, 2024).

Another intriguing study conducted by psychologist Barbara Fredrickson, PhD, of the University of North Carolina at Chapel Hill, has revealed a new finding: people who experience continued success maintain a 3-to-1 ratio between positive and negative thoughts. In other words, for every negative thought, they cultivate three positive thoughts to balance. These findings were presented in the book entitled "Positivity, The 3 to 1 Ratio That Will Change Your Life", not yet available for the Portuguese (Fredrickson, 2009).

Thus, according to current science, the path to happiness or subjective well-being would be to: experience more positive emotions than negative ones (in a ratio of 3:1); be engaged, carry out challenging activities according to individual skills; maintain quality relationships with significant others; to create and make life meaningful, so that it is worth living; have goals in life, whether small or large, and make efforts to achieve their fulfillment (Rozeira, 2024).

Importantly, positive psychology began to fit into cognitive behavioral therapy (CBT) in the mid-1990s, when researchers and therapists began to explore more deeply the elements related to well-being and happiness within the context of CBT. Since then, CBT has increasingly integrated positive psychology concepts and techniques to promote not only the reduction of symptoms, but also the cultivation of positive emotions, the pursuit of personal satisfaction, and the development of a meaningful life. This movement is called the 3rd wave of Cognitive Psychology (Rozeira, 2024).

REFLECTIONS ON PSYCHIATRY AND MENTAL HEALTH

Psychiatry has been successful in decreasing people's malaise, but not always in increasing their well-being, for a variety of reasons. First, throughout its history, psychiatry has focused predominantly on the treatment of mental illness, leaving the understanding and development of mental health as a whole in the background. This limited approach may result in a lack of emphasis on increasing people's well-being, since attention is primarily focused on remediation of negative symptoms.

In addition, the categorical nature of the classifications used in psychiatry also contributes to this gap. By dividing people into categories of healthy and sick, these classifications can increase separation and contrast between the two groups, rather than promoting interventions that cultivate everyone's mental health. This emphasis on distinguishing between health and disease can disregard the complexity and individuality of each person, making it difficult to promote well-being comprehensively.

Traditional methods of diagnosis and treatment in psychiatry also have their limitations. The lengthy training required for practitioners and the costs associated with treatments can restrict the availability of these interventions to a small number of individuals, leaving many without access to the care needed to promote their mental well-being.

Furthermore, both psychology and psychiatry have historically emphasized the study of pathology and weakness to the detriment of the investigation of human strengths and virtues. This approach can result in a lack of focus on developing and promoting people's positive qualities, which are essential for increased well-being.

To promote mental well-being more effectively, there is a need to take a more holistic approach, one that recognizes the interconnectedness between the biological, psychological, social, and spiritual aspects of mental health. This includes not only the treatment of mental illness but also the promotion of factors that contribute to a meaningful and satisfying life, considering each person's individuality and cultivating their positive qualities.

The absence of mental disorders does not guarantee individual flourishing, nor a perception of fulfillment and happiness in life. Happiness is a condition that goes beyond the mere absence of unhappiness, distinguishing itself qualitatively.

Many publications choose to use the term "subjective well-being" instead of "happiness" due to the difficulty in directly addressing the concept. This preference reflects the search to measure the well-being reported by people who consider themselves happy.

HUMANIZATION OF HEALTH CARE PRACTICES

During the nineteenth and twentieth centuries, we witnessed a series of technological advances applied to healthcare at all levels of care, ranging from prevention to rehabilitation of comorbidities. Parallel to technological development, the biomedical conception often interprets disease as a deviation from biological norms, reducing complex phenomena to simple principles of cause and effect. This model, which separates mind and body, treats the body as a machine and minimizes social, psychological, and behavioral aspects (Goulart; Chiari, 2010).

It is important to recognize the contributions of technological advances, but it is also essential to consider the human, experiential, psychological, and cultural dimensions of the disease, as well as the nuances in verbal and non-verbal communication in interactions between health professionals and users (Goulart; Chiari, 2010).

In Brazil, since the 1970s, there have been debates about the role of health and patients' rights, with emphasis on the 1988 Constitution, which recognizes health as a universal right and establishes the autonomy of individuals in their health care. Beginning in the 1990s, several countries, including members of the WHO, signed declarations on patients' rights, emphasizing respect, equity, and the free exercise of individual choice (Goulart; Chiari, 2010).

According to Rozeira (2024), the fight for patients' rights reflects social and political transformations, contributing to the construction of democracy and citizenship in Brazil. In addition, there is a growing recognition of the need to invest in health professionals to ensure more humane care, considering adverse working conditions.

The humanization of health care is a relevant issue nowadays, especially in the Brazilian context, where principles such as comprehensiveness, equity and social participation require a review of daily practices, valuing both the dignity of the worker and that of the user of the health system (Goulart; Chiari, 2010; Rozeira, 2024).

Although there have been advances in the discussion and restructuring of health services, there is a scarcity of studies that address the theoretical and philosophical bases for these changes. The concepts of comprehensiveness and humanization must be discussed and contextualized to ensure their effective application (Goulart; Chiari, 2010; Rozeira, 2024).

Humanization, when conceived as a health policy, cannot be treated only as an abstract principle. Its effectiveness depends on the implementation of concrete and specific practices, but it is important to avoid compartmentalization and isolation of these actions. For example, separating the humanization of childbirth from the humanization of emergencies can limit their scope and impact (Goulart; Chiari, 2010).

In addition, it is essential to consider the conditions of health workers, who often face mechanized work processes and deal with situations of pain, suffering, and death on a daily basis.

The training of these professionals from graduation is also crucial to ensure a humanized approach to health care (Stewart, 2017).

The National Humanization Policy, launched in 2004, highlights the importance of a problem-solving and welcoming service, combating depersonalization and guaranteeing the rights of users. Humanization should not only be a moral predication, but an operative concern with the right to health, involving the reorganization of health services and practices (Rozeira, 2024).

Humanization as a State policy needs to be implemented in a transversal way, going beyond the boundaries of the different fields of knowledge involved in the production of health. This requires planning, strategic decisions, and the implementation of collective actions, always guided by the right to health (Rozeira, 2024).

To ensure comprehensive and humanized health care, it is necessary to involve all levels of management, implementation of actions and the participation of society. Everyone must be committed to this proposal, whether in the provision of health services, in working in the health sector, or in the use of health services (Rozeira, 2024).

Humanization is not only a moral predication, but a practice that requires a critical and reflective approach, involving the training of health professionals and managers. This implies questioning the foundations of the prevailing biomedical model and seeking a new practice that recognizes the experience of patients' suffering (Goulart; Chiari, 2010).

These reflections extend to several health professionals, whose education is often still based on biomedical premises. To promote humanized care, it is necessary to recognize the person and the subject, respecting their cultural diversity and guaranteeing their autonomy (Stewart, 2017; Rozeira, 2024).

The humanization of health is not limited only to clinical care, but also involves a change in the structures and labor relations in health services. This requires the active participation of all those involved, from managers to service users, and the consideration of their opinions and suggestions during the decision-making process (Goulart; Chiari, 2010).

In addition, humanization demands an integration between care practices and care management, recognizing that these processes are interdependent and inseparable. This implies changes in the organization of health services, in the dynamics of the teams, and in the planning and evaluation mechanisms (Goulart; Chiari, 2010).

Humanization in professional practice in the health sector has undergone significant transformations, especially in the relationship between health professionals and users. Previously, the excessive valuation of science often placed professionals in a position of superiority, distant from patients. However, sensitivity and affectivity are becoming essential elements in care (Goulart; Chiari, 2010).

The analysis of interactions between health professionals and users reveals the importance of non-verbal cues in communication, especially in the demonstration of feelings such as interest, attention, tranquility, surprise, tension, tiredness, restlessness, indifference, anxiety and irritation. These signals can significantly influence the quality of the interaction and the user's perception of the care received (Stewart, 2017; Rozeira, 2024).

Nurses, for example, should be attentive to their non-verbal communication, as it can facilitate or hinder interaction with users. The expression of feelings such as interest and tranquility can create an environment conducive to dialogue and acceptance, while the demonstration of irritation or indifference can damage the relationship of trust and negatively affect the user experience (Goulart; Chiari, 2010).

In addition, it is important for professionals to be aware of the contradictions between their verbal and non-verbal communication, thus avoiding distorted interpretations by users. However, many professionals are not sufficiently attentive to these aspects of communication, which can compromise the humanization of care (Stewart, 2017; Rozeira, 2024).

Humanization in the context of health goes beyond communication and involves improving the working conditions of professionals, building bonds between teams and users, and valuing values related to the defense of life and health promotion. It is a process that requires changes in the concrete practices of health services and in the way professionals relate to users (Goulart; Chiari, 2010).

However, it is important to avoid excessive idealizations about the relationship between health professionals and users, recognizing that this relationship is complex and multifaceted. Humanization does not necessarily mean that professionals should be friends or like their patients, but rather that they should offer quality care, respecting the needs and rights of users (Stewart, 2017).

Therefore, humanization in health requires a joint effort of professionals, managers, and users to promote more welcoming, respectful, and effective care. This involves not only changes in care practices, but also a broader reflection on the values and conceptions that guide health care (Goulart; Chiari, 2010).

The lack of consideration of the communicative dimensions in the doctor-patient relationship can lead to misunderstandings and difficulties in transmitting adequate information, affecting treatment adherence. Therefore, humanization requires an approach that values dialogue, attentive listening, and mutual respect between professional and patient (Stewart, 2017).

It is important to emphasize that humanization is not limited to an act of charity on the part of professionals, but rather to an encounter between subjects who share knowledge, powers, and experiences. This encounter is essential to establish healthy bonds and build a relationship of trust and respect (Goulart; Chiari, 2010).

The personal experience of professionals as patients has been valued as a source of knowledge that complements scientific knowledge. This experience allows for a broader understanding of patients' needs and expectations, contributing to a more humanized practice (Goulart; Chiari, 2010; Stewart, 2017).

Communication between professionals and patients is one of the most important aspects in the care relationship. Patients value physicians who treat them with attention, respect, and empathy, and who are able to communicate effectively. This humanized communication is essential to ensure a constructive and trusting relationship between professional and patient (Goulart; Chiari, 2010; Stewart, 2017).

Sensitivity and attentive listening on the part of professionals are essential to understand the needs of patients and offer quality care. The humanization of professional practice in the health sector requires an approach that considers not only the technical aspects, but also the emotional and relational dimensions involved in patient care (Goulart; Chiari, 2010).

The quality of care is closely linked to the time dedicated to the consultation and the communication established between professional and patient. Patients value attention and personal involvement during treatment, demonstrating expectations regarding the establishment of effective communication. On the other hand, lack of communication can generate frustration and affect the patient's perception of the quality of care (Stewart, 2017).

In addition, humanization in health also involves rethinking the process of training professionals, which is often centered on technical learning and emphasis on biomedical aspects, to the detriment of humanistic and relational aspects. It is necessary to promote training that values not only scientific knowledge, but also sensitivity, empathy and the ability to establish therapeutic bonds with patients (Stewart, 2017; Rozeira, 2024).

By recognizing that patients' emotional well-being is as relevant as their physical health, we make room for a more comprehensive and effective approach to health care (Rozeira, 2024).

After reading this study, we will conclude that humanization in medical care is not limited to clinical procedures and drug prescriptions; It also encompasses the ability to establish meaningful and empathetic connections with patients. In this context, the science of happiness plays a key role, as it seeks to understand the factors that contribute to a full and satisfying life.

By applying the principles of the science of happiness in clinical practice, we are prioritizing not only the cure of disease, but also the promotion of the integral well-being of patients. This implies considering their emotional, social, and psychological needs, in addition to purely medical issues (Rozeira, 2024).

Through humanization and the science of happiness, healthcare professionals can offer more complete and compassionate care that takes into account not only the body but also the mind and

spirit of patients. This not only contributes to the success of the treatment, but also to the construction of a relationship of trust and collaboration between professional and patient (Rozeira, 2024).

FINAL THOUGHTS

Happiness is a rich and plural experience that reveals itself in many ways in our human journey. Over time, we've learned that happiness isn't just a single or definitive state, but rather a complex tapestry of moments, emotions, and interactions that bring us joy, satisfaction, and meaning. This diversity and complexity of happiness is reflected in our everyday language, such as when we wish "lots of happiness" in celebrations, recognizing that there are myriad ways and nuances to experience well-being and contentment in life.

An inspiring example of this plurality of happiness can be found in genuine interactions with children. Your innate ability to live in the present moment, express emotions unfiltered, and find joy in the little things in life serves as a powerful reminder of the purity and simplicity of happiness. In special moments of connection and sharing with children, we experience an exchange of mutual happiness that connects us to a deeper, more authentic dimension of our humanity.

Carlos Drummond de Andrade, in his poetic wisdom, masterfully captured the essence of these ephemeral moments of happiness. His words resonate with us, reminding us of the importance of finding happiness in the little things and the absence of apparent motive. It invites us to cherish and celebrate the moments of joy and contentment we encounter on our daily journey, acknowledging the beauty and fragility of these precious moments (Roitman, 2022).

Csikszentmihalyi (1990) notes that despite advances in health, technology, and scientific knowledge, little is known about happiness compared to the ancient Greeks. He criticizes contemporary values that associate happiness with wealth, consumption, and physical appearance, stating that such values are ineffective in the pursuit of happiness.

Most aspects related to happiness are psychological in nature, such as personality, optimism, resilience, and positive emotions. Sociocultural issues, such as religiosity, can influence happiness in part through these emotional aspects.

The rise of happiness to the status of a science, particularly through Positive Psychology, represents a significant evolution in the understanding and appreciation of human well-being in all its complexity and plurality. This innovative approach emphasizes the importance of cultivating human virtues, strengths, and aspirations as essential components in the pursuit of a full, meaningful, and happy life.

By embracing the plurality and complexity of happiness in all its forms and nuances, we can enrich our lives and promote more complete and sustainable well-being. This ongoing journey of discovery, appreciation, and celebration of the precious moments that life offers us invites us to

cultivate a deeper and more meaningful relationship with happiness, guiding us in our search for a life filled with joy, meaning, and connection.

The rise of happiness to the status of a science, particularly in the field of Positive Psychology, marks a significant evolution in the understanding of human well-being. This approach promotes the development of human virtues and strengths as essential components in the pursuit of a full and meaningful life. Additionally, integrating the science of happiness as a healthcare strategy offers a more holistic approach to medical care, strengthening the relationship between healthcare providers and patients and contributing to a more empathetic and effective care environment.

The science-centered approach to happiness offers an innovative and comprehensive perspective for health promotion and the humanization of health care. By focusing not only on treating disease but also on promoting human flourishing and quality of life, this approach recognizes the importance of considering patients' emotional, social, and psychological well-being.

Understanding the potential benefits of this approach is critical to transforming the way we deliver healthcare. Firstly, by integrating principles of positive psychology into clinical practices, healthcare professionals can help patients develop effective coping skills, foster emotional resilience, and strengthen the internal resources needed to cope with life's challenges.

The integration of happiness science as a health strategy provides a more holistic and humanized approach to medical care. Prioritizing emotional and mental well-being in addition to physical health, this approach strengthens the relationship between healthcare professionals and patients, contributing to a more welcoming, empathetic, and effective care environment. By adopting this perspective, healthcare becomes more compassionate and patient-centered. This implies that professionals not only treat physical symptoms, but also consider the emotional, social, and environmental context in which patients are embedded.

This approach can also contribute significantly to the humanization of health care, strengthening the relationship between health professionals and patients. By acknowledging and valuing each patient's individual experience, healthcare providers can create a more welcoming, empathetic, and supportive environment where patients feel heard, understood, and respected.

By promoting human flourishing and quality of life, healthcare becomes more proactive and preventive, seeking not only to treat existing diseases but also to prevent future health problems from arising. This involves educating patients about healthy lifestyle habits, encouraging physical activity, a balanced diet, adequate sleep, and stress management.

In conclusion, by recognizing and cultivating happiness as a fundamental aspect of the human experience, we can enrich our lives and promote more complete and sustainable well-being. This ongoing journey of discovery and appreciation of the precious moments that life offers us invites us to embrace happiness with gratitude, joy, and a deep sense of purpose.

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Social media and quality of life – For good or for bad?

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ABSTRACT

The internet emerged in Brazil in the early 90's, in states such as Rio de Janeiro and São Paulo, first with access only to Universities and for research purposes and soon after with home access networks and mobile networks that went viral in all sectors and became an instrument of communication and information in all age groups. Whether it's for meeting and meeting people, as well as for shopping, traveling, research, among

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others. Along with the internet came the social media Orkut, Facebook, Whats App, Twitter (X), Instagram, Linkedin, and now the TIk Tok, where everyone can post any kind of opinions that in some cases can have a harmful characteristic. Social media has been used to look for jobs, to shop, to study, to date, to research, and many other functions. On any subject, the internet offers a multitude of sites of everything you want to know, just type and wait for the results. However, what has been observed in recent years is the increase in access to websites directed to information, as well as the increase in people who use this tool, in order to know a little more about various subjects, This study aims to describe, through a narrative bibliographic review, describe the role of social media and its influence on the quality of life in society.

Keywords: Social Media, Sources of Information, Quality of Life.

INTRODUCTION

In Brazil, internet access to the general public was still made available to the general public in a very timid way, with the action of the Federal Government (through the Ministry of Communication and the Ministry of Science and Technology) in an attempt to implement the necessary infrastructure and define parameters for the subsequent operation of private companies providing access to users. Since then, internet access in our country has experienced a tremendous growth. According to the IBGE, in 2013, 7.2 million Brazilians accessed the internet through a tablet or cell phone, and even at that time the computer was still responsible for the largest number of accesses (IBGE, 2018; DIZARD, 2000; BRAZIL, 2014).

The Internet, or global information system, is formed by a worldwide network of interconnected computers, represents today the largest repository of information known in the world, and is available to any individual who accesses the network anywhere (DIZARD, 2000; BRAZIL, 2015). The arrival of this technology has brought countless facilities to people's daily lives, as well as contributed immensely to the advancement of science, sales, socialization, administrative processes, leisure, communication and knowledge. Developed countries have been investing more and more in the area of technoscience (F0X, 2004).

In this way, how the internet has been contributing with information related to various areas of knowledge, studies (XAVIER, 2013; PAIVA 2013) report that it could influence lifestyle, as well as early detection of health problems and disease, or even cause a disease when misused. However, we must not forget that the Internet and more recently the Social Media Boom can have their positive side, as long as health promotion strategies can be disseminated through this means of communication in order to promote quality of life. The objective of this study is to describe, through the narrative literature review, the role of social media as a source of information and quality of life today.

METHODOLOGY

This is a narrative literature review study, where studies define narrative as a way of understanding experience in a process of exchange between researcher and researched. Narrative research can be described as a methodology that consists of collecting stories about a certain topic, where the researcher will find information to understand a certain phenomenon. In this study, we sought references on the theme Social Media and its relationship with Quality of Life, in the SciELO and PubMed databases. We chose to use the narrative literature review due to the scarcity of studies related to the theme, as well as its relevance today. Only 12 articles were found in PubMed, and 3 in Scielo on the subject using the descriptors Social Media and Quality of Life. For this study, the inclusion criterion "Social Media and Quality of Life" was determined in a composite manner.

RESULTS

It is necessary to understand that information technology and the increasingly constant use of the internet have been significantly changing the way people interact with each other, and this involves communication, relationships and connection with the world. However, the use of this technology, depending on the user, may represent in some cases a barrier to be overcome if the life history, education, culture, language, health, among other aspects, which will influence the use of this technology, are considered. (XAVIER, 2013; PAIVA, 2013).

With the advent of instant messaging-related applications, there is a greater interest in individuals using the Internet, including elderly people who some time ago had no interest in the Internet, whether for communication with a distant loved one, or for communication with friends or even the formation of chat groups (MIRANDA, 2009; IBGE, 2020; BRAZIL, 2017).

The transition from analog to digital technology represented a significant rupture for individuals in the various life cycles, who became accustomed to living with technologies of a different order, different from radio and TV. The use of instruments of the digital age represents a new learning, which does not allow the use of previous knowledge to build this skill, and in this way, lead to a positive impact on the cognitive exercise carried out in the attempt to discover this tool (BAUDIN et al 2020; PAIVA, 2013; MARTERS, 2008).

According to 2022 PNAD data, the number of Brazilians who accessed the internet was 161 million. The number of people aged 10 and over who accessed the internet in 2022 in Brazil jumped to 161.6 million. This represents 87.2% of the national population, compared to the 84.7% recorded in 2021. When the data relate to the elderly over 60 years of age or older who use the Internet, it rose from 24.7% in 2016 to 62.1% in 2022 (IBGE, 2024).

Also according to the PNAD – National Household Sample Survey – (IBGE, 2024), with regard to private school students, they represent 98.4% of users against 89.4% of public school students who used the Internet in 2022. Also according to the report, the most used equipment to access the Internet in 2022 was the mobile phone (98.9%), although with a considerable difference, followed by TV (47.5%) (IBGE, 2024).

The number of individuals, according to these studies, who accessed the internet via microcomputer decreased from 63.2% in 2016 to 35.5% in 2022. Access to the internet through tablets also fell from 16.4% to 7.6% in this period. The Continuous PNAD program also investigated, for the first time in 2022, the frequency with which people used the Internet: 93.4% used it every day, 94.4% of users accessed the internet to talk by voice or video calls. Also according to the IBGE, (2024). Other purposes reported were: sending or receiving text, voice or image messages through applications other than e-mail (92.0%); watching videos, including programs, series and movies (88.3%) and using social networks (83.6%) (IBGE, 2024).

According to PNAD data, adolescents spend more and more time online and connected to each other through digital technologies, as well as being the ones who use social media the most. Mobile device ownership and social media use have reached unprecedented levels, and concerns have arisen that this constant connectivity may harm the mental health of users in general, especially adolescents who are still in the process of cognitive impairment (ANDREASSEN, 2016).

There is widespread speculation that the rise in depression and anxiety is being driven by changes in the way teens interact with each other through social media and time online. The claims are that teens are increasingly missing out on opportunities to socialize and are more likely to be harassed and victimized online by being under constant attack from idealized people and at the mercy of carefully curated images that can lead to upward social comparisons, envy, and in turn, lower well-being and increased rates of depression. studies demonstrate inconsistent and mostly small associations between the amount of digital technology use and mental health, without any way of discerning the cause of the effect (APPEL and CRUZIUS, 2016; ARND-CADDIGAN et al, 2017; TWENGE, Jean M. et al., 2018).

In developed countries such as the United States, when it comes to Internet user profiles, it is observed that more and more people are using the internet as a source of information and guidance, for flirting, to demonstrate their skills and knowledge, to understand health problems or related to the promotion of health and well-being (ZICHUHR, 2012).

According to the WHO (World Health Organization), Quality of Life is defined as the perception that an individual has of his or her life, in the context of the culture and value systems in which he or she lives and in relation to his or her goals, expectations, standards and concerns. However, the Internet and Social Media fit the pattern of perception and culture of modern society. (WHO, 2024; OLIVEIRA, 2020).

However, despite the role of the internet today and its importance in this globalized world, as a source of information and connection between individuals, it is possible to observe a multitude of sites with harmful content to users, where the phrase "Internet lawless land" is used. In Brazil, the journey to control this content is beginning, but it is believed that Social Media offers outdated or even misleading information on various topics considering current scientific knowledge (MOURA, 2021; Center for the Digital Future The World Internet Project, 2016; MARTESR, 2008).

Due to the reach of the internet to the most varied groups, it has been used in the recruitment of participants in scientific studies, due to the wide reach of the network, as well as the growing use of social media by the general population. Social networking sites such as Facebook, Twitter(X) and Google+, Instagram and Tik-Tok provide access to the most diverse populations of readers who make use of the social network (BENDER, 2017; MOURA, 2021).

There is widespread speculation that the rise in depression and anxiety is being driven by changes in the way teens interact with each other through social media and time online. The claims are that teenagers are increasingly missing out on opportunities for face-to-face interaction (Arnd-Caddigan, 2017), are likely to be harassed and victimised often online, and are under constant attack from idealised people and carefully crafted images, for a reality that often does not exist.

FINAL THOUGHTS

In the field of research, the use of social networks offers benefits such as identification of risk conditions, dissemination, information and promotion of positive changes in behavior. However, ethical considerations regarding the use of social networks for vulnerable individuals such as children and adolescents who, according to what is presented in this study, are mostly Internet users, the digital world can bring with it rapid and unprecedented changes in the way individuals spend time, connect to the world, and communicate with each other. Mobile ownership and social media use have reached unprecedented levels among today's society, even in the most remote places. Perhaps this is not surprising, as digital devices and the possibilities they provide are especially strong attractions for young people, given their high need for affiliation, social approval and novelty seeking. As individuals spend a large part of their time using social media, there is an urgent need to understand the effects of this use and to harness new technologies in ways that support without harming mental health and wellbeing. Social Media could be an instrument to promote quality of life, however the scarcity of studies on the subject and the lack of control over the contents found is still a barrier to be broken, so that we can understand its role in our society, benign or malignant.

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Artificial Intelligence in dentistry: Advances and applications in modern clinical practice

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ABSTRACT

The use of Artificial Intelligence (AI) has become relevant in several areas in recent times. The applicability of AI in healthcare points to promising results by helping with stages such as diagnosis, planning and treatment, increasing the possibility of success. With this in mind, this chapter discusses the latest advances in AI in the dental specialties of periodontics, dentistry, prosthetics, oral and maxillofacial surgery and legal dentistry, highlighting its benefits and future prospects.

Keywords: Artificial Intelligence, Dentistry, Machine Learning, Deep Learning, Neural Network.

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INTRODUCTION

In the last few years, there have been many technological advances, especially in the development of Artificial Intelligence (AI). AI comprises a field of science that seeks to enable machines to perform tasks that use human intelligence. Given its popularity, some AI models have attracted attention, such as ChatGTP, Siri, Alexa and Google Assistant, as they simplify everyday tasks and open up new forms of interaction and collaboration between humans and machines. The potential of AI goes beyond virtual assistance and is being used in various sectors, including medicine, finance, manufacturing and transport, helping to innovate and optimize processes.

The inspiration for the emergence of AI began in 1943 when some scientists began to question whether it was possible to replicate the structure of a neuron that makes up the human brain, at which point they created the first simplified concept of a brain cell in a mathematical model (McCulloch & Pitts, 1943).

In 1950, Alan Turing created a test called the "Turing Test", which assessed the machine's ability to simulate conversation with humans, in such a way that if the human could not distinguish whether they were talking to another person or to the machine, the machine was an intelligent machine (Turing & Haugeland, 1950).

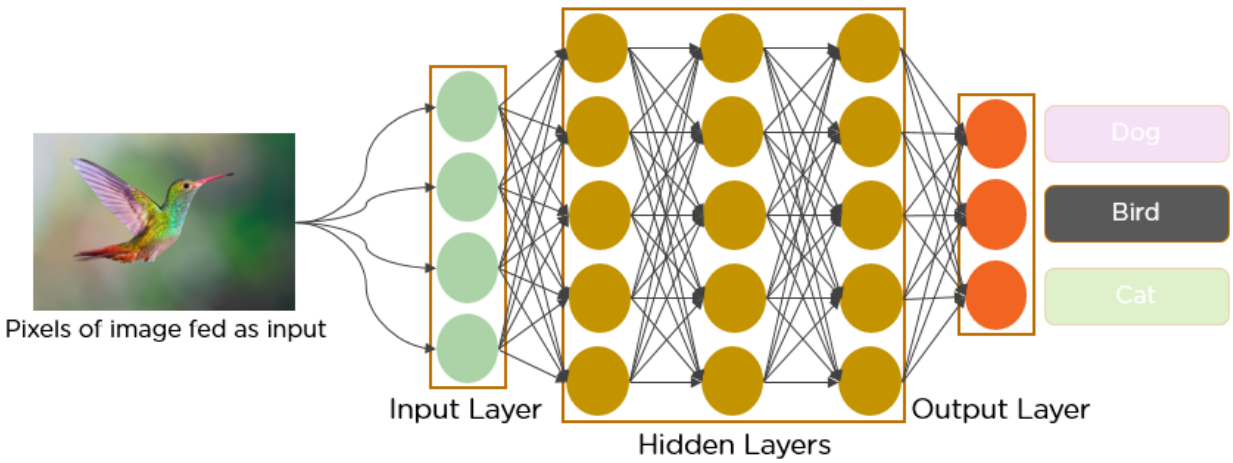
In 1955, at Dartmouth, the term "artificial intelligence" was presented by John McCarthy, Marvin Minsky, Nathaniel Rochester and Claude Shannon. The researchers sought to discover how to instruct machines to use language, forge abstractions and concepts, solve classes of problems exclusive to humans and improve themselves (McCarthy, Minsky, & Rochester, 2006).

Throughout this process, Artificial Intelligence has taken shape and is now subdivided into various segments, some of which are Machine Learning (ML) and Deep Learning (DL). In ML, systems are trained to carry out intelligent activities without the need for pre-established rules, adjusting themselves based on examples provided. This is especially relevant in healthcare, where ML can identify patterns in diagnostic data, improve treatments and even help in the discovery of new drugs, thus reducing human error and improving patient care (Alowais, Alghamdi, Alsuhebany et al., 2023).

DL is a part of ML in which systems learn not only isolated patterns, but also a combination of them, resulting in a complex system. The difference between DL and ML lies in the learning approach and the amount of data used. The pillars of DL are Artificial Neural Networks (ANNs), which mimic the neurons of the brain in a non-linear mathematical model. These networks consist of three layers: input (where information is entered), hidden (where processing takes place) and output (where decisions are made). The aim is to hierarchically organize the input information in order to calculate the correct values at the output, simulating human cognitive skills such as problem-solving and decision-making (Nguyen, Larrivée, Lee, Bilaniuk, & Durand, 2021).

There are different variations of ANNs, and another that is widely used in the field of dentistry is Convolutional Neural Works (CNNs), a specialized type of artificial neural network that is very useful for extracting image characteristics through convolutional operations. Using a special architecture for connecting neurons and mathematical operations to process digital signals, it is the most widely used algorithm for image recognition (Ding el al., 2023).

Figure 1. Example of a CNN's functionality.



Source: https://www.analyticsvidhya.com/blog/2021/05/convolutional-neural-networks-cnn/

AI is emerging as a promising tool in the field of dentistry. Its use is increasingly relevant in areas such as periodontics, dentistry, dental prosthetics, oral and maxillofacial surgery, and legal dentistry.

Its applications are mainly focused on diagnosis, clinical decision-making, therapeutic planning and prognosis, which highlights the many benefits of its incorporation into routine dental practice (Nguyen, Larrivée, Lee, Bilaniuk, & Durand, 2021; Ossowska, Kusiak, & Świetlik, 2022; Ding et al., 2023).

This technology, when applied effectively, has the potential to revolutionize care in various dental specialties. The journey towards an AI-assisted future in dentistry has already begun and its impact promises to be transformative.

APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN DENTAL SPECIALTIES

PERIODONTICS

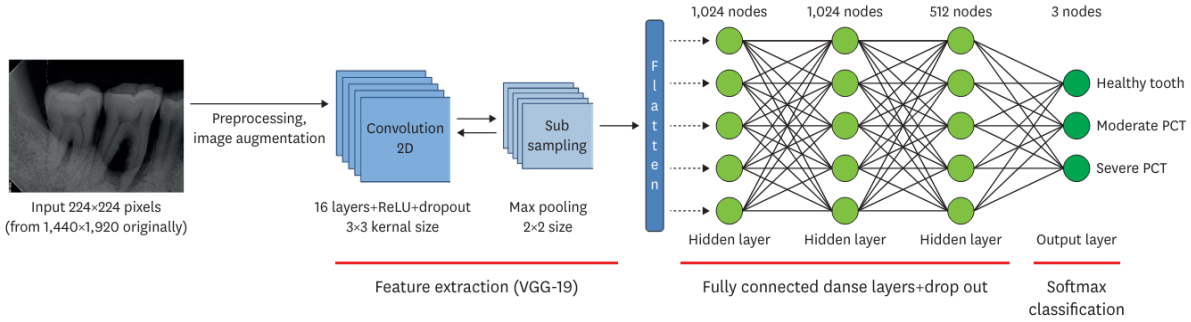
Periodontics is an area of dentistry whose function is to protect and treat the tissues of the periodontium affected by periodontal diseases, such as periodontitis, where bone resorption occurs and, consequently, tooth loss.

AI has shown promise in this area, with several studies demonstrating the effectiveness of using CNNs to diagnose periodontal problems. Krois et al. (2019) and Chang et al. (2020) used

CNNs to analyze radiographs in order to provide efficient diagnoses and predictions about periodontal disease, comparing the results with the opinion of experienced professionals in the field. The data obtained was similar when compared to the professionals, indicating that the use of CNNs can help in the imaging diagnosis of periodontal disease.

It is important to note that these studies have some limitations, such as the limited availability of databases and the variable quality of the radiographs. For the system to work properly, high quality radiographs are required, but this is not always the case.

Figure 2. Demonstration of the functionality of CNNs in the evaluation of radiographs for the assessment of healthy teeth, moderately periodontally compromised teeth and severely periodontally compromised teeth.



Source: Copyright by Chang et al., 2020.

Therefore, the use of neural networks can help dentists diagnose periodontal disease. However, in order to achieve a more accurate diagnosis, it is essential to carry out a clinical examination, including the use of a periodontal probe to assess bleeding and probing depth, as well as pulp tests, which are fundamental to the final diagnosis (Lee, Kim, Jeong, & Choi, 2018).

Thanathornwong and Suebnukarn (2020) highlight the importance of prospective studies aimed at improving the techniques used in AI systems. In addition, the search for more up-to-date neural network systems could make a significant contribution to advances in the diagnosis of periodontal disease.

RESTORATIVE DENTISTRY AND PROSTHODONTICS

Restorative Dentistry is the branch of dentistry that works to repair teeth through restorative treatments, while prosthodontics covers the manufacture of parts that are capable of restoring the crown of teeth or replacing teeth in spaces where they are missing, with the aim of re-establishing oral function.

With technological development, workflows in these areas have increasingly used digital resources and, as a result, AI applications have been increasing progressively. Currently, there are reports of AI models as a tool with the potential to assist in various stages of restorative treatments, with applications ranging from the diagnosis of the oral condition and initial planning to the

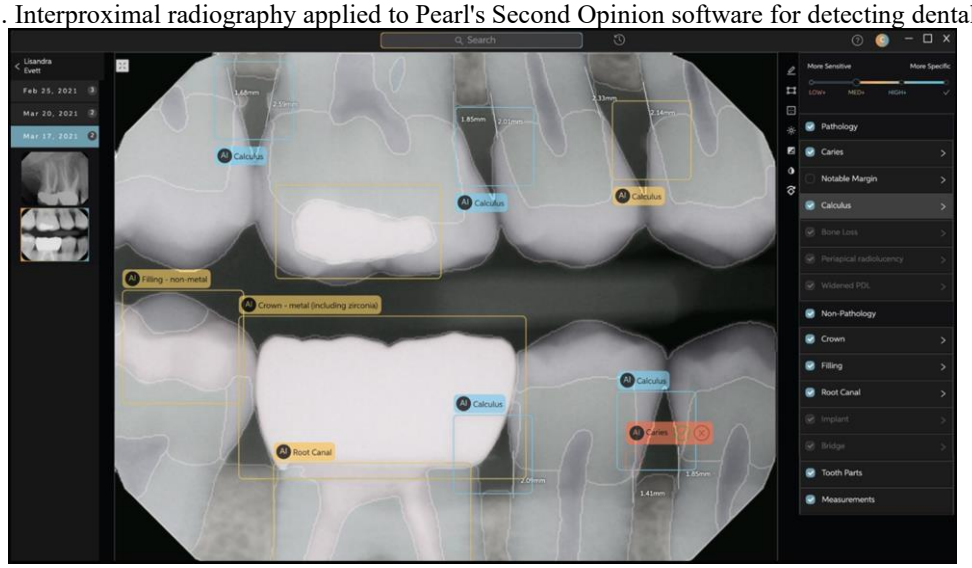
manufacture of prosthetic parts, which enables more efficient work processes and treatments than the methods usually used (Ahmed et al., 2021; Ding et al., 2023; Revilla-León et al., 2023).

The application of CNNs to aid in the diagnosis of dental condition has been evaluated by some studies and has been successful in detecting proximal lesions on interproximal radiographs when compared to professionals in the field (Chen, Guo, Ye, Zhang, & Liang, 2022).

This technology was also able to correctly identify caries on occlusal and smooth surfaces, as well as classify them into non-cavitated or cavitated caries lesion categories using photographs of permanent teeth as a basis. The findings reinforce the high viability of applying AI methods to diagnose dental caries by being able to do so with greater precision (Kühnisch et al., 2022).

One of the most recent advances in AI for diagnostic purposes was the creation of Pearl's Second Opinion software, which surpassed human accuracy in detecting signs of common dental pathologies and conditions on radiographs, such as incipient caries or early signs of periapical radiolucency (Kukucka, 2024).

Figure 3. Interproximal radiography applied to Pearl's Second Opinion software for detecting dental caries.



Source: https://www.hellopearl.com/products/second-opinion

Some researchers have developed an AI-based computer vision algorithm programmed to analyze panoramic radiographs in order to automatically detect and classify dental restorations, achieving a success rate of over 90% for both purposes (Abdalla-Aslan et al., 2020).

In addition, AI technology has performed well in predicting the likelihood of composite resin crowns detaching. This was proven in a study that evaluated crowns manufactured using computer-aided design/computer-aided manufacturing (CAD/CAM) by analyzing images of dental preparations in 3D models obtained by scanning selected patients. In this way, by being able to predict possible failures, the use of AI directs the production of restorations with greater precision and safety (Yamaguchi et al., 2019).

Technological advances are also present in CAD/CAM, with the implementation of AI Scan 2.0 in the 3Shape TRIOS intraoral scanner, which facilitates the digitization of mandibular and maxillary components. AI Scan 2.0 displays intelligent discernment by identifying soft tissue along with other crucial intraoral details. The result is a flawless final digital document that accurately encapsulates the patient's intraoral situation free of unnecessary soft tissue information and therefore more useful in clinical applications (Ding et al., 2023).

Figure 4. Scanner 3Shape TRIOS.



Source: https://www.3shape.com/en

Other applications of AI are also present in the automatic design of crowns and removable partial dentures, which is becoming increasingly relevant in helping with procedures such as selecting tooth color, mapping the finishing line of preparations and predicting facial changes in patients with removable dentures (Revilla-León et al., 2023).

Crowns produced by 3D printing in composite resin using AI obtained better marginal adaptation to the preparation, as well as considerably reducing the time spent when compared to other methods involving human labor, such as waxing and digital drawings (Liu et al., 2024).

An AI method called 3D-Deep Convolutional Generative Adversarial Network (3D-DCGAN) was used to automatically produce dental crowns using lithium disilicate material. As a result, the designed pieces showed greater similarity to natural teeth in terms of both morphology and biomechanics, indicating that this technology is capable of offering high precision in the reproduction of customized dental crowns (Ding et al., 2023).

AI also contributes to analyzing and improving the composition of prosthetic parts. AI has been able to identify the components that are effective in providing high flexural strength of

composite resin and thus predict greater success of the materials' performance in masticatory function (Li et al., 2022).

Optimization in the casting process of metal prosthetic parts was also possible in another study, due to the minimization of porosity in the cast metal and a reduction in overall manufacturing time. In view of the above, there is a greater chance of achieving the desired results in rehabilitation with prostheses produced using AI (Revilla-León et al., 2023).

It should be noted that, given the benefits of technologies that apply AI, both dental professionals and patients benefit from the possibility of more accurate diagnoses, more efficient planning and execution of procedures, automatic and agile production of prosthetic parts, as well as greater comfort, safety and speed in restorative and prosthetic treatments. It is considered that improvements still need to be made to overcome some limitations, such as providing improved information, and more studies are needed to broaden the scope of clinical applications.

BUCOMAXILLOFACIAL

In the area of oral and maxillofacial surgery, the responsible professional is characterized as an bucomaxillofacial, who will work in the diagnosis and treatment of conditions related to the face, mouth, jaw and associated structures, trained to deal with a variety of conditions, including congenital craniofacial deformities, facial trauma, jaw diseases, orofacial tumors, temporomandibular dysfunction and orthognathic surgery.

Mouth cancer

Lately, there has been growing interest in the application of AI techniques for the prognosis and diagnosis of oral cancer. These techniques encompass ANNs, genetic algorithms, fuzzy logic, among others, and are emerging with a substantial impact, refining diagnostic accuracy in various medical disciplines (Al-Rawi et al., 2022).

Some research that employs ANNs for the early detection of oral cancer, using technology that includes the digitization of cytological slides, has already shown the effectiveness of AI to be comparable to that of conventional cytology and histology (Al-Rawi et al., 2022).

Another study using CNNs to classify tongue cancer patients based on oral endoscopic images showed acceptable performance in diagnosing tongue cancer, revealing that CNNs are more effective at discriminating between mild and severe malignant lesions. CNN algorithms are proving to be a suitable tool for cancer detection. In another study, it was possible to identify and distinguish between several different types of tumors using intraoral optical images (Heo et al., 2022).

Figure 5. Endoscopic Device.



Source: The Autors 2024.

AI shows greater accuracy in analyzing and predicting oral cancer compared to traditional diagnostic methods. In addition, most AI algorithms show accurate results in predicting the occurrence of oral cancer (Rosma et al., 2010).

It can be concluded that artificial intelligence is more accurate at analyzing and predicting oral cancer than traditional diagnostic methods. In addition, most AI algorithms show accurate results in predicting the occurrence of oral cancer (Chauveron et al., 2024).

Facial prostheses

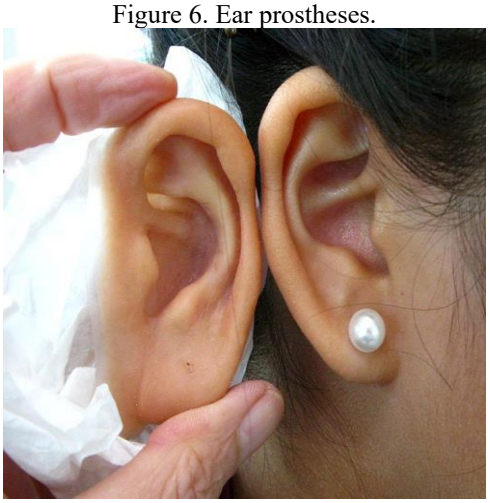
In a field where science, technology and aesthetics converge synergistically, bucomaxillofacial specialization stands out for its unique ability to restore not only functionality, but also aesthetics in subjects affected by facial deformities, mostly caused by cancer treatments and severe mutilations resulting mainly from car accidents. When patients undergo cancer removal, they will have facial deformities, and a multidisciplinary medical team has developed significant projects in which patients' facial appearance and functionality are restored through facial prostheses.

This specialty can be seen as the only viable method for social integration, directly contributing to their quality of life (Carvalho et al., 2013).

These professionals need extensive anatomical knowledge, especially when deformities affect reference points of unique facial elements, such as the nose, so canonical measurements are crucial for harmonious integration of the face (Cardoso et al., 2006).

Conventionally, facial prostheses are made by replicating the patient's individual features using a plaster and alginate matrix. From these molds, plaster or wax models are replicated, which are subsequently filled with the elastomer (Carvalho et al., 2013).

Figure 6. Ear prostheses.



Source: https://br.pinterest.com

Despite morphological and symmetrical understanding, professionals face significant restrictions in the production of materials, due to the propensity for inadequate results, including the formation of bubbles or failures in anatomical transfer (Brophy, 2005).

The integration of technology in identity reconstruction is emerging as a promising alternative in the manufacture of 3D facial prostheses, offering speed and a high aesthetic standard. 3D printers initially use images from the Eigenfaces library, the Eigenfaces method extracts and encodes relevant information from the facial image for analysis (Agarwal et al. 2010).

Some authors propose an approach for restoring gaps in images using RNCs, demonstrated using the example in the following figure (Liu et al. 2018).

Figure 7. Facial reconstruction representation using CNNs.



Source: The Autors 2024.

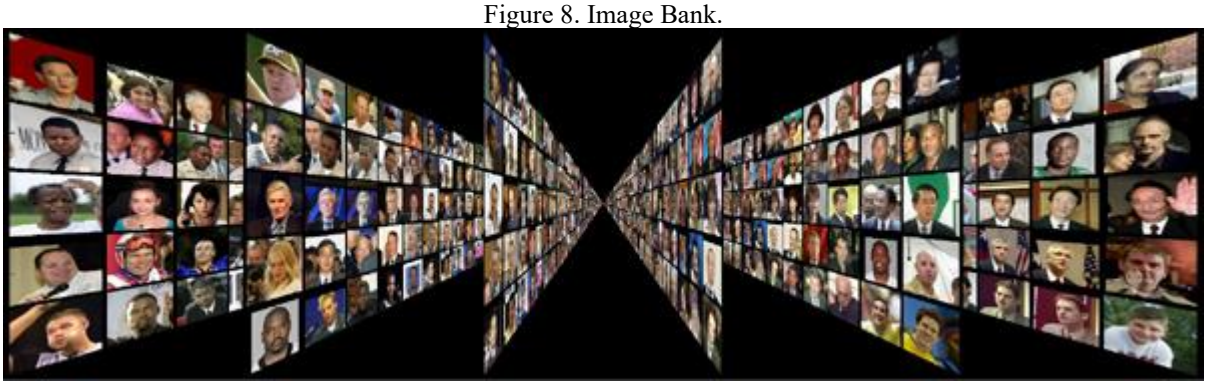
The first tests were not very effective. Analyzing the images using neural networks proved costly, especially as the resolution increased from 64x64 to 1000x1000 pixels (Albawi et al., 2017).

Like researchers in the past, the search for improved rehabilitation methods for mutilated patients continues, and in this context, AI has emerged to address the challenges faced in creating facial prostheses (Albawi et al., 2017).

Important references to large, labeled data sets:

1. **Labeled Faces in the Wild (LFW)**: Database with more than 13,000 images of faces collected from the web, with each face labeled. Last updated in May 2017.
2. **Bosphorus Database:** Aimed at 3D and 2D human face processing research, with 4666 images of faces from 105 subjects.
3. **ImageNet**: Data set with more than 15 million high-resolution images, labeled in 22,000 categories, collected and labeled using Mechanical Turk.

Figure 8. Image Bank.

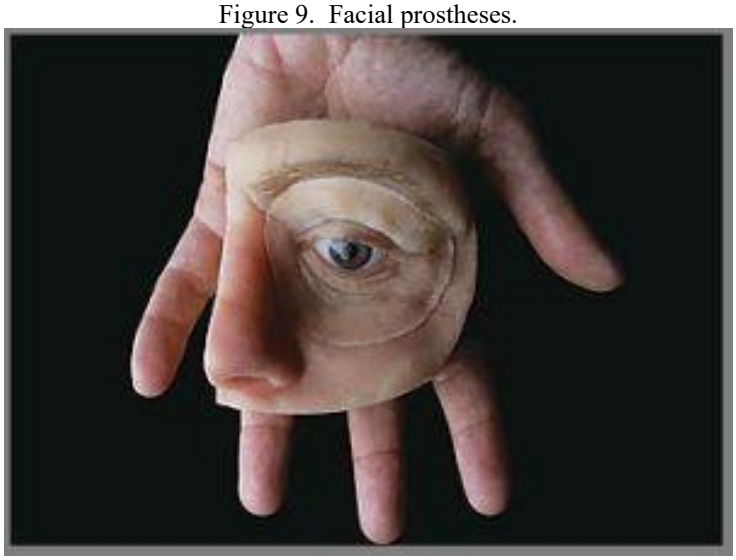


Source: https://vis-www.cs.umass.edu/lfw/

The effectiveness of an image processing algorithm is intrinsically linked to the quality of the image on which it is used (Agarwal et al. 2010).

The production of 3D facial prostheses begins with capturing images of the patient's affected region, using artificial intelligence to analyze proportions and facial features. Once the model has been approved, artificial intelligence coordinates the manufacture of the prosthesis, considering both aesthetic and functional aspects, using the 3D printing technique (Agarwal et al. 2010).

Figure 9. Facial prostheses.



Source: https://br.pinterest.com

Therefore, in the field of prosthesis manufacturing, the technology employed allows for the integral production of these devices through the combination of 3D printers and AI. This approach, based on the plasticity of these technologies, makes it possible to precisely shape the different constituent parts of the prosthesis, ensuring meticulous customization to meet the patient's functional and aesthetic needs (Becker et al 2016).

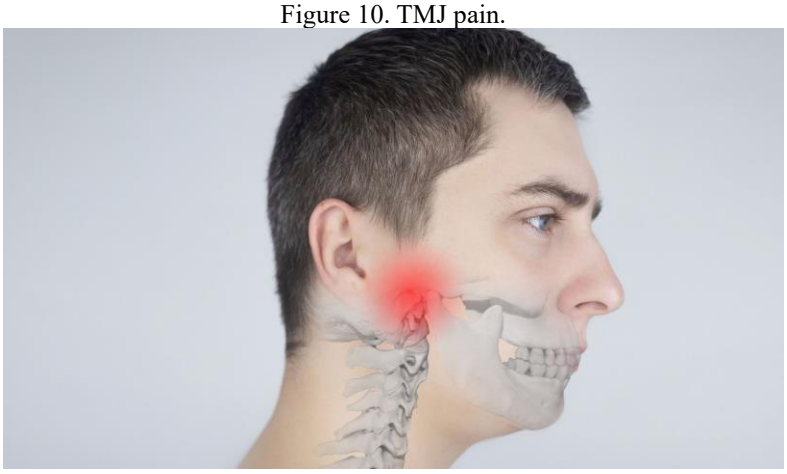
Temporomandibular disorder

Still in the field of bucomaxillofacial, we are faced with other challenges such as TMD (temporomandibular disorder), where we are seeing success with the inclusion of AI.

Generally, TMJ (temporomandibular joint) disorders include medical conditions that affect the joint and its associated structures, resulting in pain in the jaw joint, dysfunction and discomfort in surrounding areas (Ozsari, Güzel, Yılmaz, & Kamburoğlu, 2023).

Data acquisition for the automated diagnosis of TMJ-related diseases plays a crucial role in ensuring the accuracy and reliability of the diagnostic process. The types and quality of data used to train and test ML and DL algorithms significantly influence the system's performance in identifying and categorizing TMJ-related conditions (Fang, Xiong, Lin, Wu, Xiang & Wang, 2023; Ozsari, Güzel, Yılmaz, & Kamburoğlu, 2023).

Figure 10. TMJ pain.



Source: The Autors 2024.

Using clean and reliable data minimizes the risk of false positives or false negatives and improves the overall performance of the system. The size of the data set used to train the algorithm is extremely important. Ensuring diversity in the dataset, covering a wide range of TMD-related cases, is crucial to allow the algorithm to deal with various conditions and manifestations. A diverse dataset avoids bias towards specific types of TMD and improves the system's ability to recognize less common disorders (Diniz de Lima, E. et al., 2021; Farook, Jamayet, Abdullah, & Alam, 2021; Ito, S. et al., 2022; Ozsari, S. et al., 2023).

LEGAL DENTISTRY

Legal dentistry is a field of work that was regulated in Brazil in the last century and its function is to apply dental knowledge to the interests of justice in order to analyze, expertize and evaluate phenomena of various kinds that may affect humans, provided that such an event is supported by the competence of the dental surgeon (Gobbo et al., 2021; Trevisol et al., 2021; Vaswani, Caenazzo & Congram, 2023).

The development and advancement of technologies has frequently revolutionized the most diverse areas, and forensic dentistry is no different. The use of AI as a means of aiding forensic examinations has been increasingly studied with the aim of providing a support system for forensic examiners (Neto et al., 2019; Mohammad, Ahmad, Kurniawan & Yusof, 2022).

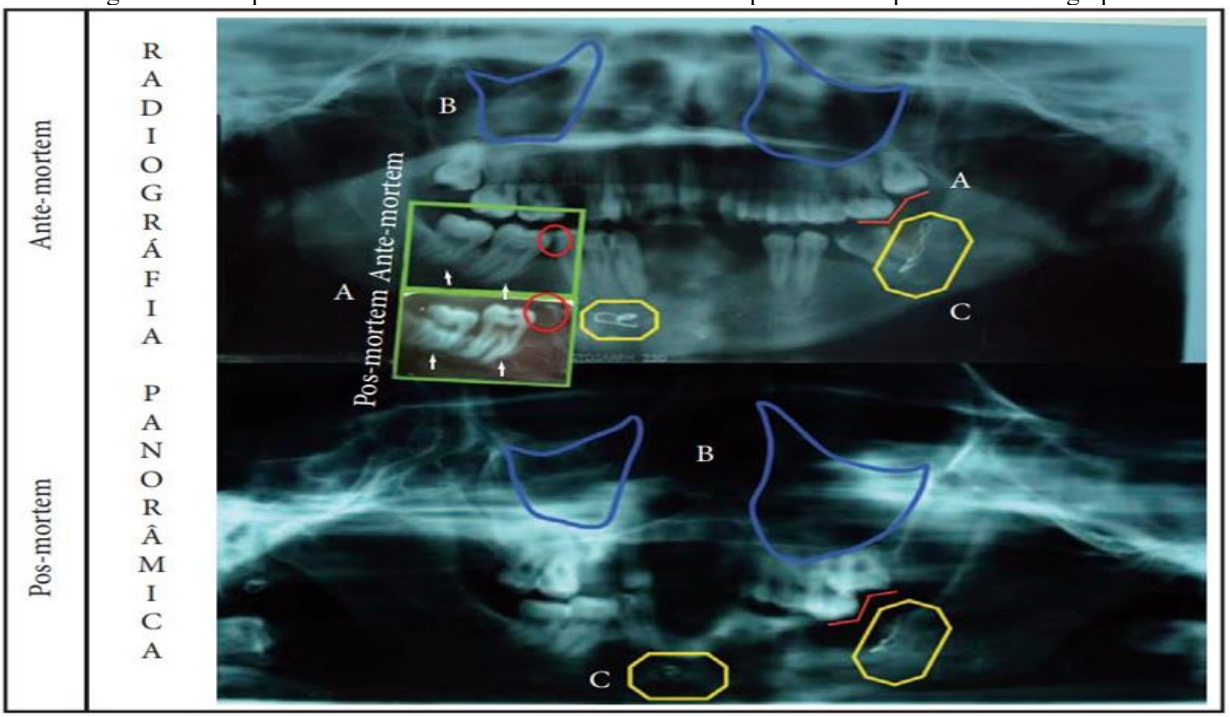
The human identification process is of paramount importance to guarantee human dignity in a number of contexts. In view of this, there are 3 basic methods:

1. Dactyloscopy, a strategy that may not be applicable depending on the individual's condition;
2. Through forensic dentistry, a method that can be applied both in simple situations and in extreme occasions, such as natural disasters with many deaths, due to the great resistance of teeth and adjacent structures;

3. DNA identification, which is a more precise technique, but is time-consuming and exorbitantly expensive (Blau, Graham, Smythe & Rowbotham, 2020; Trevisol et al., 2021).

In this context, AI, with the application of its subfields, has the potential to provide a structured decision support system for dental examiners. By training AI with pre-processed X-ray data, where they are trained to identify relevant characteristics in the images, such as structures, restorations, tooth loss and other properties, they would be able to recognize and evaluate the similarities and differences between the information collected before and after death, being able to support the expert in the decision of whether the information agrees or not (Neto et al., 2019; Fan et al., 2020; Kim, Ha, Jeon, Lee & Han, 2021; Mohammad et al., 2022).

Figure 11. Comparison between elements in ante-mortem and post-mortem panoramic radiographs.



Source: Copyright by Musse et al., 2011.

Artificial intelligence can also be used to determine age through radiographic analysis. When knowledge of the chronological age of a living or dead individual is relevant, such as in the case of victims with no proven age, the identification of juvenile offenders or the adoption of minors (Heinrich, 2024; Shen et al., 2024).

In this context, the use of AI with image processing and ML techniques, together with training with large volumes of data, can, through analysis of the panoramic radiographs of the target individuals, classify the stages of mineralization of the teeth and produce an age assumption. As a result, by using these results in conjunction with the examination carried out by the dental expert, a

greater accuracy of chronological age estimation can be achieved (Miranda, Neves, Gomes, & Corte-Real, 2016; Gobbo et al., 2021; Shen et al., 2024).

CONCLUSION

In view of the above, dentistry has always advanced very quickly, but it has never been so closely associated with the development and application of technologies. Among recent technological tools, artificial intelligence has become an object of great investment as it is capable of revolutionizing the work of dental surgeons in a wide range of specialties, making it possible to deliver better quality treatments by increasing the accuracy of diagnoses, aiding in the planning and prediction of treatment results, as well as reducing the working time of dentists. Finally, it is hoped that with the constant and progressive development of AIs, in the future they will be able to surpass the performance of specialists, enabling a real revolution in oral health care, significantly impacting patients' quality of life.

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Gut-Brain Axis: The role of gut microbiota in immune and neurological homeostasis

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ABSTRACT

The knowledge of the interaction between the gut microbiota and the central nervous system is growing more and more with surprising discoveries, especially in how it influences aspects of human health. It is worth noting its influence on the regulation of the immune system, based on the production of metabolites. Another important factor in this relationship is the behavior of the blood-brain barrier and the production of neurotransmitters, such as serotonin, which directly impact humoral characteristics and brain function. Not far away, the microbiota is related to the appearance of neurodegenerative and immunological diseases in specific cases. Thus, it is very important to highlight strategies that promote a healthy microbiota with the aim of preventing and treating these conditions, such as therapeutic perspectives with an emphasis on the role of prebiotics and probiotics that act directly in the maintenance of intestinal and brain health.

Keywords: Gut-brain, Microbiota, Neurotransmitters, Blood-brain barrier, Enteric nervous system, Neurodegenerative diseases.

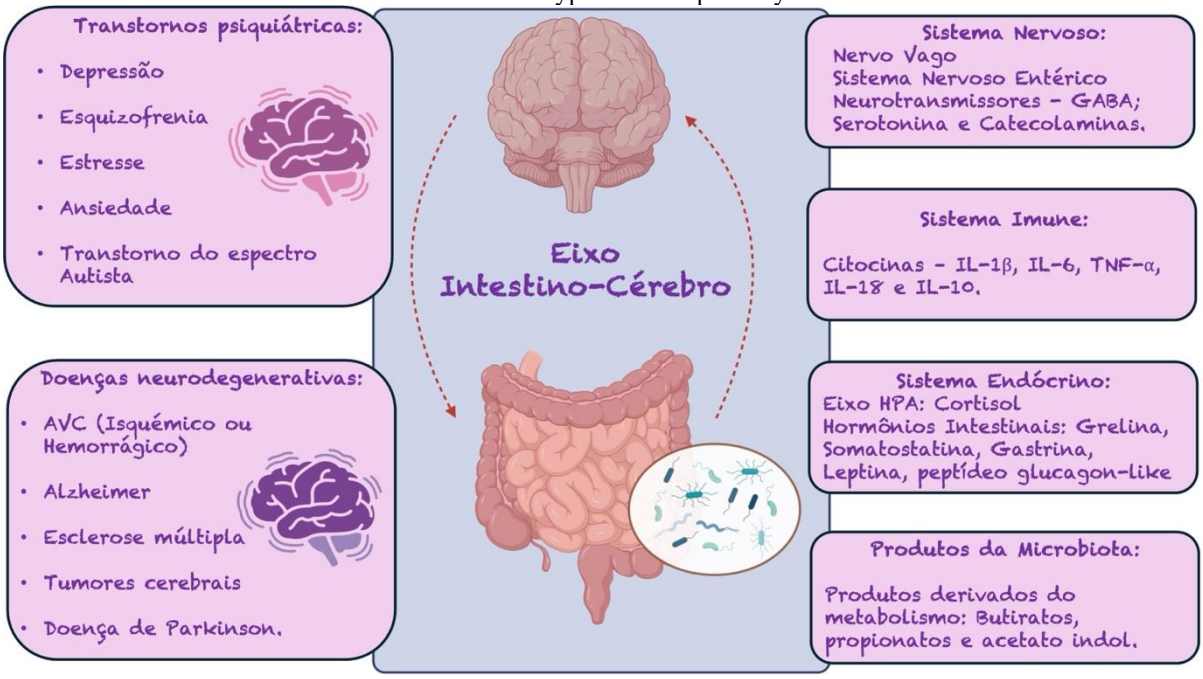
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INTRODUCTION

The field of neurogastroenterology studies the interaction between the brain and the gut, highlighting the great importance of the connection between these two systems, which may initially seem quite distinct. The gut-brain axis is a complex network of communication that involves the enteric nervous system, the central nervous system, and the gastrointestinal tract. This interaction is not only limited to the transmission of motor and sensory signals related to digestion, but also plays a role in emotional, behavioral, and cognitive regulation.

In this interaction, a very important component must be taken into account, the gut microbiota, a diverse community of trillions of microorganisms, bacteria, viruses and fungi. Unlike the pathologies that are usually associated with these organisms, this interaction, in this case, exerts a dominance over human physiology by modulating food digestion and the regulation of the immune system (**Figure 1**)

Figure 1. Schematization of the Gut-Brain axis, highlighting the systems involved and their products. In addition, the clinical correlations involved in axis imbalance. PAH: Hypothalamic-pituitary-adrenal.



In this chapter, we will learn about how the gut microbiota modulates an interaction with neurotransmitters, such as serotonin and gamma-aminobutyric acid (GABA), and immune functions. In this way, we will explore how signals from the intestine act through the enteric nervous system, influencing not only food digestion, but also humoral regulation, stress response, and even the development of immunological diseases, such as Parkinson's disease and multiple sclerosis (**Figure 1**).

These scientific discoveries are redefining our understanding of the relationship between the gut and the brain, revealing a complex interplay in which mind and body intertwine in surprising ways, with direct impacts on health and well-being.

GUT MICROBIOTA AND IMMUNITY

The intrinsic interaction between these systems, as described above, presents a large field of research in the most varied themes and discussions, such as the diet based on the predominant Western diet, that is, a diet based on the intake of red meat. This diet, if not properly regulated, can lead to a picture of microbiota dysbiosis, since it alters the balance of macrobiotic metabolites, such as short-chain fatty acids (SCFAs) and trimethylamine pro-atherogenic N-oxide (TMAO), which is a result of choline and carnitine that are in the composition of red meat. This imbalance interferes with a higher risk of developing cardiovascular diseases, mainly due to TMAO. It is also possible to infer that the low amount of foods with fiber causes a reduction in the production of SCFAs, as in the case of butyrate, which will have consequences in the increase of intestinal permeability along with an increase in bacterial toxins in the bloodstream. This cascade of events stimulates the innate immune system, which will be another factor in the increase in cardiovascular disease and a prescriber for the development of insulin resistance.

In this way, dysbiosis, by stimulating the innate immune system, implies its dysregulation by increasing immune activity in the body's own cells. Not only the factor described above, the development of autoimmune diseases such as type 1 diabetes mellitus, is also related to antibiotic treatments, cesarean deliveries and poor breastfeeding are contributing factors to this condition. To understand how this microbial dysfunction is responsible for the autoimmune picture, it is necessary to understand that the imbalance between the innate and adaptive systems through bystander activation mechanisms and molecular mimicry.

Molecular mimicry has its functioning briefly described from the moment when an immune response against a specific microbiotic agent causes a cross-reaction against the organism's own epitopes. Consequently, the persistence of this adaptive immune reaction against this microorganism tends to lead to an increase in the epitopes against which an autoimmune response arises, even though the initial foreign body has already been eliminated. One of the ways to circumvent this problem related to the dysregulation of the immune system is based on a promising therapeutic approach, fecal microbiota transplantation (FMT), which has the potential to prevent or delay autoimmune and autoinflammatory diseases.

Not only mimicry, it is essential to understand bystander activation to understand the whole general picture of the situation, since it represents a phenomenon in which the immune system is prolonged activated due to the constant presence of certain microorganisms that results in an increase

in autoreactive T cells that also start to "fight" the body's own antigens. These microorganisms, in addition to being related to the condition of providing antigens to the immune system, start to produce short-chain acids (SCFAs) that further intensify the autoimmune response process.

So far, it has been possible to understand how dysbiosis is related to an increase in the development of cardiovascular diseases and the emergence of autoimmune situations, however this whole picture leaves "traces" and "traces" for complications in patients with sepsis, acute respiratory distress syndrome. All this disturbance to the host has a strong negative effect on the diversity of the intestinal microbiota, this reduction is responsible for making the body more susceptible to opportunistic infections, greater risks of kidney dysfunction and decreased muscle mass. This whole picture tends to lead to a cycle of recurrent infections with greater losses of the intestinal microbiota and a reduction in the correct functioning of the immune system, thus reaching sepsis. In this sense, as a consequence of the fragility mentioned above, the excessive growth of the microbiota caused by sepsis and the translocation of microorganisms from the intestine to the respiratory tract, there is an induction of systemic inflammatory responses in which all these events indicate that sepsis is an unbalanced immune reaction to an infectious agent, in which the immune response against the agent is compromised and there is excessive inflammation, due to the increased passage of bacteria from the gut into the bloodstream.

In addition to all the information presented so far, it is very important to remember and describe that the intestinal microbiota plays a fundamental role in the maturation of the immune system after birth, regulation of the entire system and in the self-antigen response throughout the individual's life. Thus, the imbalance of the microbiota is one of the factors responsible for the emergence of conditions that lead to the appearance of immune dysregulations, such as allergies, autoimmune and inflammatory diseases.

From tests carried out in mice that did not present germs, that is, without the presence of the microbiota, it was possible to identify malformation of the lymphoid organs, especially in the spleen and mesenteric lymph nodes, as a consequence of which they had reduced intestinal Peyer's plates with less presence of TCD4 cells and IgA deficiency.

The microbiota is also responsible for modulating the immune system by producing molecules with immunomodulatory and anti-inflammatory properties that are capable of influencing immune cells. Among them are the short-chain fatty acids (SCFAs) mentioned above, which, through signaling through receptors such as GPR109A/HCA2, play an essential role in the regulation of immune homeostasis and in the balance of immune tolerance and responses to pathogens. This interaction actively participates in the production of regulatory T cells (Tregs). Not only SCFAs, there is the production of metabolites derived from indole and polyamines that exert immunomodulatory functions, such as the integrity of the intestinal mucosa, from indole, which contributes to the

strengthening of the defense barrier against pathogens and stimulates the production of antimicrobial substances and intestinal goblet cells.

It is also possible to measure that the microbiota can influence the presence of bone mass in the body. It is known that the main cause of bone loss is the result of estrogen deficiency after menopause, this occurs due to an imbalance of bone renewal and resorption caused by the effect of estrogen on the immune system. This deficiency of the hormone causes an increase in the production of pro-inflammatory and pro-osteoclastogenic cytokines such as TNF, alpha and RANKL, which directly affect this balance. Thus, studies in rats free of the intestinal microbiota showed changes in bone mass, but the results are conflicting and inconclusive, since it was possible to identify an increase in this mass while other studies showed negative effects due to the reduction of the IGF-1 level. Antibiotic studies have also shown divergent results on bone density varying exposure time, age, sex, and treatment protocols.

In mice free of the microbiota, it was possible to identify a reduced number of osteoclasts and lower levels of pro-inflammatory cytokines in the bones and alterations in the immune system, as previously seen. Such characteristics normalized from the moment these animals began to be raised with the presence of the microbiota. These studies reveal something new and surprising about the interaction of these two systems, but they require more research to fully understand this interaction.

It is worth mentioning that the interaction between the immune system and the microbiota occurs through a two-way pathway, that is, both influence each other. In this case, it is possible to observe such interaction in the control of microbial composition and compartmentalization on the balance between mucosal and lumen bacteria, carried out by the immune system, where an outer layer of mucus in the colon acts as a reservoir of microorganisms that contributes to restoring the microbiotic balance in any disturbances. It is also worth mentioning the importance of peptides and antimicrobial receptors in the small intestine, which play a similar role in defending against the entry of pathogenic bacteria.

Another interaction of great importance for the human body is the development of antigen-presenting cells (APCs), such as dendritic cells and macrophages. Because it is possible to identify that a dysbiosis can lead to a reduction in mature APC cells. Some studies have indicated that bacterial colonization can induce the recruitment of gastrointestinal dendritic cells and influence the differentiation of Th17 cells.

Therefore, based on all the information contained in this chapter, it is undeniable that there is an intense and gigantic relationship between the intestinal microbiota and the immune system, a bidirectional interaction that interferes with the entire homeostasis of the human body, from the immune response to a simple pathogen to the development of serious autoimmune diseases and bone

health in general. Thus, understanding this interaction is necessary for the development of therapeutic and preventive strategies for a wide variety of health conditions.

BLOOD-BRAIN BARRIER AND NEUROTRANSMITTERS

The blood-brain barrier (BBB) plays a very important role in the integrity of the nervous system by participating in the control of the flow of substances between the bloodstream and brain tissue. In the previous topic it was possible to observe how the intestinal microbiota actively participates in the modulation of the immune system as well as in other parts of the body, now it will also be possible to identify how microbiotics act on the integrity of the barrier and what are their effects on it.

Initially, it is important to consider that short-chain fatty acids (SCFAs) are fundamental to understand this interaction, which will be described and understood throughout this topic. Its production is correlated by the fermentation of dietary fibers in the colon. They are basically composed of three compounds with influence on the subject to be treated, acetate, propionate and butyrate, each with specific proportions in the lumen of the colon. These acids are absorbed by the intestinal mucosa and can be detected in the blood in varying concentrations.

It was possible to observe in a study that butyrate has beneficial effects on the barrier, such as the positive regulation of tight junction proteins. It was also identified that animal tests, that oral administration of sodium butyrate or colonization with bacteria that produce this substance, resulted in a decrease in the permeability of the blood-brain barrier and a better preservation of it after traumatic brain injuries. In addition, the intraperitoneal administration of butyrate showed improvements in cases of neuroinflammation in elderly mice, whereas in transgenic mice with loss of synaptic and neuronal learning, intracerebroventricular applications had effects on the improvement of learning and memory in these animals, that is, an eventual therapeutic potential in the recovery of brain injuries.

Other SCFAs, such as propionate, have also shown neuroprotective, anti-inflammatory, and permeability-reducing effects in studies with human brain endothelial cell culture models. However, high brain levels of propionate may be related to exacerbated symptoms in certain neuropsychiatric conditions, such as autism. A condition that can be mitigated with butyrate supplementation, which shows that the balance between these substances is crucial, not only the individual levels of these metabolites. In addition, SCFAs participate in the maturation of microglial cells, which maintain the integrity of the BBB.

A small observation can be made with regard to recent studies that found nucleic acids and proteins derived from bacteria, viruses and fungi were detected in the brains of deceased individuals with Alzheimer's disease. Such discoveries raised the possibility that these microbial metabolites,

such as SCFAs, may be produced locally, that is, by infiltrating microbes present in the brain, something very important for the development of a "brain microbiome", however this idea still presents controversies around its existence. In this same study, it was possible to identify the presence of immunostains that provide information on the presence of fungal species in brain tissue in these same patients, such as *Candida albicans*, which is typically identified in mammalian intestines. Its observation occurs in the forms of buds and with hyphae, which suggests a growth within the brain tissue. However, it remains uncertain whether gut microbes have significant impacts on the availability of SCFAs within the brain through "local residents."

Trimethylamine (TMA) is another metabolite produced by the gut microbiota of great importance for understanding this interrelationship. To understand its practical effect on the body, it is necessary to be aware of its production, which occurs through compounds such as choline, lecithin, carnitine and trimethylamine oxide-N (TMAO) that are present in certain foods. Regarding TMAO, it is important to note that its presence in large quantities at plasma levels is associated with an increased risk of neurodegenerative diseases, such as Alzheimer's, increased chances of colorectal cancer and cardiovascular diseases. In addition, not only its negative effect, it is also worth mentioning that this compound has shown therapeutic potential in conditions such as Alzheimer's, again, by restoring the ability of the TAU protein to promote the assembly of microtubules essential for neuronal function. This shows that the concentration of this substance is fundamental for what the effect will be on the body.

In addition to the metabolites already mentioned, such as SCFAs and TMAO, it is important to remember amino acids such as tryptophan, which also participates in the regulation of brain health. This compound is metabolized by the microbiota in order to produce neurotransmitters, such as gamma-aminobutyric acid (GABA), which plays a crucial role in the central nervous system, by acting mainly as an inhibitor, that is, decreasing neuronal activity, helping to regulate neural excitation and maintain balance in the brain. In addition to these functions, it is worth mentioning that it participates in the reduction of anxiety, induces sleep, controls muscle tone and plays a role in pain modulation. Thus, it is possible to infer that the microbiota plays a very important role in the modulation of the nervous system and homeostasis in general.

In the same way that amino acids play essential roles in maintaining brain health, vitamins produced by the gut microbiota are also essential for this occurrence, such as vitamin K, which is associated with the prevention of Alzheimer's disease, and the modulation of fibrillation of alpha-synuclein, a protein linked to Parkinson's.

Regarding the modulation of the nervous system by means of neurotransmitters, it is possible to highlight that its influence on the serotonergic system occurs in addition to the presence of a deficiency of the intestinal microbiota, since the administration of probiotics "*Bifidobacterium*

infantis" in mice results in reduced concentrations of 5-hydroxyindoleacetic acid (5-HIAA), which is a metabolite of serotonin, in the frontal cortex along with significant values of plasma concentrations of tryptophan and kynurenic acids. Such studies are essential because they confirm the ability of the gut microbiota to exert a great influence on the serotonergic system.

In addition, the microbiota not only directly uses tryptophan, but is also able to metabolize it, which reduces its availability to the host. It is noteworthy that certain bacterial strains harbor the enzyme tryptophanase, which mediates the reaction of producing indole 3-acetic acid (IAA) from tryptophan. Such enzymatic capacity is associated with gastrointestinal abnormalities in autism spectrum disorders. However, this process of IAA production from tryptophan is not completely understood, but it is of great importance to further understand this relationship, since it is already known that certain specific bacterial strains can produce serotonin from tryptophan *in vitro*.

In the previous topic it was possible to identify how the intestinal microbiota interferes in the functioning of the immune system through various mechanisms and actions, while in the current one it was possible to understand that the microbiota also interferes in serotonergic modulation. Thus, as serotonin modulates immune responses, as evidenced by the association of 5-HT receptors in immune cells, in view of the above, this is another way that the intestinal microbiota interferes with the immune system.

In addition to modulating the release of neurotransmitters and influencing the blood-brain barrier, the microbiota is also present in the behavioral and humoral influence of human beings. Some studies have shown that there is a clear change in the microbiota in mice with depression. Not only in animal trials, administering a combination of probiotics to healthy volunteers has also been shown to alleviate psychological distress, including depressive symptoms. In addition, there is clinical evidence that proves the efficacy of antibacterial agents, such as minocycline, in modulating depression.

Previously, some effects of serotonin and how the microbiota interferes with its presence in the human body have been described, according to this, some metabolites of tryptophan, which include this neurotransmitter, play a crucial role in the pathogenesis of anxiety and depression. Certain medications that increase serotonin availability, such as selective serotonin reuptake inhibitors (SSRIs), MAO inhibitors (MAOIs), and tricyclic antidepressants (TCAs) play an important role in reducing depressive symptoms. Thus, the advancement in the understanding of the composition of the intestinal microbiota has verified the contribution they have to the development and clinical phenotype of these diseases.

Another study demonstrates the above by revealing greater anxiety behaviors in mice without microbiota compared to conventionally reared mice. However, the behavioral normalization of these

animals does not occur easily with microbial repopulation, which indicates the existence of a critical period for the occurrence of its influence.

GUT DYSBIOSIS AND NEUROLOGICAL AND IMMUNOLOGICAL DISEASES

The gut microbiota is notably essential for several processes of the nervous system, such as neurogenesis, myelination and microglial activation and is capable of modulating behavior and cognition, in addition to being responsible for altering the susceptibility and progression of neurodegenerative diseases. In this way, it is believed that the pathogenesis of diseases such as Parkinson's Disease (PD) and multiple sclerosis is closely linked with the imbalance of the gut - gut dysbiosis.

In terms of prevalence, PD is one of the fastest growing neurological diseases worldwide and although it is primarily defined by motor symptoms such as tremors and muscle stiffness, it is interesting to note more than 200 years ago, in the first formal description of the disease, James Parkinson recognized that gastrointestinal dysfunctions were part of the clinical spectrum of the disease. He further speculated that PD could have its roots within the gastrointestinal system.

It should be noted at the outset that the gut microbiome, composed of billions of microorganisms, evolves along with the host to form a complex mutualistic relationship, so that the gastrointestinal tract provides a nurturing environment for the microbial community, while the microbiome performs a wide range of essential functions that influence host physiology.

This host-microbiome interaction, along with individual microbiome variability in response to lifestyle changes, is important when interpreting disease-related changes in gut microbiome composition and function. Because aging is an integral contributor to the pathophysiology of PD and exerts a significant influence on the gut microbial ecosystem, it is crucial to consider these factors.

Studies have revealed that people with PD tend to have an increased abundance of certain beneficial bacteria, such as *Akkermansia* spp., *Bifidobacterium* spp., and *Lactobacillus* spp. These bacteria play important roles in gut health and are often found in probiotic preparations. The increased abundance of *Akkermansia* spp. has been associated with slow colonic transit and low body weight and/or fat mass, common characteristics in individuals with PD.

Importantly, the role of a single microbial species cannot be considered in isolation, but rather within a community context that takes into account the net effects of bacteria sharing similar metabolic functions versus those with contrary actions. This more comprehensive understanding is essential to understanding how the gut microbiome may be involved in the pathophysiology and progression of not only PD but also other neurological diseases.

Thus, it is evident that some intestinal problems and interventions, in addition to dietary factors, may be associated with a subsequent risk of developing and progressing PD. For example,

constipation, inflammatory bowel disease, irritable bowel syndrome may implicate in the pathophysiology of the disease.

Another pathology constantly related to gut dysbiosis is multiple sclerosis (MS), a disease that contrasts with Alzheimer's disease (AD) and Parkinson's disease (PD), mainly affecting young adults, especially females. It is a demyelinating disease of the central nervous system (CNS) with an inflammatory component: it is characterized by chronic inflammation in both the white and gray matter of the brain and spinal cord, which causes the destruction of the myelin that covers neurons. Although the mechanisms underlying MS are not yet fully understood, it is postulated that an unsatisfactory functioning of the immune system is the most likely cause of the disease. In addition to chronic inflammation, an alteration in the selectivity of the blood-brain barrier in the brain of MS patients has been observed. This state facilitates the migration of immune cells (mainly T cells) to the nervous system and penetration into the brain. After infiltration into the CNS, T cells begin to recognize myelin as a trigger for the immune system, which causes increased inflammation and results in demyelination.

The pathophysiology of MS may also be linked to genetic and environmental factors. Early obesity, reduced levels of vitamin D in the blood, and insufficient exposure to sunlight, as well as smoking, are the causes most frequently described in the literature. All of these aspects can also indirectly affect the gut microbiota – as microbes can control immunity by regulating T cells, the gut microbiota has received attention as an important factor in MS pathology.

In recent studies, it has been shown that there are considerable differences between stool samples from MS patients and samples from the control group (with healthy subjects). Samples from MS patients revealed decreased levels of Bacteroidetes spp. *Clostridium* spp., *Faecalibacterium* spp. and *Prevotella* spp. (the latter produces propionate, which is an SCFA). In addition, an increase in the abundance of *Methanobrevibacter* spp. and *Akkermansia muciniphila* was observed in different types of the pathology. In addition, it is interestingly demonstrated that transplanting the microbiota of MS patients into germ-free mice resulted in intensification of experimental autoimmune encephalomyelitis (EAE), a type of demyelinating disease in animals, in contrast to germ-free mice treated with healthy microbiota. These results suggest the potential involvement of the microbiota in the development of MS and its impact on disease progression.

Recent evidence suggests that immune system activation in MS originates in the gut. Other studies report that altering the immune response in MS triggers changes in the gut microbiota. Establishing the triggering event is difficult: is it inflammation of the gut or the brain?

In addition, attention to the intestinal microbiota has also been shown to be important in the field of rheumatology, with the possibility of positively impacting patients in the area. However, there is still a long way to go for a better understanding of the gut microbiota related to human immunity -

the vast majority of studies carried out in humans are correlational and do not allow us to understand with certainty whether intestinal dysbiosis precedes the disease or presents itself as a consequence of it.

In this sense, in this field, the use of antirheumatic drugs is a good example of how the mobilization of the intestinal microbiota and its imbalance can affect its functionality. We can mention, as an example, sulfasalazine, a drug used to treat inflammatory arthritis and ulcerative colitis, which relies on the enzymatic cleavage made by gut microbes.

THERAPEUTIC PERSPECTIVES

So far we have seen how the connection between the intestine and the brain is complex, involves several regions, parts of the human body and is capable of altering several vital functions, that is, a deep "dialogue" occurs between these regions. In this continuous "conversation" it is very important to remember a fundamental factor for its occurrence or change, the diet. Probiotics and prebiotics combined with a balanced diet become protagonists of this entire process, not only of intestinal health, but also of all modulation of mental and emotional state. Thus, this chapter will deal with a therapeutic universe exploring how their interactions act directly on the dynamics of the gut-brain axis, focusing mainly on the emotional and cognitive state.

At the outset, it is important to point out that the action of probiotics is highly studied all over the planet, with numerous researches carried out. Concomitantly, these studies demonstrate that the introduction of probiotic bacteria into the diet is able to raise the levels of neurotransmitters in brain tissues, and thus offers a kind of prevention of depressive treatments. In one of these studies, the presence of *Lactobacillus plantarum* (DP189) resulted in antidepressant effects in rats subjected to corticosterone-induced chronic stress. Effects that were circumvented from a 3-week period in which behavioral, histopathological, and biochemical improvements began to occur, including improved memory, special learning, and a reduction in anhedonia. In line with this study, another test carried out with strains of *L. plantarum* It showed similar results in healthy male mice, highlighting its antidepressant and anxiolytic effects. At biochemical levels, DP198 supplementation was responsible for reducing the numbers of apoptosis of neurons in the hippocampus.

In addition, the stress caused to these animals resulted in a lower number of neurotransmitters such as serotonin, dopamine and norepinephrine, a situation that was circumvented with the administration of the probiotic. These studies were also able to demonstrate that live probiotics are able to influence the gastrointestinal microbiota and modulate the immune response. Inactive probiotics, on the other hand, exert an anti-inflammatory role.

In addition to the strains taught in the previous studies, another strain known as *Bifidobacterium breve* (CCFM1025) when analyzed in mice on chronic stress, it was able, after a

period of five weeks, to significantly reduce behaviors related to anxiety and depression. Not only that, the strain helped attenuate inflammation caused by the high hyperactivity of the hypothalamic-pituitary-adrenal (HPA) axis, since elevated serum corticosterone levels in these stressed animals were restored to normal.

Now moving on to human trials, a pilot study with ten patients diagnosed with major depressive disorders (MDD) without the influence of antidepressant medications underwent probiotic supplementation. This administration was responsible for a significant reduction in anxiety levels and overall improvements in the patients' mood as early as the fourth week of testing. In addition, there are also improvements in the anhedonia and sleep quality of each participant throughout the supplementation period.

Also in patients with major depressive disorders, it was possible to analyze the biochemical parameters when supplemented with *Lactobacillus plantarum* 299v (LP299v) that indicated a significant decrease in kynurenine concentration and improvements in cognitive functions in the LP299v group compared to the placebo group, which demonstrates a positive correlation between the use of probiotics and the enhancement of cognitive functions. Although serum levels of inflammatory cytokines remained unchanged in all groups, it was still possible to observe a reduction in symptoms of depression along with significant drops in urinary cortisol levels, which suggests positive effects of the probiotic in the regulation of physiological stress.

Along with patients with MDD, another strain, but this time with the *Bacillus coagulans* MTCC 5856 has also been tested in individuals with irritable bowel syndrome. The results remained the same, with a significant reduction in clinical symptoms of depression. In addition, positive effects of the strain were observed on sleep quality and decreased levels of myeloperoxidase, an enzyme involved in regulating the immune system. Thus, these findings highlight the therapeutic potential of probiotics in the context of the gut-brain axis, which paves the way for new approaches in the field of mental disorders.

Regarding the effects of prebiotics on depressive disorders, the literature is scarcer, with less testing and information regarding probiotics. However, it is still possible to find studies, such as treatment with fructooligosaccharides (FOS) in the relief of depression-like behaviors. In addition, in models of chronic stress caused by corticosterone induction (CUMS) in rats, the administration of FOS was able to restore elevated corticosterone levels, which demonstrates a normalization of the activity of the hypothalamic-pituitary-adrenal (HPA) axis. Not only that, the treatment also contributed to the restoration of the integrity of the intestinal epithelium compromised by the stress model. In addition to the treatment process with FOS, it is possible to understand that the administration of galacto-oligosaccharides (GOS) in male mice, induced to anxiety, during a period of three weeks was able to reduce the anxiety in the tests.

Such studies highlight that both treatment with fructooligosaccharides and galacto-oligosaccharides have the potential to exert antidepressant and anxiolytic effects, as well as significant changes in behavior and brain neurochemistry. Thus, it is possible to affirm great potential in therapeutic strategies in the maintenance of intestinal and brain health.

Moving back to human studies, the efficacy of the combined use of probiotics and prebiotics as complementary therapy in reducing depressive symptoms in a study conducted with 110 patients showed very promising results. All individuals with MDD were in three distinct groups. Two of them received probiotic supplementation, while the last received placebo for eight weeks. All supplementation groups showed a significant decrease in Beck Depression Inventory (BDI) scores compared to the placebo group. These findings underscore the potential of the symbiotic approach in the complementary treatment of depression, gaining a new therapeutic perspective in the context of the gut-brain axis.

As time and the scientific world advances, it becomes increasingly necessary to seek specific interventions aimed at modulating the intestinal microbiota and improving the immune system as the purpose of an increasingly better search for homeostasis. Thus, in order to encompass these two fields, new therapeutic perspectives are needed, such as the meta-analysis of clinical trials published by the journal "*Nutritional Neuroscience*" in 2021 that discerns about the reduction of cases and symptoms of depression by probiotic supplementation, the improvement of the effectiveness of traditional antidepressants through interventions directed at the gut microbiota according to a study published by the journal "*Psychological Medicine*" in 2020 and among other diverse literary studies.

However, to translate these findings into concrete clinical interventions, it is essential to understand other underlying mechanisms, such as the modulation of neurotransmitters from probiotics such as serotonin and gamma-aminobutyric acid (GABA) that are closely linked in mood and behavioral regulation.

This more detailed and deeper understanding of these mechanisms will allow the development of more accurate and truly effective therapeutic perspectives for the general population. Finally, research should continue to explore these specific interventions on how to modulate the microbiota, improve immune function, and the relationship with the central nervous system.

In the course of all the topics, it was possible to explore the complex and intrinsic world of the gut microbiota and all its comprehensive participation in human health. From the regulation of the immune system to the modulation of brain function, each bacterium that resides in the intestine plays a key role in a huge network of physiological processes.

The growing search for understanding this relationship between the microbiota and the entire immune process presents a new paradigm in medicine with numerous questions and future discoveries that are very important for human health. Today it is possible to understand that bacteria

not only aid in food digestion, but are also responsible for producing crucial metabolites that modulate the immune response and control inflammation. In addition, they directly influence the integrity of the blood-brain barrier, the production of neurotransmitters, which generate significant impacts on mood, brain function and in cases of depression.

Intestinal dysbiosis, which occurs due to an imbalance in the microbiota, emerges as a significant factor for the occurrence of crucial neurological diseases that are well known and have a great impact on the world population, from Parkinson's disease to multiple sclerosis. However, there is hope if this situation of imbalance occurs, since there are strategies that promote the balance of the microbiota again, as in the case of the use of probiotics, prebiotics and an adequate diet. Thus, there are opportunities to prevent and treat these debilitating conditions.

Therefore, it is of great importance that research on the gut-brain axis continues to explore new therapies and interventions that correlate the modulation of these two systems together. It is possible, by virtue of all that has been discussed throughout these four topics and the numerous researches mentioned, to say that one of the futures of medicine may lie in the ability to carefully manipulate these macrobiotic communities for the benefit of human health. May these topics serve as a guide to the understanding and powerful use of all this very rich ecosystem that resides within each human being, not only shaping each being, but also the life of each one.

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Analysis of cerebral concussion in combat sports

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ABSTRACT

Introduction: Through the action of external biomechanical forces that cause a change in brain acceleration within the braincase, there is the possibility of a change in mental state. This may be accompanied by a brief period of amnesia known as cerebral concussion. For a concussion to be characterized, it is not necessary for there to be loss of consciousness. In combat sports, this change occurs frequently and deserves attention to preserve the integrity of the athletes. Objective: To analyze the levels of cerebral concussion in combat athletes: kickboxing , muay thai , boxing and mixed martial arts (mma) after impact to the braincase. Material and methods : This research has a semi-qualitative approach characterized as a clinical trial and analyzed the levels of cerebral concussion using the SCAT3 behavioral study . Results: Moderate physical, cognitive and emotional symptoms were found in boxing, MMA and k1. Severe symptoms were also found in k1 athletes, not being predominant during sleep. And, the muay group thai showed statistical differences for physical and cognitive classifications, which suggest that cerebral concussion occurred. Glove specifications, the use of head protectors and the period in which the athlete is exposed to repeated blows to the head become determining factors in quantifying concussion levels in combat athletes. Conclusion: The changes found point to an important cerebral concussion in combat sports, especially in the physical and mental aspects of muay athletes Thai .

Keywords: Traumatic brain injury, Cerebral concussion and combat sport.

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INTRODUCTION

Head injuries in fights involving knockouts are called cerebral concussions. In this situation, an alteration in mental state is found, accompanied by a brief period of amnesia due to external biomechanical forces that can be directly or indirectly transmitted to the brain. This can cause temporary or permanent impairment in cognitive, physical and psychosocial functions.

For a concussion to be characterized, it is not necessary for there to be a loss of consciousness, however in some situations there is a temporary loss of consciousness, as cerebral concussions can be mild, moderate or severe. Mild or moderate concussions are characterized by no loss of consciousness, in which the affected person experiences temporary confusion and, if symptoms such as headache, nausea and mental changes occur, they resolve in less than 15 days in a mild situation. or when characterized as moderate, it is remedied in more than 15 days. In severe classification, there is loss of consciousness for any period.

Those affected by concussion do not always develop post-concussion syndrome. However, when it extends to the days and weeks following the trauma, it presents a set of symptoms such as: disability, headache, dizziness, insomnia and difficulty concentrating. The incidence of headache and dizziness can be higher than 90% within a month. Furthermore, around 25% of those affected may experience headaches one year after the trauma. Furthermore, the number of people who experience memory problems can reach up to 59%, as symptoms can persist for months or up to 1 year (Pagura, Anginah , 2016).

Since cerebral concussion can also occur directly (after impact and/or blow to the head), the knockout becomes an essential factor for the final outcome to occur during the boxing event or practice.

Although there is proven research reporting cerebral concussion in boxers, studies of this nature in kickboxing *(* k1 *)* , *muay thai* and *mixed martial arts* (*mm*). Furthermore, understanding the changes found is important in developing new behaviors in the search for preserving the athlete's integrity.

The present study will analyze, using a *SCAT3 questionnaire* , the behavior of athletes after an impact on the cranial cavity or within seven days after the injury as an instrument for characterizing the sample, with the purpose of verifying whether there is a difference in the neurological outcome in situations of cranial impact. in boxing, *mixed martial arts* , *kickboxing* and *muay Thai* .

GOALS

Analyze cerebral concussion levels in combat athletes: k1, *muay thai* , boxing and mixed martial arts (*mma*) after impact to the braincase.

CEREBRAL CONCUSSION

Through the action of external biomechanical forces that occur directly through impact on the head or indirectly through the phenomenon of cerebral deceleration within the braincase, when transmitted to the brain there is the possibility of a change in the mental state, which can be accompanied by a brief period of amnesia being called cerebral concussion (PAGURA, ANGINAH, 2016).

Through impact on the cranial cavity, due to a direct blow to the head, neck, face or any part of the body, the posterior region of the brain separates from the cranial vault, which causes the rupture of vessels, leading to expansive injuries. This impulsive force transmitted to the brain generates a short-term impairment of neurological function, which resolves spontaneously and can evolve from minutes to hours (TATOR CH, 2013; MCCRORY et. al, 2015).

For a concussion to be characterized, it is not necessary for there to be a loss of consciousness, but it is possible in some situations to encounter a temporary loss of consciousness, as, as a result of a mild trauma to the head, brain cells can be damaged, causing a chemical imbalance in the brain, Furthermore, the rotational forces exerted on the region of the central nervous system, located between the midbrain and thalamus, cause a temporary interruption in the functioning of the reticular neurons, resulting in a brief fainting spell. Injuries closed by cerebral acceleration and deceleration forces trigger a disordered metabolic cascade or biochemical injury, such as glucose hypometabolism or adenine nucleotide disarray (TATOR CH, 2013).

The impairment in neurological function may be short-lived, with the possibility of resolving spontaneously and, in some cases, signs and symptoms may evolve from minutes to hours or be even longer lasting. 80 to 90% of concussions resolve within a short period of 7-10 days (MCCRORY et. al, 2013). Sometimes, acute clinical symptoms reflect a functional disturbance without structural damage, not being noticeable in neuroimaging studies (IANOF JN et. al, 2014).

A blow to the head that does not require immediate surgical treatment is not always simple and can become a hidden enemy (PAGURA, ANGINAH, 2016). In the presence of neuropathological changes, clinical signs and symptoms reflect a functional disorder rather than a structural lesion, thus there is no abnormality on standard structural neuroimaging (MCCRORY et. al, 2015).

Neuroimaging exams such as computed tomography and magnetic resonance imaging, when not performed using a diffusion technique, will not identify changes in cognitive functions or diagnose brain metabolic activity or visual signs such as headache, exaggerated drowsiness, loss of consciousness, dizziness, mental confusion or change in behavior. When not identified during a medical consultation, the involvement may take on a greater proportion. However, when following appropriate parameters and procedures such as: *PET tests Scan* (positron emission tomography) that superimposes anatomical images on metabolic images or resonance with tactography , the event can

become benign, directing decision-making regarding diagnosis and management (PAGURA, ANGHINAH, 2016; ABCMED, 2016).

Brain impact does not always trigger a concussion, and it is necessary to identify symptoms that indicate a change in the level of consciousness (PAGURA, ANGINAH, 2016). When the impact occurs, the determining factor in identifying the level of concussion are the symptoms and the time in which the condition is resolved. Therefore, it is classified as: mild, moderate or severe. Common symptoms include transient confusion, headaches, nausea and mental changes. In mild classification, such symptoms resolve in less than 15 minutes, when moderate, in more than 15 minutes and in severe concussion, in addition to the presence of the aforementioned clinical aspects, there is also loss of consciousness for any period (PAGURA, ANGINAH, 2016).

Such changes in consciousness can range from a small event such as disorientation or mental confusion to loss of consciousness for minutes. In the last one mentioned, a suspicion of concussion is noticeable through one or more visual signs that can be identified by the loss of consciousness or inability to respond, the confused look, the athlete lying motionless on the floor, being slow to get up, unstable standing, with imbalance or falls and lack of coordination. In addition, you may present signs and symptoms that suggest acute concussion, such as somatic symptoms, headache, cognitive symptoms (feeling like you are in a fog), emotional symptoms such as, for example, lability, as well as physical signs, which include loss of consciousness or amnesia, behavioral changes and cognitive deterioration demonstrating slower reaction times and sleep disturbance (PAGURA, ANGINAH, 2016).

In the presence of one or more components, concussion is suspected, requiring appropriate management and control. Structural concussion injuries cannot be detected using conventional neuroimaging tests. Acute concussion is a diagnosis based on clinical assessment that reflects functional disturbances through physical, cognitive symptoms, emotional and sleep disorders (HALL, CHAPMAN, 2005).

It is sometimes common for those affected by concussion to present post-concussion symptoms, such as: headaches, dizziness, insomnia and difficulty concentrating in the following days and weeks, and the incidence of headaches and dizziness can be high, lasting for months and/or or a year or more, in which the difficulty in concentrating, symptoms of anxiety and depression subsequently increase. The common signs and symptoms of a concussion are characterized into four categories: physical, cognitive, emotional and sleep (DOE, AB, 2015; PAGURA, ANGINAH, 2016). Furthermore, cognitive, vestibular and oculomotor impairments may occur (KONTOS et. al,. 2015).

Since many signs and symptoms associated with a concussion are vague, the most common disorders are outlined in the following table:

Table 1 - Common Signs and Symptoms of a Concussion

Physicists	Cognitive	Emotional	From sleep
Headache	Feeling mentally "foggy"	Irritability	Somnolence
Nausea	Feeling sluggish	Sadness	Sleeping less than normal
Vomiting	Difficulty concentrating	More emotional	Problems falling asleep
Balance problems	Difficulty remembering	Nervousness	
Dizziness	Forgetting recent information or dialogues		
Visual problems	Confusion about recent events		
Fatigue	Slow response to questions		
Light sensitivity	Repetition of questions		
Numbness/Tingling			
Stun or shock			

Source: Book - BURKE-DOE, A.; JOBST, EE Clinical cases in physiotherapy and neurological rehabilitation. Porto Alegre: AMGH, 2015.

An athlete diagnosed with a concussion may experience one or more symptoms. And, although symptoms resolve within 7 to 10 days, some individuals experience persistent changes that can last up to three months (DOE AB, 2015).

A recent study carried out on football athletes finds that after concussion there is the presence of post-traumatic migraines and cognitive impairments. However, this does not conclude whether the effects are persistent or whether there is a specific recovery time (KONTOS et. al, 2013).

According to McCrea et. al 2013, clinical concussion related to sports concussion occurs in days, with prolonged reports associated with acute indicators of more serious injuries being common.

The neuropsychiatric test is an important aid for the decision to return to sport, and the recovery stages after concussion for full return to daily activities must occur gradually, respecting rest and, after this, tasks for the brain gradually. Thus, the athlete will be able to return without restrictions and with medical clearance to be subjected to situations that could result in a new head trauma (MCCRORY et.al, 2012).

RELATIONSHIPS BETWEEN RULES AND ATHLETE'S VULNERABILITY IN THE MODALITIES INVESTIGATED

Boxing: According to rules 19 and 20 of the International Boxing Association (AIBA) respectively, it is mandatory to use a genital protector throughout the fight. Furthermore, it is mandatory to use a mouthguard, as it protects the dental arch and mouth against orofacial trauma, according to evidence, which can result in bone fractures and injuries to the neck and brain (CAVALCANTI et. al, 2012).

In addition, the glove specifications for elite men's competitions are also a rule: Ten (10) *Oz gloves* for the light fly (49 kg) to medium light (64 kg) category, and twelve (12) *Oz gloves* for the medium category medium (69 kg) to super heavy (more than 91 kg). Gloves were inserted into the

sport to prevent or postpone hand fractures and not to protect the practitioners' faces (ARNONI, DUARTE, 2014).

In boxing, a knockout is considered any blow or combination of blows that renders the boxer unable to continue fighting, therefore, if a participant goes to canvas and does not get up within a specific period of ten seconds he is considered knocked out and the opponent receives victory by *knockout* (*ko*) . National level fights consist of six 3-minute rounds, with title fights consisting of ten 3-minute rounds, with intervals between fights lasting 10 to 30 days.

AIBA is the entity that regulates Olympic boxing and its medical team decided, in October 2013, that elite category boxers would no longer use head protectors, stating that disuse would minimize the occurrence of concussions. However, the *British of Sports Medicine* evaluated the linear and angular acceleration force, finding a significant reduction of at least half compared to the absence of the protector. Through empirical knowledge through practice, the technical team and fighters state that the use of protective equipment only reduces facial injuries, while the use of protective equipment aggravates brain damage. However, there is no consensus within boxing regarding the use or removal of this protective equipment.

The referee is the boxer's first protection, taking care of the athlete's physical integrity during the fight and immediately opening the count when an athlete is hit and falls. Therefore, even if you are fit for the fight, the eight-second count is opened, and it is the referee's role to request medical intervention in the event of any injury.

Mixed martial arts (mma)- In *MMA* , according to the unified rules described by the National Confederation of *Mixed Martial Arts* (*CNMMA*) and the Brazilian Confederation of *Mixed Martial Arts* (*CBMMA*), the use of a mouth guard and genital protector approved by the confederation is mandatory. glove specifications approved and provided by the commission, which must weigh: 4 *OZ* (113 grams), not exceeding 6 *OZ* (170 grams), and some larger size gloves *2XL – 4XL* (*2XL – 4XL*) being permitted even that slightly exceed 6 ounces (170 grams).

MMA gloves are poorly padded, making fractures more frequent (MATOS A, 2017).

In all types of fights, weekly *sparing* is recommended at most twice a week, as training is much more intense than a fight. This occurs because the competition lasts about 15 minutes while training can last up to two hours a day on a daily basis (THOMAZINI et. al, 2008).

During competitions there is no count given after the fall, as the sport allows submission, and there is a combination of techniques from different martial arts disciplines, without limitation of grappling, finishing blows, kicks and effective attacks. Therefore, if a fighter is knocked down and loses consciousness or does not immediately defend himself, he is declared knocked out by *ko* or *technical knockout* (*tko*) , being called *ko* when the opponent is unconscious, and, *tko* when the referee stops the fight because the athlete no longer defends himself intelligently. Given this, since in

MMA *the* end of the fight is not just through the *ko* or *tko* , the main objective of this is not to generate concussion, however the period in which the athlete is exposed to blows can become is a determining factor for the event to happen.

Kickboxing (k1)- According to the Brazilian *Kickboxing Confederation* (*CBKB), the k1* modality is characterized by full contact combat and, in it, the application of all *full contact blows is permitted.* and *low kicks* , as well as knees and spinning punches. Therefore, blows to the head in the frontal and lateral areas are legal areas when using combat techniques. The following safety equipment is mandatory: Shin guards only in the "sock" style that cover the instep; Anklets; Helmet; Bandages for wrapping wrists; Genital protector; Mouth guard; Gloves 10 *OZ* .

When comparing boxing gloves with k1, it is possible to observe that in the first mentioned modality the gloves are thicker on the front, while in the second the gloves are more flexible (MATOS A, 2017).

The referee is responsible for the physical integrity of the athlete, also certifying that a *kickboxer* weakened person does not suffer unfair or unnecessary blows. After the athlete is hit by a direct blow that takes him to the canvas, the eight-second count begins. If the athlete does not show signs of returning to the fight during the count, the fight is ended by *tko* .

In *k1,* the greatest volume of combinations of blows is given by the upper limbs, due to the fact that the greater the forcefulness of the blow, the better scored the athlete who delivered the blow will be - a factor that will weigh on the worsening of symptoms due to the intensity when there is effective contact. .

Muay thai - The Brazilian Confederation of *Muay Thai* (*CBMT*) is one of the confederations that regulates the sport in Brazil, which originated in Thailand and is considered a national sport. The *muay Thai* is an art recognized as "the art of eight weapons", requiring physical and mental discipline, which includes standing combat strikes, characterized by the combined use of fists, elbows, knees, shins and feet, which makes it a fight effective and full contact.

The protective equipment used during combat is: Genital protector; mouth guard and gloves (depending on the category they can be: 6, 8, 10, 12, 14 or 16 *Oz*).

In the sport, the greatest force of blows is delivered through knees and elbows, it is important to highlight that there is no protective equipment for the place from which the blows will be delivered, thus resulting in an aggravating point for the athlete who receives such combinations of attacks. blows, as there is great force when such contact occurs. Therefore, it is the referee's responsibility to ensure the athlete's physical integrity.

CONTROL OF CEREBRAL CONCUSSION

Concussion control must exist from the beginning of the season, before training and competitions. Furthermore, it is essential to position the medical team through general checks of the athlete's health at the beginning of the season, the sports coach and the referee, prioritizing the athlete's physical and mental integrity. Recently, the medical committee of the *Federation Internationale de Football Association* (*FIFA)* proposed a new protocol for concussion management, under the chairmanship of Dr Michel *D' Hooghe* , who highlighted an education program for staff doctors, coaches, referees, officials and players, which must be carried out.

The immediate conduct of whether or not an athlete should be removed from the match in the event of a concussion can be based on the current tool of the IV World Consensus on Concussion in Sport, which is *SCAT3* . This is a standardized assessment of signs and symptoms of the condition and, when correctly applied, provides preventive information regarding the athlete's current clinical status, history of injuries, as well as cognitive aspects of orientation, immediate and delayed memory, concentration, coordination and balance. . The individual's ability to respond to stimuli will also be consistent with the level of consciousness and can be measured through scales and scores, based on motor and verbal responses and eye opening to external stimuli. In the presence of post-concussion symptoms, a neurologist should perform baseline assessments of pre-season neuroimaging, *Pet- CT* and MRI scans (PAGURA, ANGINAH, 2016).

In boxing, for returning after a knockout, there are specific rules for time off, which may vary in *ko* or *tko situations* between: 30 days, without loss of consciousness; 90 days, with loss of consciousness lasting less than 1 minute; 180 days, with unconsciousness lasting more than 1 minute; reaching up to 12 months for a third attack without loss of consciousness, and 18 months for a third attack with loss of consciousness (PAGURA, ANGINAH, 2016).

MMA modalities , *k1* and *muay Thai,* no actions were found in the literature that control concussion through damage.

SPORTS CONCUSSION ASSESSMENT TOOL – SCAT3

Document developed for use by doctors, therapists, certified athletic trainers, healthcare professionals, trainers and others involved in caring for injured athletes, whether at the recreational, elite or professional level (MCCRORY et.al,2013).

SCAT3 questionnaire is a clinical examination protocol that lists 22 possible symptoms of concussion, with only the presence of one symptom being sufficient for diagnosis. SCAT3 *is* the third edition of the sports concussion tool which replaces *SCAT* and *SCAT2* published in 2005 and 2009, being a useful diagnostic aid for practitioners, which is composed of a combination of clinical tests

including balance tests, which can be as accurate as a computerized neuropsychological screening tool (TATOR, CH, 2013).

The symptom assessment summary includes:

- ✓ Assessment of symptoms (clinical status);
- ✓ History of previous injuries;
- ✓ Cognitive aspects of orientation, immediate and delayed memory and concentration;
- ✓ Balance exam;
- ✓ Coordination exam;
- ✓ Education on the topic.

All of these points provide a standardized assessment of signs and symptoms, and for the score summary to be complete, it is necessary to complete all the sections above, which are divided into several steps. They are: Symptom scale; Immediate memory (concentration of digits backwards, months in reverse order and delayed recall); Balance examination (two-legged position, single-legged position and tandem posture); Upper limb coordination exam. However, due to limited time for data collection in fight events (10 minutes after the fight), only the symptom assessment stage (ANNEX I) was used to carry out the study, making it necessary for there to be complete completion of all sections of the assessment a study with collections 7-10 days post impact. With this information and post-trauma application, baseline testing with *SCAT3* is useful for interpreting post-injury exam results.

In October 2016, in Berlin, at the international sports concussion conference, a new concussion control tool, *SCAT5* , was validated, which is composed of the following sections: Recognize; To remove; Reevaluate; Rest: Rehabilitate; Refer; To recover; return to sport; Reconsider; residual effects and sequelae; Risk reduction (MCCRORY et. al, 2016).

METHODOLOGY

The present study was registered with the Research Ethics Committee under CAAE: 67239517.4.0000.5427. The research had a qualitative approach, being characterized as a cross-sectional clinical trial to evaluate the levels of cerebral concussion in combat athletes. Participants had access to the free consent form and those who agreed to participate voluntarily were informed of the ethical standards for research with human beings, as guaranteed by the National Research Ethics Commission (CONEP) of the National Health Council, of the Ministry of Health, did not receive financial incentives. Participation took place with the application of the *Scat3 questionnaire* ten minutes after the end of the fight in athletes who suffered an impact on the cranial cavity in boxing, *mixed martial art (MMA), K1 and muay Thai* . A control group consisting of pedestrian runners was also included. The reports were recorded for later analysis and this was guaranteed by an

authorization signature. The data collected was guaranteed confidentiality in accordance with ethical precepts of the research. Carrying out the application of the behavioral study via SCORE has authorization from the organizers of combat events and *runners* .

For the application and collection of data, there are standards for scoring the questionnaire, and the results considered normal often depend on the individual's age and education. To this end, the following inclusion criteria were used: Practitioners of the aforementioned modalities with minimum experience of 2 years; have at least primary education; Have not suffered any previous head trauma; Do not constantly use medication.

The exclusion criteria were: Having severe cognitive disability; have a diagnosis that confirms any neurological alteration.

Repeated blows to the head can, in the long term, develop chronic degenerative disease, and the analytical nature of the research will help to understand the changes found, being an important process in the development of new behaviors in order to preserve the integrity of the athlete.

The sample analyzed through a behavioral study via *score* , using the *SCAT3 questionnaire,* shows the levels of cerebral concussion after the cerebral impact. The test will be administered verbally 10 minutes after the impact or within seven days after the impact. The population will be made up of 3 (three) athletes practicing *mixed martial arts arts - mma* , 3 (three) boxing athletes and 3 (three) street running athletes *(runners)* at the end of the race. The study aims to compare the occurrence of concussions in the four modalities mentioned above in which there is an impact on the head and in a fifth modality in which there is no impact (athletics/street running), with the aim of highlighting early symptoms and possible evolution of trauma. .

Through the data collected, the results were evaluated by calculating the average of symptoms by athletes and modalities.

For data analysis, values that presented a normal distribution (*Kolmogorov -Smirnov Test*) were analyzed, allowing the use of mean and standard deviation calculations for the variables (Physical, Cognitive, Emotional and Sleep). The *Student t test was* used to compare the group itself. All statistical analyzes were performed using the *SigmaStat* 3.5 program, adopting a significance level of $p<0.05$.

Therefore, the research consists of searches in public and private digital libraries, books, magazines, and also a field study, characterized as a clinical trial to obtain the results.

RESULTS

The collection results were separated by the respective groups: Control, boxing, *mma , k1* and *muay thai* , for which a table was arranged for each sample group, according to the 22 questions that

make up the *SCAT3 questionnaire* , analyzed individually in response from each athlete, and further identified through the categories: Physical, cognitive, emotional and of sleep.

CONTROL GROUPS - *RUNNERS*

Athlete 1- Female; practicing athlete between 3 and 5 years; first place in the general category; presented moderate symptoms of pressure in the head, sensation of slowing down and fatigue, totaling a score of 7.

Athlete 2- Male; athlete for more than 5 years; presented moderate fatigue and emotional symptoms, totaling a score of 4.

Athlete 3- Male; practicing athlete between 3 and 5 years; presented moderate fatigue and emotional symptoms, totaling a score of 7.

Athlete 4- Female; practicing athlete between 3 and 5 years; did not present any symptom score.

Athlete 5- Male; athlete practicing for more than 5 years; presented moderate symptoms of feeling slowed down and fatigue, totaling a score of 4.

Athlete 6- Male; practicing athlete between 2 and 3 years; did not present any symptom score.

Table 2- Control group- *runners*

Symptoms	Athlete 1	Athlete 2	Athlete 3	Athlete 4	Athlete 5	Athlete 6
Physicists	3 ├2	2	3	0	2	0
Cognitive	2	0	0	0	2	0
Emotional	0	2	4	0	0	0
From sleep	0	0	0	0	0	0
Total score	**7**	**4**	**7**	**0**	**4**	**0**

Symptom classification: 0-1 (none) and 2-4 (moderate). Where ├: interval between different symptoms of the same symptom class.

Boxing Athletes

Confrontations consisting of 3 rounds of 2 minutes each and a 1-minute break. The athletes used protective equipment: mouth guard, helmet and 10 *oz gloves* .

Athlete 1- Female; practicing athlete between 2 and 3 years; category 61 kg; fight #4; using a helmet; combat duration of 3 *rounds* of 2 minutes each; red corner; although the athlete is the champion of the confrontation, she received repeated blows to the head; presented moderate symptoms of pressure in the head, slowing down and fatigue and severe symptoms related to the emotional aspect, totaling a score of 11.

Athlete 2- Female; practicing athlete between 2 and 3 years; category 61 kg; fight #4; using a helmet; combat duration of 3 rounds of 2 minutes each; blue corner; in the 2nd round she suffered a

knockdown ; presented moderate symptoms of fatigue and severe symptoms related to the emotional aspect, totaling a score of 6.

Table 3- Boxing athletes

Symptoms	Athlete 1	Athlete 2
Physicists	3	0
Cognitive	2	2
Emotional	6	4
From sleep	0	0
Total score	**11**	**6**

Symptom classification: from 0 to 1 (none), from 2 to 4 (moderate) and from 5 to 6 (severe).

Arts Athletes

The clashes consisted of 3 rounds of 3 minutes and a 1-minute break. The athletes used the following protective equipment: 06 Oz gloves, mouth and genital protectors.

Athlete1- Male; athlete for more than 5 years; mma modality ; category 90 kg; suffered *knockout* at 2'55 of the 1st round; presented severe symptoms of headache, emotional pain and irritability, totaling a score of 18.

Athlete 2- Male; athlete for more than 5 years; mma modality ; category 120 kg; suffered *technical knockout* at 3'15 of the 2nd round; through visual perception he presented severe emotional symptoms, however the athlete reported not presenting any classification of symptoms in the questionnaire.

Table 4- *MMA athletes*

Symptoms	Athlete 1	Athlete 2	Athlete 3
Physicists	6	0	0
Cognitive	0	0	3
Emotional	6 ├6	0	6
From sleep	0	0	0
Total score	**12**	**0**	**9**

Symptom classification: 0-1 (none), 2-4 (moderate) and 5-6 (severe). Where ├: interval between different symptoms of the same symptom class.

Kickboxing athletes

Confrontations consisted of 3 *rounds* of 3 minutes each, with a 1-minute break. All athletes used the following safety equipment: 10 oz gloves, helmet, genital protector and mouth guard.

Athlete 1- Male, practicing the sport for 2 to 3 years, has completed high school, won the confrontation, and, during effective confrontations involving punches and knees, although he won the fight, the athlete presented physical and emotional symptoms at moderate levels , totaling a score of 8.

Athlete 2- Male, practicing the sport for 3 to 5 years, completed high school, was the winning athlete of the fight, received blunt blows to the braincase and presented severe physical symptoms, totaling a score of 12.

Athlete 3- Male, practicing the sport for 2 to 3 years, has completed high school, won the match, had effective clashes during the match, presented moderate physical symptoms, totaling a score of 9.

Athlete 4- Male, practicing the sport for 2 to 3 years, has completed high school, received blunt blows to the head, was declared the loser and presented moderate to severe physical symptoms, and moderate emotional symptoms, totaling a score of 26.

Athlete 5- Male, practicing the sport for 3 to 5 years, has completed primary education, as a result of fighting for *no contest* (there being no winner of the fight), it was a confrontation composed of blunt blows to the body and head, the athlete presented moderate and severe physical symptoms, totaling a score of 9.

Athlete 6- Male, practicing the sport for 3 to 5 years, has completed high school, suffered four *knockdowns during the fight ,* two in the first *round* , one in the second and one in the third, the confrontation was for the judges' decision, in the in which the athlete was declared a loser and presented moderate to severe physical, moderate cognitive and severe emotional symptoms, totaling a score of 27.

Table 5- K1 athletes

Symptoms	Athlete 1	Athlete 2	Athlete 3	Athlete 4	Athlete 5	Athlete 6
Physicists	4	6 ├6	3 ├2 ├1 ├2	6 ├3 ├4 ├3 ├6	3 ├6	3 ├3 ├2 ├4
Cognitive	0	0	1	0	0	4
Emotional	4	0	0	4	0	5
From sleep	0	0	0	0	0	6
Total score	**8**	**12**	**9**	**26**	**9**	**27**

Symptom classification: 0-1 (none), 2-4 (moderate) and 5-6 (severe). Where ├: interval between different symptoms of the same symptom class. The presence of physical symptoms is frequent at moderate to severe levels.

Muay Thai athletes

Fights consisting of 5 *rounds* of 2 minutes each and a 1-minute break. Athletes used the following protective equipment for categories up to 69 kg: Shin pads, genital protector, mouth guard and 6 *oz gloves* .

And for categories above 70 kg, fights consisting of 5 rounds of 3 minutes each and a 1.5 minute break, the protective equipment used were: genital protector, mouth guard and 08 *Oz gloves* .

Athlete 1- Male, practicing the sport for 20 years, has completed high school, received and was affected by blunt knees and elbows to the body and head, was the winner of the confrontation

and had moderate physical symptoms and moderate to severe symptoms of the cognitive, totaling a score of 23.

Athlete 2- Male, practicing the sport for 5 years, has completed high school, received and applied blunt blows to the body and head, was the winner by decision of the judges, presented moderate physical and sleep symptoms and also severe emotional symptoms, totaling a score 13.

Athlete 3- Male, practicing the sport for 3 to 5 years, has completed high school, applied blunt blows and, although he was the winner, was also affected by blows to the brain and body, presenting moderate cognitive symptoms and severe physical symptoms and emotional, totaling a score of 17.

Athlete 4- Female, practicing the sport for 3 to 5 years, has higher education, lost the fight by decision of the judges, in which she received blunt blows from the knee and elbow to the body and head, presented moderate to severe physical, cognitive and emotional, totaling a score of 26.

Athlete 5- Female, practicing the sport for 3 to 5 years, has higher education, won the fight by the judges' decision, in which she received knee and elbow blows to the body and head, presented moderate physical symptoms, totaling a score of 4.

Athlete 6- Male, practicing the sport for 3 to 5 years, has higher education, in a balanced fight, received effective blows to the body and head, becoming the winner of the fight by the judges' decision, presented moderate to severe physical and moderate emotional symptoms, totaling a score of 13.

Athlete 7- Male, practicing the sport for 3 to 5 years, has high school education, was the loser of the match by decision of the judges in a balanced fight, received blunt blows to the body and head, presented severe cognitive symptoms, totaling a score of 12.

Athlete 8- Male, practicing the sport for 3 to 5 years, has high school education, suffered *a KO* in the 1st *round* , presented severe emotional symptoms, totaling a score of 12.

Athlete 9- Male, practicing the sport for more than 5 years, has completed high school, was the winner of the fight in the first round, in which he had an effective exchange of blows, presented moderate to severe physical symptoms, severe symptom related to sleep , moderate to severe emotional symptoms and also severe cognitive symptoms, totaling a score of 28.

Table 6 - Muay athletes thai

Symptoms	Athlete1	Athlete2	Athlete3	Athlete4	Athlete5	Athlete6	Athlete7	Athlete8	Athlete9
Physicists	4 ├3 ├3	2 ├3	6	3 ├2 ├5	4	1 ├2 ├6	0	0	2 ├2 ├5
Cognitive	5 ├4 ├3 ├1	0	3 ├2	5 ├2 ├2	0	2 ├2	6 ├6	0	5
Emotional	0	6	6	5 ├2	0	0	0	6 ├6	6 ├6 ├2
From sleep	0	two	0	0	0	0	0	0	0
Total score	**23**	**13**	**17**	**26**	**4**	**13**	**12**	**12**	**28**

Symptom classification: 0-1 (none), 2-4 (moderate) and 5-6 (severe). Where ├: interval between different symptoms of the same symptom class. The presence of physical and cognitive symptoms is frequent at moderate to severe levels.

Muay Thai Modality

Figure 1. Physical analysis: *Runner's* : control group performed the 6 km run ; *Muay Thai* : group that carried out fighting as a modality; data expressed as mean ± standard deviation; statistical analysis, *Student 's t-test* , significance value, p <0.05.
* p = 0.048

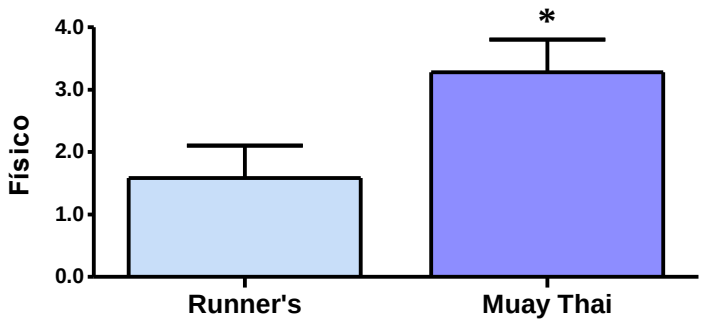


Figure 2. Cognitive Analysis: *Runner's* : control group performed the 6 km run ; *Muay Thai* : group that carried out fighting as a modality; data expressed as mean ± standard deviation; statistical analysis, *Student 's t-test* , significance value, p <0.05.
* p = 0.044

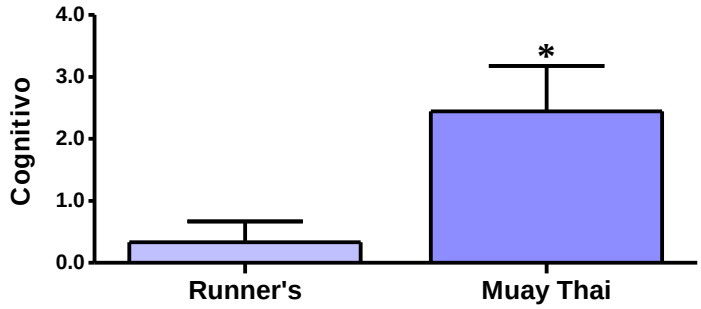


Figure 3 . Emotional Analysis: *Runner's* : control group ran 6 km as a modality; *Muay Thai* : group that carried out fighting as a modality; data expressed as mean ± standard deviation; statistical analysis, *Student 's t-test* , significance value, p <0.05. Not significant
NS: p = 0.184.

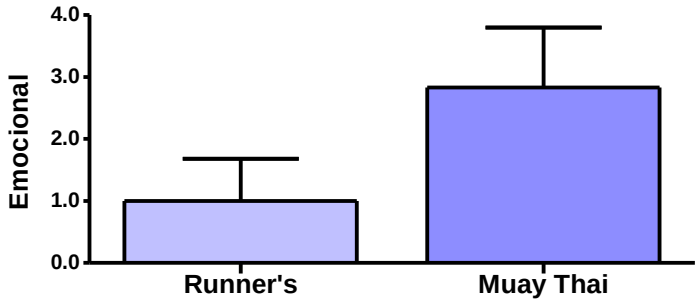
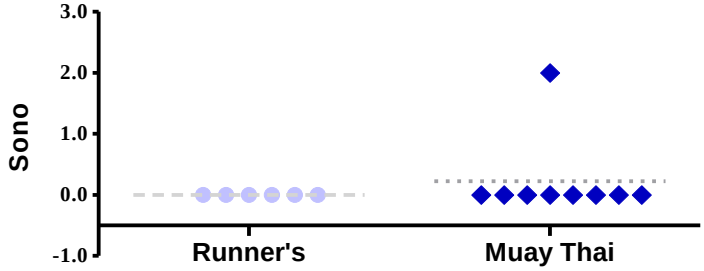


Figure 4. Sleep Analysis: *Runner's* : control group performed the 6 km run ; *Muay Thai* : group that carried out fighting as a modality; data expressed as mean ± standard deviation; statistical analysis, *Student 's t-test* , significance value, p <0.05. p = 0.435



INDIVIDUAL SYMPTOM AVERAGES

Some athletes presented more than one symptom within the variables, making it necessary to quantify the symptoms and calculate the athletes' individual averages for each variable category (physical, cognitive, emotional and sleep).

To analyze sample data, the measure of central tendency was used: Mean. To obtain the arithmetic mean, simply add up all the values of all the data and divide by the total number of data. Since the mean in statistics refers to the equilibrium point of a given concentration of data in a distribution, all values are added together and divided by the number of added values.

In arithmetic, the mean for ungrouped data is represented by: $X=\frac{\sum x}{x}$, where $\sum_x$ = sum of all values of $_x$. Therefore, the average will indicate the center of gravity of a set of data (CALLEGARI, SIDIA; 2009).

In this way, the presence of individual symptoms per scale for each athlete, which represent levels: None, moderate or severe, was simplified based on the individual average through the variable categories, represented in the following table.

TABLE 7 – Individual Means of the Modalities Investigated

1- *RUNNERS*	TO 1	A2	A3	A4	A5	A6			
PHYSICIST	2.5	2	3	0	2	0			
COGNITIVE	0	0	0	0	2	0			
EMOTIONAL	0	2	4	0	0	0			
SLEEP	0	0	0	0	0	0			
2- BOXING	TO 1	A2							
PHYSICIST	3	0							
COGNITIVE	2	2							
EMOTIONAL	6	4							
SLEEP	0	0							
3- *MMA*	TO 1	A2	A3						
PHYSICIST	6	0	0						
COGNITIVE	0	0	3						
EMOTIONAL	6	0	6						
SLEEP	0	0	0						
4- *KICKBOXING*	TO 1	A2	A3	A4	A5	A6			
PHYSICIST	4	6	4.5	4	4.5	3			
COGNITIVE	0	0	1	0	0	4			
EMOTIONAL	4	0	0	4	0	5			
SLEEP	0	0	0	0	0	6			
5- *MUAY THAI*	TO 1	A2	A3	A4	A5	A6	A7	A8	A9
PHYSICIST	3.5	2.5	6	3.5	4	3	0	0	3
COGNITIVE	3.5	0	2.5	3	0	2	6	0	5
EMOTIONAL	0	6	6	2.5	0	0	0	6	5
SLEEP	0	2	0	0	0	0	0	0	0

0-1	NONE
2-4	MODERATE
5-6	SEVERE

DISCUSSION

According to the data analyzed, it is possible to observe the following changes in the boxing modality **:**

- ✓ Physical and cognitive symptoms: Moderate levels;
- ✓ Emotional: From moderate to severe.

MMA modality :

- ✓ Physical and emotional: Severe levels;
- ✓ Cognitive: Moderate.

MMA modality does not have the main objective of generating concussion, as it is a modality in which it allows submission, therefore the data collected has the influence of this factor on the collection results (CNMMA, 2017). Due to the small sample size, it is not possible to say that in this modality there will be the presence of symptoms at such levels.

In *k1* it is possible to observe the following frequencies of symptoms:

- ✓ Physical: From moderate to severe;

- ✓ Cognitive: Moderate;
- ✓ Emotional: From moderate to severe;
- ✓ From sleep: Isolated case at a severe level.

The presence of physical and cognitive symptoms in the *k1 modality* is very common, since the forcefulness of the blows applied has great efficiency, not disregarding the greater flexibility of the gloves that cover a larger impact area (MATOS A, 2017).

muay mode *thai* , as it had a larger sample size, it was possible to carry out statistical analysis, comparing the modality with the control population, in which the following results are evident:

- ✓ Physical: Moderate to severe symptoms, with statistical difference.
- ✓ Cognitive: moderate to severe symptoms, which has a statistical difference.
- ✓ Emotional: From moderate to severe, however when comparing with the control population there is no statistical significance.
- ✓ Sleep: Just an isolated situation at a moderate level, without statistical significance.

In a combat situation, the cerebral impact called *knockout* (ko) or the period in which the athlete is exposed to blows, becomes a determining factor in the occurrence of cerebral concussion, given that, in combat sports, the objective is often is to generate attack on the opponent (ANGHINAH, PAGURA, 2016).

The use of a head protector (helmet) was evaluated by the *British of Sports Medicine,* analyzing the linear and angular acceleration force, and found a reduction of at least half compared to the absence of the protector in boxing. According to Tator , wearing a helmet prevents catastrophic injuries such as brain lacerations and intracranial hematomas, however it does not prevent all brain trauma as it does not inhibit the brain's rotational acceleration. Regarding the use of protective equipment, an important concept of risk compensation is also highlighted, in which the insertion causes a change in behavior, bringing greater safety to the athlete, adopting more violent techniques, thus increasing the rate of injuries. . It is still empirically known by technical teams and fighters that the helmet only reduces facial injuries, in which the use of it worsens brain damage, by increasing the impact area, and there is no consensus between its use or removal.

The helmet inhibits the visibility of cuts and injuries, and, as cerebral concussion is an “internal” condition not seen by the naked eye, it ends up becoming a hidden enemy, because if there are cuts, bruises and apparent injuries, the athlete is immediately treated by a doctor or referred for further examinations and, if there is no evidence, the patient is released and continues a normal life. An injury that is not visible does not generate concerns with protocols that prioritize the integrity of the athlete, and can thus lead to a hidden enemy, and when the perception of signs and symptoms of concussion appears, it is only after a long period of practice (ANGHINAH, PAGURA , 2016).

In contact fighting sports, due to the repetitive impact, the action can lead to future neurological consequences and thus the accumulation of microlesions , with high levels of fatigue, low energy, mental confusion and high mood disturbances, unlike musculoskeletal injuries. (KONTOS et. al, 2015). To this end, it is already understood and guided by boxing confederations that, during weekly training sessions, sparing using gloves is carried out a maximum of twice. THOMAZINI et. al. emphasize that sparing is the most vivid part of living with pain and experienced several times before the fight itself every week.

It is extremely important to analyze the size of gloves: In *MMA ,* glove sizes are from 4 to 6 OZ; In Boxing and K1 it is 10 to 12 OZ and in *Muay Thai,* depending on the weight, it can vary from 6 to 16 OZ. Therefore, the smaller the size of the glove, the greater the intensity of the blow.

It is important to evaluate changes related to mood and more pervasive affective symptoms, as when ignored or improperly managed, they can lead to chronic symptoms, with the possibility of even suicidal intentions (KONTOS et. al, 2015). During the collection, many athletes (mainly *muay thai*) said they did not present signs or symptoms at the moment, however, athletes with more than three years of practice reported sometimes presenting physical and cognitive signs in their daily lives characterized as acute symptoms “NOT NOW, BUT I NORMALLY FEEL IT”.

Second impact syndrome is due to inadequate diagnoses, in which athletes do not respect the time off and return to competitions before fully recovering, leaving themselves exposed to a new injury (PAGURA, ANGHINAH, 2016).

The global consensus to prioritize athlete integrity also aims to transfer knowledge, so that the ability to treat or reduce the effects of concussive injury after the event is minimal, with education and detection for athletes, referees, coaches and the general public a pillar for progress in concussion control (MCCRORY et. al, 2016).

In the types of fights analyzed, there is the presence of physical symptoms basically due to the fact that the athlete seeks to improve results in combat, the emotional aspects are accentuated when the athlete is exposed to blows for a longer time and is affected by *ko* or *tko* . Cognitive predominance is represented in higher classifications in the *muay modality thai* , the characteristics of the size of the gloves as well as the use of elbows and knees that deliver blunt blows which do not have protective equipment designate the efficiency of the impact, determining the presence of symptoms in the cognitive category. Sleep symptoms appear in isolated situations and do not present significant percentages.

Due to the absence of official events in some of the modalities investigated, as well as the low rate of fight closures not being defined by *ko* , the numbers of participants as samples are small so that advanced statistical calculations can be carried out, with statistical application being used only in the modality where it has the largest population (*muay Thai*).

Currently, athletes are stronger, and have greater tactical rather than technical concentration, increasing the intensity of the blows and, on the other hand, resisting subsequent blows for a longer period, and the stronger the impact, the greater the risk. concussion, not disregarding the mechanism of acceleration and deceleration of the brain inside the skull (ANGINAH, PAGURA; 2016).

Therefore, during combat, as a rule of numerous confederations, the referee is the athlete's first protection, striving for physical integrity during the fight. And so that the other current protections (technical and medical team) efficiently manage the influencing mechanisms, preventing the effects of cerebral concussion, in the long term, from causing the evolution of symptoms, reaching chronic effects.

CONCLUSION

The present study aimed to analyze the levels of cerebral concussion in combat athletes: boxing , *mma* , *k1* and *muay thai* after the impact on the braincase (there was no fall or moment of concussion in the control group).

Through the sample average, moderate physical, cognitive and severe emotional symptoms were found in the boxing modality, while in *MMA,* physical and cognitive symptoms were at moderate to severe levels and a severe presence of emotional levels, however, the sample in both modalities did not It was enough to state that in every practitioner there will be the presence of such symptoms after the cerebral impact. For *k1* , physical, cognitive and emotional symptoms of moderate and severe levels are evident in the sample, not being predominant in sleep. And, the *muay group thai* in which statistical analysis was applied *Student* 's *t-test* significance of $p<0.05$, showed statistical differences for physical and cognitive classifications in the modality, which suggests that cerebral concussion occurred.

In analysis of the frequent presence of symptoms in the physical classification in the *muay sport thai* , is explained by the momentary presence due to the fatigue installed as a result of physical effort in combat, whereas the statistical difference and presence of cognitive symptoms in the long term can become an aggravating factor, which is already verified verbally during data collection.

However, understanding the changes found is important in the development of new behaviors to preserve the physical and mental integrity of the athlete, making it necessary to carry out further studies in the area, as well as raising awareness among the population involved in combat modalities, so that concussion control is applied before, during and after each season, in order to prevent chronic effects such as: neurological and psychosocial damage.

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ANNEX 1- DATA COLLECTION FORM

Inclusive data

Evaluated athlete:

Modality:

( ) Boxing; ( )MMA; ( ) K1; ( ) *Muay Thai ;* ( ) Street race;

Education level:

( ) Complete elementary school; ( ) Complete Medium; ( ) Graduated;

Practice time:

( ) From 2 to 3 years; ( ) From 3 to 5 years; ( ) More than 5 years;

Do you use medications:

( ) Yes; ( ) No;

Previously suffered head trauma:

( ) Yes; ( ) No;

Annex 1- *Scat3*

***SCAT 3* QUIZ – BOXING**			
Scat3- Boxe Sport Concussion Assessment tool			
		SCORE	
SYMPTOMS	**None 0 ├ 1**	**Moderate 2 ├ 4**	**Severe 5 ├ 6**
Headache			
Pressure in the head			
Neck ache			
Nausea or vomiting			
Dizziness			
Blurred vision			
Balance problem and dizziness			
Light sensitivity			
Noise sensitivity			
Feeling of slowing down			
Feel like in a fog			
Do not feel good			
Difficulty concentrating			
Difficulty remembering (memory)			
Fatigue/lack of energy			
Confused			
Somnolence			
Problems falling asleep			
More emotional			
Irritability			
Sadness			
Nervous or anxious			
QUESTIONNAIRE COMPLETED VERBALLY BY THE ATHLETE VIA SCORE ON A SCALE OF 0 ├ 6			

Action of transdermal release of hormone-based pharmaceuticals

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ABSTRACT

Transdermal release of hormone-based drugs is a promising approach for the treatment of a variety of medical conditions, offering benefits such as stability of plasma levels, reduction of side effects, and improved patient adherence to treatment. This article has reviewed the challenges, advancements, and prospects of this technology. Challenges include the complexity of human skin and the need to overcome skin barriers. Technological advances, such as the use of absorption promoters and advanced delivery systems, have shown promising results. Future prospects include the customization of delivery systems and the integration of real-time monitoring technologies. In short, hormonal transdermal release represents an important innovation in medicine, with the potential to improve patients' quality of life.

Keywords: Transdermal release, Hormonal drugs, Challenges, Advances, Future perspectives.

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INTRODUCTION

HISTORICAL CONTEXT AND RELEVANCE OF HORMONE THERAPY

Hormone therapy has long been a key tool in medicine, offering solutions to endocrine disorders, gender transition, and menopausal symptoms. Traditionally, these hormones have been administered orally or by injection, which, although effective, have limitations such as fluctuations in plasma levels and adverse side effects (Silva et al., 2019). In the face of these challenges, the search for alternative methods of administration has been constant.

ADVANCEMENTS IN TRANSDERMAL RELEASE TECHNOLOGIES

Transdermal delivery technology, which began to be developed in the 1970s, offers a promising alternative for the continuous and controlled administration of drugs, including hormones. Such systems provide the controlled release of the drug through the skin, directly into the bloodstream, avoiding the first metabolic passage and reducing the variation in hormone levels (Costa et al., 2021).

IMPORTANCE OF HORMONES AND MEDICAL APPLICATIONS

Hormones such as progesterone, estrogen, and testosterone play vital roles in various biological functions. The efficacy of hormone delivery via transdermal systems has been widely studied, showing promising results in improving patient adherence and reducing side effects (Martins et al., 2020). This is particularly important in long-term treatments, such as hormone replacement therapy in postmenopausal women.

CHALLENGES IN TRANSDERMAL HORMONE RELEASE

Despite advances, transdermal release faces significant technical challenges. Human skin is an extremely effective barrier against the entry of external substances, which can limit the efficiency of the absorption of hormones with higher molecular weight or hydrophilic characteristics (Barreiros et al., 2022). Researchers have investigated various strategies to overcome these barriers, such as the use of absorption promoters and microneedling technologies.

FUTURE PERSPECTIVES AND INNOVATIONS

The continued evolution of transdermal delivery technologies promises significant advancements in the field of personalized medicine and hormone therapy. Recent studies point to the development of intelligent systems that can monitor hormone levels in real time and adjust dosage autonomously, promoting an even more personalized and effective therapy (Fernandes et al., 2023).

THEORETICAL BACKGROUND

PRINCIPLES OF TRANSDERMAL DRUG RELEASE

Transdermal drug delivery involves the administration of drugs through the skin into the systemic circulation. This route of administration offers several advantages over traditional methods, such as avoiding hepatic metabolization and providing a controlled and steady release of the drug (Prausnitz et al., 2004). Although the skin is an effective barrier against external agents, it can be permeated using various technologies, such as matrix, reservoir and microneedle systems, each with its own specific mechanisms and applications (Benson, 2005).

HORMONES AND THEIR THERAPEUTIC APPLICATIONS

Hormones, such as estrogen, progesterone, and testosterone, perform vital functions in the body and are commonly used in hormone replacement therapies. Estrogen is essential for the treatment of menopausal symptoms, while testosterone is used in replacement therapies in men with hypogonadism and in women to improve postmenopausal libido (Simon et al., 2005).

DEVELOPMENT OF TRANSDERMAL HORMONE RELEASE SYSTEMS

The development of transdermal hormone delivery systems has been motivated by the need to improve treatment adherence and minimize side effects. Studies have shown that transdermal systems, such as estrogen and testosterone patches, maintain more stable hormone levels, reducing risks and increasing treatment efficacy (Kuhl, 2005). In addition, recent innovations include the use of nanocarriers and gel-based systems, which promise even more efficient and less invasive absorption (López et al., 2020).

BARRIERS AND CHALLENGES IN TRANSDERMAL ADMINISTRATION

The main barrier to effective transdermal administration of hormones is the human skin, particularly the stratum corneum. Overcoming this barrier without compromising the integrity of the skin is a challenge that has been addressed through the use of absorption promoters, such as fatty alcohols and terpenes, and techniques such as iontophoresis and phonophoresis (Karande et al., 2004).

FUTURE PERSPECTIVES

The future of transdermal hormone release looks promising with the integration of advanced technologies such as dissolvable microneedles and controlled feedback systems that adjust hormone dosing in real-time based on biological sensors (Park et al., 2019). These innovations have the potential to transform hormone treatment, making it more personalized and efficient.

DISCUSSION

CHALLENGES IN TRANSDERMAL HORMONE RELEASE

The transdermal release of hormones faces several challenges, mainly related to the complexity of human skin and the need for effective and safe drug delivery. The skin barrier, especially the stratum corneum, is significantly resistant to the penetration of external substances, which hinders the absorption of hormones (Karande et al., 2004). In addition, factors such as drug solubility, molecular size and chemical stability directly influence the efficacy of the release (Prausnitz et al., 2004). Therefore, overcoming these barriers is crucial for the development of efficient transdermal systems.

TECHNOLOGICAL ADVANCES AND STRATEGIES ADOPTED

To overcome the challenges in the transdermal release of hormones, several strategies have been adopted. The development of absorption promoters, such as terpenes and fatty alcohols, has shown promising results in improving skin penetration (Benson, 2005). In addition, advanced delivery systems, such as matrix patches and reservoirs, have been designed to provide a controlled and constant release of hormones, minimizing fluctuations in plasma levels (López et al., 2020). Recent studies also explore the potential of nanotechnology in hormone encapsulation, aiming to increase the efficiency and accuracy of delivery (Costa et al., 2021).

CLINICAL IMPLICATIONS AND THERAPEUTIC BENEFITS

Transdermal hormone delivery systems offer a number of therapeutic benefits. Compared to conventional methods such as oral administration, they provide a more stable and constant absorption of hormones, reducing the incidence of side effects and improving patient adherence to treatment (Kuhl, 2005). In addition, these systems are especially relevant in long-acting therapies, such as hormone replacement therapy in postmenopausal women, where the stability of hormone levels is crucial for symptom relief (Martins et al., 2020).

FUTURE PERSPECTIVES AND CHALLENGES TO OVERCOME

Despite the advances, there are still challenges to be overcome in the transdermal release of hormones. Optimizing skin penetration and minimizing side effects are areas of research that are constantly evolving. In addition, the customization of transdermal systems according to the individual characteristics of patients is a promising prospect for the future (Park et al., 2019). The integration of biometric sensors into delivery systems can allow for even more precise therapy, adjusting the dosage according to the specific needs of each patient (Fernandes et al., 2023).

CONCLUSION

Transdermal hormone-based drug delivery has shown to be a promising approach for the treatment of a variety of medical conditions, offering significant benefits in terms of therapeutic efficacy, patient compliance, and minimization of side effects. Throughout this article, we explore the challenges faced by this technology, as well as the advancements and prospects for its future development.

One of the main issues discussed was overcoming cutaneous barriers in the effective delivery of hormones. We have seen that the complexity of human skin, including the lipid barrier of the stratum corneum, poses a significant challenge. However, strategies such as the use of absorption promoters and advanced delivery systems have shown promising results in improving skin permeation.

The reviewed studies also highlighted the clinical benefits of transdermal hormone release systems, such as stability of plasma levels, reduction of side effects, and improved patient adherence to treatment. This is particularly relevant in long-acting therapies such as hormone replacement therapy in postmenopausal women, where consistency of hormone levels is essential for symptom relief.

Looking ahead, we have identified several areas that deserve attention in future research. Customization of delivery systems according to individual patient characteristics is a promising area, as well as the integration of real-time monitoring and control technologies to adjust dosing more precisely. In addition, the optimization of formulations and the development of new materials and devices will continue to drive the evolution of this technology.

In summary, advances in the transdermal delivery of hormone-based drugs have the potential to revolutionize clinical practice, providing more effective, safer, and more convenient therapies. With continued investment in research and development, we can expect a significant expansion in the scope and application of these systems, thereby improving the quality of life for patients worldwide.

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Integrative review on the investigation of knowledge and adherence to contraceptive methods in young adults

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ABSTRACT

Concern about avoiding unplanned pregnancies motivates the use of contraceptive methods, but the effective transmission of knowledge about these methods is limited. The doctor-patient relationship plays a crucial role in providing guidance on contraception, aiming to meet patients' individual needs. The objective of this integrative review was to investigate knowledge and adherence to contraceptive methods in young adults, addressing adherence, reasons for choice, consequences and adaptability. 23 articles were reviewed, of which seven met the inclusion criteria. The studies analyzed highlighted the importance of considering social, cultural and individual factors when choosing contraceptives, aiming to improve the services offered. The results indicated that most women use short-term methods, but there is growing interest in long-term methods. The review also addressed the relationship between hormonal contraceptives and mental health, as well as risk factors associated with their use. Raising awareness about contraception from an early age and inclusive approaches are crucial to promoting adequate sexual and reproductive health among young people. This study highlights the need for a patient-centered approach to ensure effective and equitable contraceptive services, as well as highlighting the importance of early education about contraception and sexual health.

Keywords: Contraception, Reproductive Health, Family Planning.

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INTRODUCTION

According to Febrasgo, in 2019, according to the National Health Survey, 52.2% (109.4 million) of the Brazilian population were women, considered to have a reproductive age of 15 to 49 years. According to reproductive planning data, among sexually active women, 80.5% (33.6 million) used some contraceptive method in 12 months, which varied according to age – 15 to 24 years (76.1%) and above 25 years (80%)[1].

Contraceptive methods are applied with the aim of preventing reproductive processes. Developing Brazil faces a major public health problem compared to developed countries: unplanned pregnancy. There are control approaches, mainly increasing access to long-acting contraceptive methods, which can contribute to a different scenario than the current one[2].

Currently, there is a varied framework of methods offered on the market, but there is a failure to transmit knowledge about them within a social context, as well as a desire on the part of women to know more. The doctor-patient relationship is crucial regarding proper guidance in the contraception process, aiming to accommodate individual needs, within the patient's reality, and as a consequence achieving maximum adherence to contraceptive methods, based on reasons for choice, adaptability and adherence[3].

Among the target population, the majority of women are healthy and have physical well-being, however it is necessary to investigate adherence to the methods, as well as how much they affect their quality of life. It is clear that there are factors that influence young people's preference for this choice; it is necessary to verify this use. Understanding values and preferences to promote a better care program. Therefore, it is clear how behavioral control can determine psychological aspects essential to adherence, especially to the oral contraceptive pill. Auxiliary counseling techniques, such as structured information and telephone calls, can improve adherence to hormonal contraceptives and reduce discontinuation rates[4].

MATERIALS AND METHODS

This article consists of an Integrative Literature Review, and adopted the objective of investigating knowledge and adherence to contraceptive methods, adopting adherence, reasons for choice, consequences and adaptability as parameters. The databases used were Pubmed and LILACS (Latin American and Caribbean Literature in Health Sciences), the latter through the virtual health library (VHL). Using the descriptor “Contraception’’, 35 articles were found in PubMed, of the integrative review type within the age range of 19-24 years, and 85 in LILACS, whose main subjects were contraceptives, contraception and hormonal contraceptives. For the descriptor “Reproductive Health’’, 74 results were found in PubMed of the systematic review type between 19-24 years of age, and 31 results in LILACS, the main subjects of which were contraception and contraceptives.

Finally, 12 articles were selected from PubMed of the systematic review type in young adults, and five articles from LILACS, addressing contraception and contraceptives as the main subjects, using "Family Planning (Public Health)" as the descriptor. All selected texts were published in the last five years, in full text, in English and Portuguese. Among the 23 articles selected, only six corresponded to the research objective, one from the PubMed platform and five from LILACS, made available free of charge, excluding repeated articles, which did not describe the methodology used or which did not correspond to the research objective.

RESULT

It was prepared in a descriptive and expository way: the type of study, objective and conclusion of the six articles on the use of contraceptives in Table 1.

Table 1: Detailed analysis of the reviewed and selected articles regarding the type of study.

Title	Authors/Year	Kind of study	Purpose of the study	Conclusion
Identification of health risk factors among women using hormonal contraceptive methods	OLIVEIRA *et al.*, 2020[9]	Descriptive study with a quantitative approach	Check whether users of hormonal contraceptives had risk factors that could make the use of medication a health hazard.	Knowledge of personal and family risk factors associated with the use of hormonal contraceptives makes it easier for chronic diseases to develop.
Different perceptions between women and their doctors about contraceptive advice: results from the TANCO survey in Brazil	MACHADO *et al.*, 2020[1]	Online quantitative research	Assess women's awareness and self-reported knowledge about contraception; detect which contraceptive is most recommended by doctors and preferred by women; assess satisfaction and compliance with the current method and assess how clinicians are evaluating their own performance in terms of contraceptive counseling and services offered compared to women's perceptions.	When choosing a contraceptive, women considered safety and effectiveness as the two most essential points. Greater attention to individual needs and expectations can help with greater knowledge, contributing to more efficient discussions and a greater likelihood of choosing the right contraceptive for each woman.
Opinions about contraception and sexual behavior among young university students in southern Brazil	STEPHANOU, DELATORRE, DIAS, 2020[7]	Cross-sectional study	Investigate differences in self-reported sexual and contraceptive behavior among young university students.	The results showed that there are difficulties in making joint decisions and negotiating the use of contraceptives.

Effect of hormonal contraceptives on depression, anxiety and quality of life: controlled study	SOUZA *et al.*, 2020[8]	Cross-sectional study	Identify the effect of using oral hormonal contraceptives on depression, anxiety and quality of life.	The use of contraceptives is not a prerequisite for the presence of depression, anxiety and changes in quality of life.
Use of contraceptive methods among health academics	PAIVA *et al.*, 2020[5]	Quantitative, descriptive and cross-sectional study	Identify which contraceptive methods are used by academics in the health field and what are the reasons that influence their adherence and/or rejection.	The consistent use of contraceptive methods is not yet a reality among these students, which is mainly due to the unavailability of condoms.
Adolescents' knowledge about contraceptive methods and sexually transmitted infections	VIEIRA *et al.*, 2021[6]	Cross-sectional study	Identify adolescents' knowledge about safe sexual practices and identify adolescents' information needs about sexually transmitted infections and pregnancy.	The adolescents had previous and possibly superficial conceptions regarding the prevention of STIs and pregnancy. Female members had greater knowledge about this.

DISCUSSION

Within the study of the approach to conception and its methods within the young population, it was revealed during a study carried out with 198 academics in the health field, where 57.1% use the male codon as their main contraceptive method of choice, 27.8 % of these students do not adhere to condoms and 64.3% of students identified same-sex relationships as the main reason for non-adherence to contraceptive methods[5,6].

Furthermore, it is important to emphasize the differences in divergences of information about contraceptives, taking into account the intimate behavior adopted by academics. Analyzes focused on this perspective revealed that, although 95% of participants reported adherence to contraceptive methods, only 22% reported regularly using condoms, revealing the need for interventions that address the perceived barriers to constant use among young people. An interesting analysis addresses the observed gender differences. Women revealed themselves to be more determined about the use of contraception, while men took their partner's opinion to a greater extent. This discrepancy demonstrates the relevance of considering the perspectives of both genders when developing strategies to promote sexual health[5,7].

In a survey whose target group was teenagers, the results obtained show that women have greater knowledge about the diversity of methods, compared to men, who in turn have less information about sexually transmitted infections (STIs) and safe sex practices, within this group,

24.6% believe that oral contraceptives prevent these pathologies. These differences highlight the need for comprehensive and equitable sexuality education for both sexes[6].

Furthermore, it was shown that there is no harmful relationship between psychological effects and preferences for combined hormonal contraceptives (CHOC), which was a frequent question when it came to contraception, with the conclusion that there are no significant adverse effects in women without comorbidities[8].

Additionally, the recognition of personal and family risk factors associated with the consumption of hormonal methods is crucial not only for women's current health, but also for their quality of life. By identifying these risk-increasing conditions, healthcare professionals must be empowered to provide a preventive and awareness-raising approach in order to reduce the incidence of long-term complications. Additional research indicates that there is a growing interest among women in long-term contraceptive methods, highlighting the importance of information and an approach related to conditions that cause harm, to expand their choices, such as the occurrence of migraines, which are the type with aura, in particular, it is considered a contraindication to the use of CHOC, due to the increase in ischemic cerebrovascular events. These findings highlight the importance of education about contraception from an early age and highlight the need for inclusive and educational approaches to promote adequate sexual and reproductive health among young people[1,9].

FINAL CONSIDERATIONS

The results of this article presented an analysis of the number of women in the Brazilian population who are of reproductive age according to Febrasgo, which corresponds to 52.2%. Among these, 80.5% used some contraceptive over 12 months, with short-term contraceptives being used mostly, but there is a growing interest in long-term methods.

Thus, still within the approach, contraceptive methods prevent reproductive processes and Brazil, still in development, faces the major issue that revolves around unplanned pregnancy, compared to developed countries.

The review was based on the Pubmed and LILACS database, whose main topics were contraceptives, contraception and female contraceptives. Therefore, the objective is to investigate knowledge and adherence to methods using issues such as security, side effects, privacy and autonomy as main parameters.

In this integrative review, the analysis suggests that women of childbearing age are concerned about preventing unplanned pregnancies. However, understanding of contraceptive methods is restricted and their dissemination is incomplete.

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Cardiovascular risk factors in patients of diabetes mellitus – Integrative review

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ABSTRACT

Due to the increase in the Risk of Cardiovascular Events, the WHO has advocated for public policies that address social and population issues in primary prevention, with the identification of individuals at high cardiovascular risk being valid in order to individualize treatment. In this sense, diabetics are the group whose main cause of death is CVD, whose medications aimed at controlling this chronic disease have the potential to reduce complications. The objective of this study is to investigate the cardiovascular risk factors in patients with Diabetes Mellitus and their possible repercussions. A search was carried out in the PubMed and LILACS (Latin American and Caribbean Literature in Health Sciences) databases, through the Virtual Health Library (VHL), using the descriptors "Risk Factors for Heart Disease", "Metabolic Syndrome" and "Diabetes Mellitus". The present study evidences Diabetes Mellitus (DM) as a risk factor for cardiovascular complications that enable endothelial dysfunction, vascular inflammation and the formation of atherosclerotic plaques. In summary, the prevention and effective control of Diabetes Mellitus are essential to reduce the impact of cardiovascular complications associated with this condition. Multifactorial approaches, including lifestyle interventions and pharmacological treatment, are essential for the management of cardiovascular risk. Therefore, it is crucial to reinforce prevention strategies, especially for patients with DM, with the aim of improving quality of life and reducing morbidity and mortality related to cardiovascular risk in this vulnerable population.

Keywords: Risk Factors for Heart Disease, Metabolic Syndrome, Diabetes Mellitus.

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INTRODUCTION

In 2010, the American Heart Association conceptualized what would be considered ideal cardiovascular health, with the objective of reducing morbidity and mortality from cardiovascular diseases (CVD), considered the main causes of death worldwide , exceeding the rate of 33%. In this sense, the Cardiovascular Health Score (CVH) was based on adequate blood pressure, cholesterol and serum glucose levels as biological parameters, and healthy eating, physical activity, ideal body weight and absence of smoking, as modifiable indicators, these being responsible for 70% of CVD deaths. It was found that in 2013, CVH in Brazil was less than 1%, a value far from the ideal rate, being an adjunct in primary cardiovascular surveillance in the country. In the 2019 National Health Survey, there was a 24% increase in the incidence of Diabetes Mellitus (DM), considered a glycemic metric among the CVH parameters. The conditions that increase the risks are correlated with the increase in the survival rate of the Brazilian population, accompanied by the emergence of diseases in the cardiovascular system, with Acute Myocardial Infarction being the main pathology responsible for deaths, followed by Stroke, Arterial Hypertension (SAH) and Atherosclerotic Disease[1,2].

Due to the increase in health conditions that lead to an imbalance in cardiovascular homeostasis, the WHO recommended public policies that address social and population issues in basic care, and it is worth highlighting a closer look at individuals considered at high risk, for better therapeutic guidance. Within this group are diabetics, a group whose main mortality factor is CVD, and medications designed to manage this chronic disease can reduce microvascular complications, such as nephropathy, retinopathy and neuropathy, in addition to mitigating systemic cardiovascular events. Furthermore, the United Kingdom Prospective Diabetes Study (UKPDS) was a randomized clinical trial that placed approximately five thousand people under intensive glycemic control for 20 years, in hospitals in England, Scotland and Northern Ireland. From there, it was possible to conclude that hyperglycemia is an independent determinant of coronary heart disease, mainly related to the intrinsic hyperglycemia of type 2 DM, doubling this predictor when concomitant with SAH. In this sense, the present study aims to investigate the determinants involved with cardiovascular risk in patients with Diabetes Mellitus and its possible repercussions, since the complications of this chronic disease are not inevitable, but are preventable in association with strict glycemic and blood pressure control. arterial[3,4,5].

MATERIALS AND METHODS

PubMed and LILACS (Latin American and Caribbean Literature in Health Sciences) databases , through the Virtual Health Library (VHL), using the keywords " Risk Factors for Heart Disease " , " Metabolic Syndrome " and "Diabetes Mellitus".

Applying the descriptor " Risk Factors for Heart Disease " and " Diabetes Mellitus" in PubMed , 18,958 results were found. Selecting complete and free texts, 8,474 results were found. Of those within the last 5 year period, this resulted in 3,815 results. Applying the clinical trials filter, 193 results were found, eight of which corresponded to the purpose of the study. The results obtained with the descriptors " Metabolic Syndrome " and "Diabetes Mellitus" were 20,119 articles. Applying the full and free text filters, 8,513 results were found, of those covering the last 5 years, 3,550 results were found. Of those corresponding to clinical trials, 98 results were found, selecting three articles that corresponded to the objective of the study.

In the LILACS database using the descriptor " Risk Factors for Heart Disease " and " Diabetes Mellitus" 464 results were found. Of those that are part of the full texts, 412 results were found. Of those that are within the period of the last 5 years, 163 results were obtained. Among those corresponding to controlled clinical trials, eight results were found, of which six articles are included in the objective of the study . Syndrome " and "Diabetes Mellitus" was 887 articles. Applying the full text filter, 778 results were obtained. Of those covering the last 5 years, 188 results were found. Of those that are part of epidemiological studies, 60 results were found , selecting three articles that correspond to the purpose of the research.

In general, articles from the last five years were included, in Portuguese and English, whose target population is adults who present symptoms and diagnosis of arterial hypertension. At the same time, systematic reviews, case reports and non-primary studies were excluded, as well as articles with irrelevant content, populations different from those established as inclusion criteria, repeated articles and not made available in full and free of charge.

RESULTS

Of the 6 (six) articles selected to prepare the results, 2 (two) were cross-sectional studies, 1 (one) was a cohort study, 2 (two) were randomized clinical trials and 1 (one) was a descriptive cross-sectional study. Therefore, table 1 elucidates the main information in the selected articles.

Table 1 - Articles selected to prepare the results.

Title	Authors/Year	Kind of study	goal	Conclusion
Prevalence of diabetes complications and associated comorbidities in family medicine at the Mexican Social Security Institute	O VALLE-LUNA *et al* ., 2018 [7]	Cross-sectional study	To compare the prevalence of complications and chronic comorbidities in patients with DM2 in 36 family medicine units from five chapters of the Mexican Social Security Institute (IMSS)	The prevalence of chronic complications of diabetes showed geographic and gender differences in the IMSS. Older age and longer duration of diabetes were important factors associated with diabetes in IMSS.
Risk factors associated with glycemic control and metabolic syndrome in patients with type 2 diabetes mellitus Villavicencio , Colombia.	PIÑEROS-GARZON; RODRIGUEZ-HERNANDEZ, 2019 [6]	Cross-sectional study	To identify risk factors potentially associated with glycemic control and metabolic syndrome (MS) in patients with DM2 at a Health Services Institution (IPS) in Villavicencio , Colombia.	Despite being a controlled population and being monitored, a high percentage of patients had inadequate metabolic control, increasing cardiovascular risk.
Evaluation of Metabolic Syndrome and Its Associated Risk Factors in Type 2 Diabetes: A Descriptive Cross-Sectional Study at the Komfo Anokye Teaching Hospital, Kumasi, Ghana	AGYEMANG-YEBOAH *et al.*, 2019 [9]	Cross-sectional descriptive study	Investigate metabolic syndrome, its prevalence and risk factors associated with type 2 diabetes at Komfo University Hospital Anokye , Kumasi, Ghana.	The prevalence of metabolic syndrome in the observed and studied population was 90.6%, with women being the most affected. Risk factors tend to increase the burden of metabolic syndrome in type 2 diabetes, such as increased plasma triglycerides, high level of body fat, low educational level, and higher anthropometric measurements of waist and hip circumference, waist-to-hip ratio, and BMI.
Heart failure with insulin degludec versus glargine U100 in patients with type 2 diabetes at high risk of cardiovascular disease: DEVOTE 14	PRATLEY *et al.*, 2019 [10]	Randomized clinical trial	To investigate baseline factors and treatment differences that are associated with an increased risk of hospitalization for HF (HF) and gain a better understanding of the possible association between severe hypoglycemia and subsequent increased risk of hHF .	In patients with type 2 diabetes mellitus and at high cardiovascular risk, there were no differences in treatment regarding hospitalization for heart failure (ICH). Previous heart failure (HF) was the strongest predictor of future ICH events, and there was an association between severe hypoglycemia and subsequent ICH.
Risk factors for type 1 and type 2 myocardial infarction	WERESKI *et al.*, 2021 [8]	Randomized clinical trial	To evaluate predictors of future type 1 and type 2 myocardial infarction events during 1-year follow-up of a population of consecutive patients who presented to the hospital	Traditional cardiovascular risk factors generally related to type 1 myocardial infarction also have relevant predictors of type 2 myocardial infarction.

			with suspected acute coronary syndrome.	
Combinations of metabolic syndrome and diabetes mellitus risk	VERA-PONCE *et al.* , 2022 [11]	Cohort study	To determine the combinations of metabolic syndrome for type 2 diabetes mellitus risk in a sample of Peruvian residents.	Risk stratification according to the combination of GAA components, low HDL and altered waist circumference could provide important value in predicting the development of T2DM.

DISCUSSION

Diabetes Mellitus (DM) not only represents a global epidemic, but is also an important risk factor for the development of cardiovascular complications. Factors such as urbanization, industrialization and changes in lifestyle contribute to the increase in the prevalence of DM, making it a significant challenge for healthcare systems around the world. Chronic hyperglycemia associated with DM plays a central role in the pathogenesis of cardiovascular complications, promoting endothelial dysfunction, vascular inflammation and the formation of atherosclerotic plaques. Therefore, it is clear that the relationship between type 2 diabetes mellitus (DM2) and increased cardiovascular risk is well established. Several studies have analyzed this relationship, which noted a higher incidence of these problems in older patients and those with a longer disease progression. Furthermore, men had more complications, while women showed a higher incidence of heart failure and comorbidities. The study highlights the urgent need to reinforce strategies to prevent these complications, especially in patients with DM2[6,7,8].

The correlation between cardiovascular events in patients with diabetes mellitus is explained by a study carried out in Colombia. The analysis carried out by two researchers with a group of Colombian men and women with DM2 demonstrated that obese patients were 1.2 times more likely to have cardiovascular diseases than individuals with a BMI below 30kg/m2. Furthermore, the study showed that individuals whose disease was uncontrolled (DM2) also had coronary syndrome. Such data obtained served to confirm and support that cardiovascular risks are exacerbated and predisposed by DM2 . Furthermore, a study carried out at the university hospital in Ghana with diabetic individuals also concluded that obesity and uncontrolled DM2 are factors that predispose to the development of diseases of the cardiovascular system[6,9].

Pratley 's research *et al.* (2019) [10] show that heart failure is the most common consequence of DM2 and is responsible for leading a large number of individuals to death. The study highlighted that those patients who followed the correct treatment through the use of oral medications or the use of insulin had a lower chance of developing cardiovascular problems when compared to those who did not use medications or used them irregularly. This highlights the need to control and care for DM2 in order to avoid possible systemic complications that lead to loss of quality of life and death[10].

The studies by Vera-Ponce *et al* . (2022) [11] highlight hyperglycemia as a crucial risk factor for the development of cardiovascular complications in patients with DM. The analysis reveals that the combination of high waistline, hyperglycemia and low HDL-cholesterol levels significantly increases the risk of type 2 DM, emphasizing the importance of glycemic control in cardiovascular risk management. Furthermore, they highlight the interconnection between metabolic factors and cardiovascular risks, highlighting the role of central obesity and insulin resistance in increasing cardiovascular risk in diabetic patients[11].

Wereski's study *et al*. (2021)[8], in turn, demonstrates that patients with DM share a similar profile of cardiovascular risk factors with patients who develop myocardial infarction, both type 1, associated with atherosclerotic plaque rupture, and type 2, multifactorial. This reinforces the need for multifaceted approaches in managing cardiovascular risk in patients with DM, including lifestyle interventions and pharmacotherapy, recognizing the common association of DM, hyperlipidemia, and prior history of coronary artery disease in both types of myocardial infarction.

FINAL CONSIDERATIONS

The present study highlights diabetes mellitus (DM) as a risk factor for cardiovascular complications, enabling endothelial dysfunction, vascular inflammation and the formation of atherosclerotic plaques. Studies highlight that men and senescent individuals present more complications in cardiovascular clinical conditions, and it is imperative to establish preventive measures to avoid these complications.

Similarly, research shows a greater risk of worsening the clinical situation in patients with obesity and patients with uncontrolled DM had frequent coronary syndromes, as they are more prone to insulin resistance in the body. Furthermore, adherence to treatment with oral or injectable medications, such as insulin, corroborates the reduction in the rate of systemic complications in the body.

Furthermore, patients with increased HDL-cholesterol, hyperglycemia and high waist circumference are risk factors as they are more likely to develop insulin resistance. These characteristics are associated with atherosclerotic plaque rupture in type 1 DM and multifactorial complications in type 2 DM.

In short, prevention and effective control of diabetes mellitus are essential to reduce the impact of cardiovascular complications associated with this condition. Comprehensive approaches, including lifestyle interventions and pharmacological treatment, are essential for managing cardiovascular risk. Therefore, it is crucial to reinforce prevention strategies, especially for patients with DM, with the aim of improving quality of life and reducing morbidity and mortality related to cardiovascular risk in this vulnerable population.

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Integrative analysis of the impact of artificial intelligence in the early diagnosis of gastrointestinal diseases

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ABSTRACT

Artificial intelligence (AI) has played a significant role in the early diagnosis of gastrointestinal diseases, showing constant evolution in contemporary medical practice. This study aims to analyze the impact of AI in this context, exploring its historical, epidemiological, and organizational implications in gastroenterology through integrative review. Studies investigating the use of AI in the diagnosis of gastrointestinal diseases were examined, using databases such as Medline and the Latin American and Caribbean Literature in Health Sciences (LILACS). The results highlight the effectiveness of AI in the early detection of gastrointestinal lesions, its contribution to improving diagnostic accuracy, and the need for continuous improvement in this field. It is concluded that the integration of AI in gastroenterological practice can offer significant benefits, including more efficient patient management and a more accurate and holistic approach to the diagnosis and treatment of gastrointestinal tract diseases.

Keywords: Artificial Intelligence, Early Diagnosis, Gastroenteropathies.

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INTRODUCTION

Artificial intelligence (AI) has significantly advanced the analysis of medical images, thus contributing to the field of gastroenterology. This has allowed an improvement in the evolution of gastrointestinal endoscopy, resulting in more accurate screening and diagnosis of gastric lesions. This way, it is possible to detect gastric changes early, especially neoplastic ones. Regarding gastric cancer, it is the fifth most common neoplasm and the third leading cause of cancer-related deaths globally. Esophageal cancer is the sixth leading cause of cancer death in the world. Thus, early diagnosis contributes greatly to the patient's survival and prognosis[1,2].

Artificial intelligence systems have been very successful in the early diagnosis of diseases of the gastrointestinal tract, ensuring a better prognosis regarding the cure of patients affected by cancers in this region, since these are aggressive diseases that lead to a large number of individuals in the world to death. The use of technological resources could increase the 5-year survival rate in patients diagnosed with gastric adenocarcinoma from just 31% to 95%. The expectation regarding the increased survival of these patients encourages hope both in patients and in the medical community[3].

It is observed that artificial intelligence has demonstrated increasing sensitivity and less time spent diagnosing cancers of the digestive system. A study carried out in Tokyo with 13,584 endoscopic images suggestive of gastric cancer demonstrated that artificial intelligence achieved a sensitivity of 58.4% when compared to endoscopists who achieved 31.9%[4].

Furthermore, regarding the accuracy of endoscopic diagnosis of *Helicobacter infection pylori* is approximately 70%, indicating that there is room for improvement in this method. Thus, the use of artificial intelligence (AI) to early detect the presence of *Helicobacter pylori* in the stomach lining, plays a key role in preventing gastric disorders and their complications. This bacterium is associated with the development of functional dyspepsia, peptic ulcers, mucosal atrophy, neoplasms and gastric cancer, in addition to causing atrophic gastritis and intestinal metaplasia[2,5].

It is important to mention that the use of AI in medical practice is not intended to replace healthcare professionals, but rather as a complement that will help identify injuries that could otherwise go unnoticed, especially with regard to oncological diagnosis. Furthermore, although many AI systems have an accuracy greater than 80%, it is necessary to carry out clinical trials to prove their feasibility, effectiveness and safety in clinical practice. Although there are current challenges, AI is likely to experience continued progress that will enable its increasingly frequent adoption in daily clinical practice in the imminent future[1, 6].

Therefore, the present study aims to analyze the impact of artificial intelligence on the early diagnosis of gastrointestinal diseases, evaluating its effectiveness, accuracy and ability to improve clinical outcomes and reduce morbidity and mortality through an integrative review. Furthermore, to

highlight better prognoses achieved with the use of artificial intelligence systems in the survival rate of individuals affected by diseases of the gastrointestinal tract.

MATERIALS AND METHODS

This is an integrative review that investigates the impact of artificial intelligence on the early diagnosis of gastrointestinal diseases, using the Medline and Latin American and Caribbean Literature in Health Sciences (LILACS) databases through the Virtual Health Library (VHL). The search resulted in the identification of 215 articles in Medline and (1) one in LILACS, which were selected based on the relevance of their objectives, using the descriptors "Artificial Intelligence", "Early Diagnosis" and " Gastroenteropathies ", combined with the boolean operator "AND". The studies included cover the period from 2019 to 2024 and present described methodology and methods, being available in English, Portuguese or Spanish, free of charge, and focusing on the application of artificial intelligence in the diagnosis of gastrointestinal diseases. On the other hand, publications such as thesis and monographs were excluded, as they do not suit the purpose of this study. Among the 23 eligible articles, 12 were selected for analysis in this review.

RESULTS

It was prepared in a descriptive and expository way: the type of study, objective and conclusion of the ten articles on the impact of artificial intelligence on the early diagnosis of gastrointestinal diseases in Table 1.

Table 1: Detailed analysis of the reviewed and selected articles regarding the type of study.

Title	Author/Year	Kind of study	goal	Conclusion
Artificial intelligence and upper gastrointestinal endoscopy: Current status and future perspective	MORI *et al.* , 2019 [2]	Quantitative study.	Identify the automation of dysplasia in Barrett's esophagus and detect early gastric cancer.	The conclusion about the study allows us to certify that with larger learning samples and well-designed prospective trials, the technology for upper gastrointestinal endoscopy can be implemented in clinical practice in the near future.
Detecting early gastric cancer: Comparison between the diagnostic ability of convolutional neural networks and endoscopists	IKENOYAMA *et al.* , 2020 [9]	Quantitative study .	Evaluate whether the performance of a convolutional neural network (CNN) in early detection of gastric cancer is better than that of endoscopists.	CNN detected gastric cancer earlier than endoscopists. Therefore, it is concluded that the CNN needs additional training to achieve greater diagnostic accuracy. However, a diagnostic support tool for gastric cancer using a CNN will be realized in the near future.
Development and validation of a	TANG *et al* ., 2020 [3]	Retrospective study.	real-time deep convolutional neural networks (DCNNs)	In conclusion, we have developed an efficient AI system based on DCNN

real-time artificial intelligence-assisted system for detecting early gastric cancer: A multicentre retrospective diagnostic study			system to detect early gastric cancer (EGC).	for real-time EGC detection. The DCNN system demonstrated excellent performance for EGC detection in independent validation datasets and improved the diagnostic ability of endoscopists-in-training to a level comparable to that of experts.
Application of artificial intelligence using a convolutional neural network for diagnosis of early gastric cancer based on magnifying endoscopy with narrow-band imaging	UEYAMA *et al* ., 2021 [8]	Quantitative study .	Build an AI-assisted CNN computer-aided diagnosis (CAD) system, based on ME-NBI images, to diagnose EGC and evaluate the diagnostic accuracy of the AI-assisted CNN-CAD system.	The system used in the study demonstrates great potential for future application in real clinical settings, which would facilitate the diagnosis of EGC using ME-NBI in practice. The CNN-CAD system uses AI to diagnose EGC using ME-NBI, with the possibility of processing many ME-NBI images that are stored in a short period of time and has a high diagnostic capacity.
Application of artificial intelligence-driven endoscopic screening and diagnosis of gastric cancer	HSIAO *et al* ., 2021 [1]	Qualitative study.	To summarize the current status of various AI applications in gastric cancer and point out directions for future research and implementation into clinical practice from a clinical perspective.	Overall, the use of AI in gastroenterology is still in its infancy. Currently, there are several retrospective models applied to both images and videos and using WLI and NBI endoscopies that have proven to have superior performance for carrying out the same tasks performed by experienced endoscopists. However, there were no attempts at clinical trials. In contrast, there are still clinical trials being carried out in order to detect colorectal polyps, it is also observed that the applications of AI in GC and its corresponding diagnostic methods are still preliminary. There are limitations to the efforts pointing to the need for continued research in the area, which can greatly contribute to making faster, more accurate and accurate assessments of GC risk. Even though we have witnessed its rapid and marked growth in the last decade, future studies are needed to speed up the machine learning process and define its role in computer-aided diagnosis of *H. pylori* and GC infections in clinical settings of life. real.
Development and evaluation of a double-check support system using artificial intelligence in endoscopic screening for gastric cancer	OURA *et al.* , 2021 [7]	Quantitative study .	Prevent missing gastric cancer and target low-quality images by developing a double-check support system (DCSS) for static esophagogastroduodenoscopy (EGD) images using artificial intelligence.	The DCSS demonstrated excellent ability to detect lesions and identify low-quality images.

Hybrid and Deep Learning Approach for Early Diagnosis of Lower Gastrointestinal Diseases	FATI; SENAN; AZAR, 2022 [11]	Quantitative study .	Develop several multi-methodologies , where the work was divided into four proposed systems; each system has more than one diagnostic method.	Future work will apply the principal component analysis (PCA) algorithm to reduce the dimensions of deep feature maps extracted by CNN models, in addition to including maps from more than one CNN model and reducing their dimensions by the PCA algorithm.
Cooperation between artificial intelligence and endoscopists for diagnosing invasion depth of early gastric cancer	GOTO *et al.* , 2023 [12]	Quantitative study	artificial intelligence (AI) classifier to differentiate intramucosal gastric and submucosal cancers and examine them to establish a diagnostic method based on cooperation between AI and endoscopists.	Cooperation between AI and endoscopists has demonstrated improved diagnostic ability to reveal the depth of invasion of early gastric cancer.
Evaluation of deep learning methods for early gastric cancer detection using gastroscopic images	SU *et al* ., 2023 [10]	Qualitative study.	Compare the performance of different models from the RCNN series for EGC.	Methods based on deep learning have contributed to the early diagnosis of cancer through endoscopic images. However, the performance of these methods did not meet the demands of clinical practice. Therefore, more advanced AI methods must be proposed for the early detection of cancer, it is necessary to develop a combination of more advanced imaging technology and AI methods.

DISCUSSION

The use of artificial intelligence (AI) to identify gastric pathologies early, such as *Helicobacter pylori* in the gastric epithelium, is crucial to prevent complications. This bacterium is responsible for functional dyspepsia, peptic ulcers, mucosal atrophy, gastric neoplasia, gastric cancer, atrophic gastritis and intestinal metaplasia. Studies indicate that the majority of gastric neoplasms are closely related to *H. pylori infection* , which leads to the need to perform a C13 urea breath test, and for subclinical cases, invasive biopsies that require more time to be performed. realization. Furthermore, there is a protocol requirement by the Kyoto Classification, the gold standard in gastroenterology for identifying the level of severity of the infection, that examiners observe the lesions with the naked eye, which corroborates the development of a new protocol that uses intelligence artificial so that the standard exam is less subjective. Gastric cancer is the fifth most common neoplasm on a global scale, affecting more than one million people, and leading to death in 78% of cases, which makes endoscopic practice a crucial exam to diagnose, treat the disease and alleviate symptoms. . Endoscopic techniques are advancing, with the use of chromoendoscopy and optical techniques with light source modulation, such as fluorescence endoscopy and elastic scattering spectroscopy. In this sense, the use of AI has proven to be of great relevance in oncological diagnosis, both in the analysis of exams and in the classification, in a precise way in the identification

and characterization of imaging exams, even subtle changes. In gastroenterology, the application of endoscopic capsules has been effective in detecting the location of mucosal changes, such as colonic polyps , especially in the 2010s with a significant increase in the search for this segment, being improved over the years regarding its specificity, sensitivity, positive predictive value and precision in the elaboration of statistics[1].

It is worth analyzing that the use of AI is still a field that needs improvement, such as the identification of *H. pylori*. Analysis systems need to have more rigorous control with a greater variety of image and endoscopy databases, with the concomitant application of convolutional neural network (CNN) algorithms that take over image processing after training with images selected by researchers, which are limited to existing models. Overcoming these challenges corresponds to better accuracy when identifying cured and infected patients, or the precise anatomical location of the site of infection, important aspects for the clinical area. To identify changes in the gastric mucosa, specific markers are used that identify surface and color, which are subsequently interpreted by endoscopists, whose assessment could be replaced by real-time AI, applying antiperistaltic agents to polyethersulfone and indigo carmine chromoscopy to identify lesions surfaces with irregular pattern[1].

Studies indicate that the use of AI is essential in the detection of gastric diseases, with a focus on dysplasia in esophageal cancer, esophageal squamous cell carcinoma, gastric cancers and *H. pylori* infection. Artificial intelligence based on machine learning is divided into deep learning (DL) algorithm and artesana (conventional) algorithm. In the latter, researchers work manually to identify characteristics with pathogenic potential based on clinical medicine, while in DL, autonomously, they extract and learn the discriminative characteristics of the image. People with Barrett's esophagus have an increased risk for developing esophageal adenocarcinoma, and its detection using AI is a promising area in an attempt to perform high-precision biopsies, endorsed by the American Society for Gastrointestinal Endoscopy, with a sensitivity of 90% and a negative predictive value of 98% in the detection of high-grade dysplasia, being one of the most promising areas in the area of endoscopy for computer-based diagnosis (CAD). Regarding esophageal cancer, the sixth leading cause of cancer death in the world, the replacement of the gold standard method of identifying lesions using Lugol's chromoendoscopy, which requires a trained professional eye to identify lesions, resulting in low specificity (70%), by a model governed by AI using CNN as a base, a machine learning with a larger amount of data, resulting in a sensitivity of 98%. Gastric cancer is linked to a high mortality rate worldwide. In the initial stages, it is difficult to identify due to its superficiality and mild erythema, and when advanced, it makes detecting the depth of the mucosal lesion a challenge, as it can reach the submucosa and it is necessary to know how to distinguish the classifications into mucosal, submucosal 1 and 2, as this will define the appropriate treatment in order to reduce the risk of metastases, using CAD in the diagnosis[2].

In a study carried out in Japan, non-magnified white light images were used in the double-check support system (DCSS) instead of retrospective analysis in the database, using artificial intelligence, with the aim of identifying low-quality images, inadequate for the diagnosis of gastric, esophageal, duodenal and stomach lesions. By using deep learning models to improve the quality of images available in DCSS, detecting lesions using the Cascade R-CNN algorithm, a highly efficient method for detecting objects in the medical environment, as convolutional neural networks (CNNs) intersect in cascade under Union-related thresholds (IoU). In addition to these mechanisms, DenseNet was used, which forms a convolutional network of layers to construct a more accurate study. Using these AI tools, a Positive Predictive Value (PPV) of 92.5%, accuracy of 80.4% and sensitivity of 86.1% in detecting lesions were obtained, this system being superior to endoscopic detection of gastric cancer. DCSS also has good accuracy when using low-quality images, helping doctors when analyzing Upper Digestive Endoscopy images. Comparatively, in a study carried out in China using the DCNN system, comparing intraepithelial, intramucosal and submucosal lesions, with an accuracy of 95.3%, contrary to the assessment carried out by endoscopists (87.3%), with high sensitivity, specificity and PPV, as the gold standard in the diagnosis of gastroesophageal cancer is upper digestive endoscopy with biopsy, however it depends on the skill and experience of the performing endoscopist, which is non-existent when it comes to algorithms and artificial intelligence tools[3,7].

Early detection of gastric cancer is of paramount importance to improve survival rates and clinical outcomes for patients. However, white light endoscopy, widely used for this purpose, faces challenges in accurately identifying cancerous lesions especially when they are small. A recently developed technique, known as endoscopic magnification with narrowband imaging (ME-NBI), has been noted for its effectiveness in distinguishing early gastric cancer from noncancerous lesions. This method uses the Vessel and Surface Classification System (VSCS) and the Simple Diagnostic Algorithm for Early Gastric Cancer (MESDA-G) which are valuable tools in this diagnostic process. Studies reveal that the rate of negative misdiagnosis when using esophagogaduodenoscopy (EGD) varies between 4.6% and 25.8%. Recently, artificial intelligence (AI), especially based on convolutional neural networks (CNNs), has made remarkable progress in several areas, including medicine. Previous research has demonstrated that AI, when trained on endoscopic images, can accurately identify gastric cancer. However, there is a lack of studies comparing the diagnostic capacity of CNNs with that of endoscopists[8,9].

Gastric cancer, in particular, is one of the most common forms of cancer in China, with early detection playing a crucial role in improving treatment outcomes. Although endoscopy is a common tool for diagnosing gastric cancer, detecting early stages can be challenging due to the lack of clear symptoms and the potential for misdiagnosis. Artificial intelligence (AI) has emerged as a promising

diagnostic tool for gastric cancer. Several AI models have been developed and tested to classify and detect gastric lesions, with encouraging results that surpass the accuracy of experienced endoscopists. These models include Inception-v3, U-Net, VGG16, ResNet50, Tango, YOLOv3, and Mask RCNN. They are able to identify abnormalities in gastroscopic images and mark their location precisely. Among AI methods, models based on convolutional neural networks (CNNs) have stood out in detecting early gastric cancer. RCNN models, including Faster RCNN, Mask RCNN, and Cascade RCNN, have been particularly effective in locating and identifying cancerous lesions in gastric endoscopy images. A recent study compared the performance of these different RCNN models in detecting early gastric cancer, demonstrating that the AI consistently outperformed the accuracy of human experts. These findings highlight the transformative potential of AI in the early detection and effective treatment of gastric cancer, offering hope for improving outcomes for patients[10].

Gastrointestinal cancer can affect both the upper tract, which includes the esophagus and stomach, and the lower tract, encompassing the colon and rectum. Detecting these cancers early is essential for effective treatment, as many cases are diagnosed at advanced stages, leading to high mortality rates. Although several diagnostic techniques such as biomarkers and endoscopy have been developed, early detection of conditions such as polyps and tumors is still challenging due to the complexity of gastrointestinal structures. The introduction of wireless capsule endoscopy in 2000 has allowed comprehensive visualization of the gastrointestinal tract, but manual analysis of images captured by this method is time-consuming and error-prone. Artificial intelligence (AI), especially algorithms such as convolutional neural networks (CNNs), has proven effective in identifying anomalies and classifying gastrointestinal diseases, assisting doctors in quickly and accurately analyzing images. Recent studies highlight the benefits of AI techniques in detecting polyps and differentiating between malignant and benign tissues. Furthermore, hybrid methods between AI and machine learning have proven to be superior even to the accuracy of human experts, promising to revolutionize endoscopic diagnosis and enabling more effective treatments for patients with gastrointestinal cancer. Gastric cancer is one of the leading causes of cancer-related death worldwide. When diagnosed early, it can be treated with endoscopic or surgical resection. However, differentiating between intramucosal and submucosal cancer is crucial in determining the best course of treatment. The accuracy of traditional diagnostic methods such as endoscopy and ultrasound is limited. Recently, artificial intelligence (AI) has been successfully applied to diagnose the invasion depth of gastric cancer, showing high sensitivity and specificity. A study focused on differentiating between intramucosal and submucosal gastric cancer developed an AI classifier and proposed a diagnostic method that combines AI analysis with the opinion of expert endoscopists. This approach promises to improve diagnostic accuracy and optimize the treatment of early gastric cancer[11,12].

FINAL CONSIDERATIONS

This article demonstrated a database that reveals the importance of artificial intelligence in the early diagnosis of gastrointestinal diseases, such as *Helicobacter pylori*. Furthermore, the elucidation regarding the Kyoto classification and endoscopy corroborates the relevance of using artificial intelligence in gastrointestinal oncological diagnoses, interpretation of exams, and identification of subtle changes that are generally not identified.

Furthermore, colorectal cancer is one of the most lethal forms of cancer in the world population, highlighting the urgency of early detection to improve patient survival. In this way, the use of artificial intelligence significantly reduces the number of undetected lesions and improves the effectiveness of colorectal cancer diagnosis. This avoids challenges like blind areas and human errors that require improved strategies.

Similarly, technological advances allow storage and processing of health data, with systems such as EnDia 2.0 helping to manage information from upper digestive endoscopy exams, applying computational processes to acquire useful knowledge for specific decisions.

However, although there has been notable progress in endoscopy, it is necessary to clarify that there are still challenges to be overcome, as AI needs to improve its database for recognizing and analyzing exams and images, which are still limited. Therefore, control systems need to expand their convolutional neural network (CNN), deep learning (DL) and conventional algorithms to obtain better image processing and exam interpretation in order to obtain a more accurate diagnosis of the pathologies investigated.

In short, Artificial Intelligence has relevant clinical aspects for the diagnosis of gastrointestinal diseases, especially with regard to neoplasms and identification of discrete changes in the digestive tract. Furthermore, studies demonstrate increasing advances in this area that lead to the early diagnosis of pathologies that affect the gastrointestinal system.

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Robotic surgery in patients with colorectal cancer: Techniques and benefits - Integrative review

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ABSTRACT

Surgical procedures using robotics are excellent options when you want to have fewer risks during and after surgery, not to mention that the recovery that the patient has when the surgery was performed using robotic means is much better and less painful than when it is performed without using these means. The objective of this study was to analyze various surgical methods using robotics, the risks and benefits of each surgery through an integrative review. In this context, the origins, impacts and evolution of robotics in the surgical field were also explored, with research and studies using descriptors such as "Robotic Surgery", "Robot Enhanced Procedures" and "Robot Assisted and Enhanced Surgical Procedures", using "LILACS", "PubMed" and "BVS" as references. However, the field of robotic surgery today is very broad and encompasses various types of treatments and procedures. It is an area of medicine that is constantly evolving, because as new technologies emerge, so do new types of methods and procedures, so the purpose of publishing this article is to bring the latest in the medical field involving robotics in today's surgical procedures, also specifying what surgical procedures using robotics are, how they are performed and their benefits, a fact that will be clearly exposed in the following chapters and paragraphs.

Keywords: Robotic Surgery, Robot Enhanced Procedures, Robot Assisted and Enhanced Surgical Procedures.

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INTRODUCTION

Technological advances in the medical field, with emphasis on the surgical field, have brought innovations to the treatment of various diseases, such as colorectal cancer [1, 2], which most of the time had very invasive surgical methods for resolving this disease, with the example of "Resection" surgery, where the abdominal part is opened to remove the part affected by cancer.

However, studies, research and work have brought to the medical field the use of robotics in surgical procedures, which will be the topic covered in this detailed analysis, bringing the latest and most innovative developments in this area. Thus, it is worth noting that the research collected for analysis presented the use of robotics as an emerging platform in the minimally invasive surgical era, which aims to overcome the limitations of laparoscopy [3], the surgical process using robotics offers fewer risks, as invasion is minimal and estimated blood loss is lower, in addition to its postoperative being low risk and less painful [3, 4].

In view of the surgeries using robotic technology, such methods end up taking longer, but this is minimal when compared to the benefits, but, nowadays, the biggest obstacles to the use of this surgery is the cost that is required to have this technology in surgical centers, in addition to the specialization that the surgeon needs to have in order to operate using robotics, which is why, nowadays in the 21st century, this technology is still little used and difficult to find in Brazil.

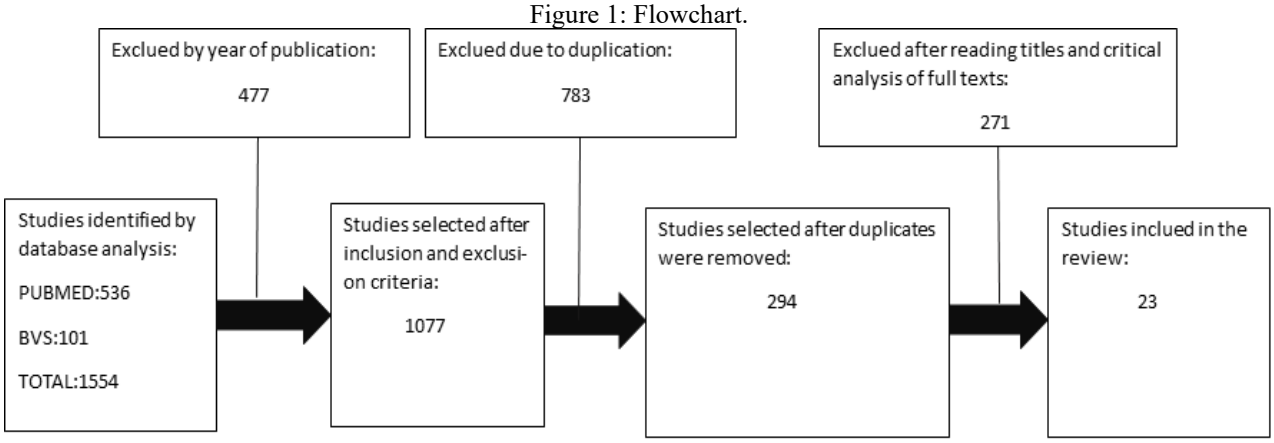
However, the objective of this study was to analyze various surgical methods using robotics, the risks and benefits of each surgery through an integrative review, through studies and research, seeking to update information on advances in robotic surgery in the treatment of colorectal cancer, concisely presenting the latest medical techniques and procedures in this area. Although, it is necessary to clarify doubts and address issues related to the methods used, due to the lack of available information.

MATERIALS AND METHODS

This study represents a integrative review that began with the scientific question "What are the benefits of robotic surgery in the prognosis of patients with colorectal cancer?", and after choosing the topic, scientific articles were analyzed in the Virtual Health Library (VHL) and National Library of Medicine (PUBMED) databases through inclusion and exclusion criteria, such as year of publication (2019-2024) in addition to the adequacy of English as the official language, in the exclusion criteria, duplicate studies and those that did not answer the question proposed by the theme were removed from this research. Consequently, the descriptors used were: robot-enhanced procedures, robotic surgery, robot-enhanced surgery and colorectal cancer, found in the Health Science Descriptors (DECS).

After checking the studies, 1554 published works related to the basic theme were found, which were then thoroughly analyzed according to the aforementioned parameters, so that 1077 remained under inspection, and 477 works were excluded. They were then screened for duplicate articles using the Endnote platform, and 784 materials were discarded. Then, after reading the titles and removing the works that were not in line with the theme, 55 surveys were included to read the full text. Finally, 24 articles were used to write this study, which will be cited in the references section. All of the above information can be seen in the flowchart in figure 1.

Figure 1: Flowchart.



RESULTS

The types of studies, objectives, and conclusions of the fourteen studies on oncological robotic surgery were elaborated in a descriptive manner and presented in Table 1.

Table 1 - Analysis of selected articles

Title	Authors/year	Study type	Objective	Conclusion
Robotic total pelvic exenteration for rectal cancer: case report and review of literature.	Stefan et al., 2021[5].	Case report.	The report describes the performance of a robotic total pelvic exenteration (TPE) in August 2018 to treat a locally advanced rectal cancer at our institution.	The robotic technique enhances the feasibility and safety of multiple organ resections for locally advanced pelvic cancers with curative intent. Literature highlights the advantages of robotic pelvic surgery, including better access to narrow areas, a stable platform, rapid interchangeability between operators using dual consoles, and superior visualization of anatomy through the three-dimensional screen.

Short learning curve in transition from laparoscopic to robotic-assisted rectal cancer surgery: a prospective study from a Finnish Tertiary Referral Centre.	Kolehmainen et al., 2023[6].	Retrospective observational study	The aim here was to study the transition from laparoscopic to robotic-assisted surgery among experienced laparoscopic surgeons.	In a study, one patient passed away within a month, but the death wasn't linked to the procedure. Surgical and oncological outcomes were consistent across all surgeons. However, surgeons with more experience in laparoscopic rectal cancer surgery had shorter console times, indicating improved efficiency. This suggests that experienced laparoscopic colorectal surgeons can safely adopt robotic-assisted rectal cancer surgery.
Robotic Versus Laparoscopic Surgery for Rectal Cancer: A Comprehensive Review of Oncological Outcomes.	Lam et al., 2021[7].	Meta-analysis.	To comprehensively compare the oncological outcomes of robotic versus laparoscopic surgery in the treatment of rectal cancer, assessing and synthesizing the available evidence to elucidate the differences between these surgical approaches.	While further randomized trials are required for validation, both techniques - laparoscopic and robotic-assisted surgery - are presently deemed acceptable for minimally invasive treatment of rectal cancer. Surgeon preference plays a crucial role in ensuring safe and optimal resection.
Essential technical aspects in robotic colorectal surgery: mastering the Da Vinci Si and Xi platforms.	Morrell et al., 2021[8].	Technical review article.	The aim of this study is to describe and guide on the technical aspects applied to standardized robotic colorectal surgery, showing the differences between the Si and Xi systems and ensuring maximum efficiency, particularly in left colon and rectal surgeries.	Robotic colorectal surgery is deemed feasible and safe in the hands of experienced surgeons, yet it still encounters challenges. Despite the Da Vinci Xi platform demonstrating greater versatility with a more user-friendly design incorporating technological advancements, proper mastery of the technology by the surgical team is essential for its seamless robotic execution in a single step.
Time interval between the completion of radiotherapy and robotic-assisted surgery among patients with stage I-III rectal cancer undergoing preoperative chemoradiotherapy.	Huang et al., 2020[9].	Retrospective observational study	The study examined short-term clinical and oncological outcomes in stage I-III rectal cancer patients undergoing preoperative chemoradiotherapy followed by robotic rectal surgery, with intervals of over 10 weeks between radiotherapy completion and robotic-assisted surgery. It also	Robotic-assisted surgery following a prolonged interval appears safe and feasible for rectal cancer patients undergoing preoperative chemoradiotherapy (CCRT). The study suggests that a time interval of 10–12 weeks is viable, as it yielded comparable clinical and perioperative outcomes and preferable oncological outcomes. However, future prospective randomized

			compared outcomes between different interval lengths (10–12 weeks vs ≥12 weeks).	clinical trials are needed to confirm these findings.
Comparison of pathologic outcomes of robotic and open resections for rectal cancer: A systematic review and meta-analysis.	Guo et al., 2021[10].	Systematic review.	The adoption of robotic surgery for rectal cancer treatment is steadily increasing. This meta-analysis aims to compare the pathological outcomes among rectal cancer patients who underwent either open rectal surgery (ORS) or robotic rectal surgery (RRS).	According to the existing evidence, robotic resection for rectal cancer yields comparable pathological outcomes to open rectal surgery (ORS) concerning factors such as CRM positivity, number of harvested lymph nodes, complete TME rates, and DRM.
Colorectal robotic surgery: INCA's experience.	Valadão et al., 2019[11].	Retrospective cohort study.	This report summarizes the single institutional experience with the use of the Da Vinci Platform in robotic colorectal surgeries conducted at an oncological surgery reference center in Brazil.	Robotic surgery is deemed safe and effective for colorectal cancer procedures, showing positive outcomes in hospital stay duration and complication rates with low conversion rates. However, obesity increases the risk of surgical complications in this context.
Feasibility and safety of robotic surgery for low rectal cancer combined with transanal total mesorectal excision.	Ando et al., 2023[12].	Retrospective observational study	The objective is to evaluate the safety and practicality of a hybrid surgical approach that combines robotic surgery with Transanal Total Mesorectal Excision (TaTME), referred to as hybrid TaTME. Parte superior do formulário	Robotic colorectal surgery, utilizing the Da Vinci Xi platform, is both feasible and safe when conducted under the supervision of skilled surgeons. While this technology provides enhanced flexibility and ease of use, its effective implementation relies on the proficiency of the surgical team. While a single docking approach is feasible, it necessitates adept utilization of the robotic system by the team.

Robotic Surgery in Rectal Cancer: Potential, Challenges, and Opportunities	Liu et al., 2022[18].	Literature review.	This brief review summarized the current status of robotic technology in rectal cancer therapy from the perspective of several mainstream surgical methods, including robotic total mesorectal excision (TME), robotic transanal TME, robotic lateral lymph node dissection, and artificial intelligence, focusing on the developmental direction of robotic approach in the field of minimally invasive surgery for rectal cancer in the future.	With the increase of surgical cases, more and more multicentered andprospectiveresearchwill provide a moresignificant reference for evaluating the safety, effectiveness, surgical, and short-term oncological effects of robotics for rectal cancer surgery.
Oncological outcomes of robotic-assisted total mesorectal excision after neoadjuvant concurrent chemoradiotherapy in patients with rectal câncer.	Chen et al., 2021[14].	Retrospective observational study	To analyze the oncological outcomes of robotic-assisted total mesorectal excision (TME) in patients with rectal cancer after neoadjuvant concurrent chemoradiotherapy (CCRT).	Robotic-assisted TME after neoadjuvant CCRT is safe and effective for treating patients with stage II-III rectal cancer in one institution with acceptable short-term oncological outcomes. It may be a therapeutic alternative to salvage surgery for T4 tumors invading adjacent organs, such as the bladder, prostate, and uterus.
Surgical outcomes of robotic transanal minimally invasive surgery for selected rectal neoplasms: A single-hospital experience.	Huang et al., 2021[9].	Case report.	This paper describes the surgical outcomes of robotic TAMIS for selected rectal tumors.	Based on the short-term results, robotic TAMIS is a feasible and safe technique for the local excision of selected rectal neoplasms.
The severity of postoperative complications after robotic versus laparoscopic surgery for rectal cancer: A systematic review, meta-analysis and meta-regression.	Wang et al., 2020[16].	Meta-analysis.	The study compares postoperative complications within 30 days after robotic surgery (RS) versus laparoscopic surgery (LS) for rectal cancer, using the Clavien-Dindo (C-D) classification to assess severity. Despite RS's demonstrated advantages over LS, few studies have explored the severity of postoperative complications in this context.	Robotic surgery presents as a secure option for treating rectal cancer and could serve as a viable alternative to laparoscopic surgery, potentially reducing the incidence of severe complications, grade IV C-D, and anastomotic leaks. However, additional extensive randomized controlled trials are imperative to validate this assertion.

Comparing outcomes of robotic versus open mesorectal excision for rectal cancer..	Jimenez-Rodriguez et al., 2021[17].	Retrospective observational study	The results of robot-assisted mesorectal excision for rectal cancer have not been fully characterized when compared with open resection.	For individuals with rectal cancer eligible for curative resection, robotic mesorectal excision is linked to decreased complication rates, reduced hospital stays, and comparable oncological results when compared to open mesorectal excision.
Postoperative complications observed with robotic versus laparoscopic surgery for the treatment of rectal cancer: An updated meta-analysis of recently published studies.	Liu et al., 2021[13].	Meta-analysis.	The objective of this study is to conduct an updated meta-analysis comparing postoperative complications observed with robotic versus laparoscopic surgery (LS) for the treatment of rectal cancer.	This updated meta-analysis found that both robotic and laparoscopic surgeries were equally effective in treating rectal cancer, with similar rates of postoperative complications. However, the analysis focused solely on postoperative outcomes and did not consider factors such as surgical duration.
Short- and long-term outcomes of robotic-assisted laparoscopic surgery for rectal cancer: A single-center retrospective cohort study.	Yamanashi et al., 2022[19].	Retrospective observational study	The goal is to examine patients who underwent Robot-Assisted Laparoscopic Surgery (RALS) at a specific facility and then clarify the short- and long-term results of these consecutive cases involving rectal cancer.	Favorable short- and long-term results indicated that robotic-assisted laparoscopic surgery was both safe and technically feasible for treating rectal cancer.
Robotic rectal resection: oncologic outcomes	Fiorillo et al., 2021[20].	Case report.	The purpose of this study is to report a single surgeon's experience on robotic rectal resection (RRR) for cancer, focusing on the analysis of oncologic outcomes, both in terms of pathological features and long-term results.	Under appropriate logistic and operative conditions, robotic surgery for rectal cancer proves to be oncologically effective, with adequate pathological results and long-term outcomes. It also offers acceptable peri-operative outcomes, further confirming the safety and feasibility of the technique.
Feasibility and Safety of Robotic-Assisted Surgery for Rectal Cancer: Short-Term Outcomes of a Pilot Study with da Vinci Xi Platform During COVID-19. Chirurgia (Bucur).	Bliznakova et al., 2023[21].	Single-center, non-randomized	This study aims to assess the clinical outcomes of robotic surgery for rectal cancer during the initial phase of implementing a surgical robot system. Additionally, this period coincided with the first year of the COVID-19 pandemic.	The study results demonstrate the successful integration of the robot-assisted platform into the surgery department despite COVID-19 limitations. This technique is anticipated to emerge as the primary minimally invasive approach for all colorectal cancer surgeries at the Robotic

				Surgery Center of Competence.
Robotic versus open surgery for simultaneous resection of rectal cancer and liver metastases: a randomized controlled trial.	Chang et al., 2023[22].	Randomized controlled trial.	To analyze and contrast the short- and long-term outcomes between robot-assisted simultaneous resection and open surgery in patients with rectal cancer and liver metastases.	In our randomized clinical trial, robotic simultaneous resection treatment of patients with rectal cancer and liver metastases resulted in fewer surgical complications, and a faster recovery to those of open surgery. Oncological outcomes showed no significant difference between the two groups.
Robotic Surgery in Rectal Cancer	Oliveira; Barbosa, 2021[23].	Literature review.	This study aims to review the literature on the significance and benefits of robotic surgery in treating rectal cancer, particularly compared to laparoscopic approaches.	Robotic and laparoscopic surgery for rectal cancer showed similar outcomes in terms of blood loss, short- and long-term outcomes, and pathological results. While robotic surgery typically takes longer and is more costly, it offers advantages such as a lower conversion rate to open surgery and benefits for urinary and sexual functions.
Role of minimally invasive surgery for rectal câncer.	Melstrom; Kaiser et al., 2020[24].	Meta-analysis.	The aim of this review is to comprehensively analyze various techniques concerning intra- and perioperative milestones, recovery, complications, and oncological and functional outcomes. It is unrealistic to expect a randomized comparison of all options in a single clinical trial.	The approach of minimally invasive surgery for treating rectal cancer is continually evolving, with laparoscopic and robotic techniques leading the way. The utilization of robotic surgery may result in a more favorable recovery of urinary and sexual functions. Additionally, local excision methods are comparable to conventional procedures. Despite being widely studied and acknowledged; uncertainties persist regarding the superiority of one technique over the other. Future technological advancements may pose additional challenges to current practices.

The current state of robotic colorectal surgery.	Rezende et al., 2019[25].	Literature review.	The purpose was to analyze published outcomes, covering complication rates, conversion, reoperation, mortality, and functional results in urinary, sexual, and fecal areas, as well as oncological outcomes related to overall or disease-free survival. This was conducted to assess the feasibility, safety, and effectiveness of robotic colorectal surgery.	There is a broad consensus on the core multimodal components across current RACS training programmes; however, validated objective assessment is limited and needs to be appropriately standardised to ensure reproducible progression criteria and competency-based metrics are produced to robustly assess progression and competence..
Robotic and robotic-assisted vs Laparoscopic rectal cancer surgery: A meta-analysis of short-term and long-term results.	Tang et al., 2021[26].	Meta-analysis.	Compare short- and long-term outcomes between robotic-assisted and robot-assisted surgeries versus laparoscopic surgery for rectal cancer.	The study suggests that robotic rectal surgery offers improved visualization of pelvic vascular lymph node tissue compared to laparoscopic surgery, enhancing lymph node clearance and protecting pelvic blood vessels. While requiring advanced surgical skills, robotic surgery is deemed safe and feasible for rectal cancer, showing favorable short-term outcomes and comparable long-term effects to laparoscopic surgery. The study concludes that robotic surgery warrants further adoption in appropriate healthcare settings for rectal cancer treatment.
Robotic-Assisted vs. Standard Laparoscopic Surgery for Rectal Cancer Resection: A Systematic Review and Meta-Analysis of 19,731 Patients	Safiejko et al., 2022[27].	Meta-analysis.	The aim of this study is to systematically assess the available evidence in the literature regarding the safety and efficacy of the robotic versus laparoscopic approach in patients undergoing curative surgery for rectal cancer	Robotic-assisted techniques offer numerous advantages compared to laparoscopic methods, including reduced operative time, lower conversion rates to open surgery, shorter hospital stays, and decreased risks of urinary retention, urinary tract infection, or ileus. These benefits contribute to improved survival rates at hospital discharge or within 30 days post-operation.

DISCUSSION

HISTORICAL EVOLUTION: FROM TRADITIONAL SURGICAL PRACTICE TO ROBOTIC SURGERY IN THE TREATMENT AND MANAGEMENT OF COLORECTAL CANCER

Colorectal cancer is one of the most prevalent malignancies globally and is classified as potentially fatal, especially when diagnosed in advanced stages. In this context, surgery has emerged as a crucial strategy for treating this type of cancer. It is estimated that between 15 and 30% of rectal cancers present as locally advanced tumors, requiring multivisceral resections. Therefore, surgical intervention plays a key role, allowing for the removal of the primary tumor, along with nearby lymph nodes that may contain cancerous cells. This approach aims not only to mitigate, but also to prevent the spread of the neoplasm, contributing significantly to the effectiveness of the treatment.[5]

In the meantime, with advances in technology and surgical techniques, medicine has increasingly less invasive treatment options, such as laparoscopic surgery and, more recently, robot-assisted surgery. In laparoscopic surgery, small incisions are made in the abdomen to insert a laparoscopic device, allowing the surgeon to view the inside of the patient's body in real time using monitoring cameras. However, laparoscopy still has significant limitations in rectal cancer surgery, including restricted access to narrow pelvic cavities, less dexterity, less precise movements and unfavorable ergonomics when compared to robotic surgery[6,7].

Robotic surgery has emerged as a more promising approach to rectal surgery compared to the laparoscopic approach, thus expanding the possibilities of minimally invasive surgery for patients with colorectal cancer. The first robotic system, called Da Vinci, was introduced in 2006 with the Si platform by Intuitive Surgical Inc. (Sunnyvale, CA, USA). Integrating a surgical console, a trolley with robotic arms and a video tower with high-definition three-dimensional vision, robotic surgery transcends the limitations of laparoscopy, representing a new era in minimally invasive surgery. [8,9]

POTENTIALITIES AND RELEVANT CONTRIBUTIONS OF ROBOTIC SURGERY IN THE TREATMENT OF COLORECTAL CANCER

Robotic surgery, or robot-assisted surgery, has emerged as a prominent approach with positive attributes for the treatment of colorectal cancer. [10] In the study by Liao et al. (apud Valadão et al.,2019), involving 1074 patients, it was possible to compare this approach with conventional surgery (laparoscopy). The results indicated that patients undergoing robotic surgery experienced a significant reduction in blood loss, resulting in less need for transfusions. In addition, there was a reduction in hospital stays and improvements in normal bowel function, indicating a faster recovery of digestive and evacuation functions[11]

Other benefits associated with robotic surgery include the minimization of surgical trauma to patients, wider visualization and technological aid for the precise identification of vascular and

nervous structures. [12,13] In addition, robotic surgery eliminates physiological tremors, offers greater ergonomic comfort and reduces surgeon fatigue[13,14,15,16,17,18,19,20].The robotic system also demonstrates ambidextrous ability during the surgical procedure, providing greater precision and allowing the execution of fine and precise movements, thanks to its advanced computer interface.In addition, there is preservation of the patient's voiding and sexual function, as this technique protects the superior and inferior hypogastric nerve plexus, as well as the pelvic nerve.[21,15]

Similarly, in their randomized clinical trial, Chang et al.[22] compared robotic surgery with open surgery for the simultaneous resection of rectal cancer and liver metastases, in which it was noted that 76 patients (44.4%) had surgical complications: 27 (31.4%) in the robotic group and 49 (57.6%) in the open group. The most common surgical complications were pleural effusion (12.2%) and surgical site infection (10.5%) and three patients (3.5%) in the robotic group were hospitalized for anastomotic fistula, while five patients in the open surgery group (5.9%) had anastomotic fistula. Furthermore, additional findings revealed that individuals who underwent robotic surgery had less post-operative abdominal drainage, a lower post-operative WBC and a shorter catheter removal time when compared to the laparoscopic group.[7]

Therefore, given the outstanding benefits of robotic surgery in the treatment of colorectal cancer, it is imperative to recognize the importance of more prospective and randomized multicentre studies in this area. These investigations are essential not only to evaluate the efficacy of the robotic platform in comparison with other approaches, such as open and laparoscopic surgery, but also to fully understand its clinical applicability and potential limitations.[13]

IMPASSES, CHALLENGES AND FUTURE PROSPECTS FOR THE APPLICATION OF ROBOTIC SURGERY IN COLORECTAL NEOPLASMS

Despite its notable benefits, the application of robotic surgery in cases of colorectal neoplasms faces challenges and impasses. In the Robotic vs Laparoscopic Resection for Rectal Cancer (ROLARR) randomized clinical trial, the robotic approach was compared with the laparoscopic approach in rectal cancer, revealing similar conversion rates and the higher costs associated with robotic surgery.[23] At the same time, initial studies corroborate this perspective, estimating that robotic surgery can be up to 2.4 times more expensive than conventional laparoscopy.[24,25]

In addition, it is worth noting the longer operative time associated with robot-assisted surgery, usually due to the additional installation required of this complex robotic system, the long learning curve, which involves training the healthcare team on simulators, the absence of tactile feedback, with the potential to result in tissue injuries due to excessive application of force, and the limited range of movement of the robotic arm, although the surgeon's experience can compensate for this

limitation[25,26]. It is also noteworthy that accessibility to this surgical method is not uniform throughout the population, with urban and rural disparities, as well as socioeconomic disparities, with patients undergoing this surgical technique being predominantly male, white, with private insurance and living in metropolitan areas[27].

In short, there is also the possibility of malfunctioning robotic devices and instruments, which can be a significant concern. These failures can occur due to a variety of reasons, including technical problems, component wear and software failures, resulting in serious complications and additional injuries for the patient.[26,27]

FINAL CONSIDERATIONS

This study, which aims to understand the positive and harmful aspects of robot-assisted laparoscopic surgery, points out that this method is extremely important for the treatment of colorectal cancer. Originally known as abdominoperineal resection, this technique has evolved as a result of an understanding of surgical anatomy and pathological aspects, and is currently known as total mesorectal excision. We believe that advances in technology have made it possible to align the total mesorectal excision technique with laboratory robotics, making it possible to qualify the results, so that its use is increasing, especially in developed countries. This is understandable, given that robot-assisted laparoscopic surgery allows a three-dimensional view, with an enlarged field, no shaking of the robotic arm, camera platforms controlled by the surgical team and good illumination of the pelvis.

On the other hand, the use of this technique requires a large financial investment, as well as being a challenging methodology, requiring qualified professionals with knowledge of precise resection of the tumor margin and an understanding of the functioning of the machinery used, as well as, in certain cases, the need for the professional to have mastery of the surgical reconstruction process. It is worth noting that several studies have shown the importance of preoperative chemotherapy, since it reduces the rate of patients with locally advanced rectal cancer and low lymph node counts.

Therefore, given the facts mentioned above, it can be seen that robotic surgery for colorectal cancer is a costly technique that is difficult to access, due to the scarcity of trained professionals, but together with chemotherapy, it shows improvement rates, helping to maintain the quality of life of individuals and making it possible to cure this pathology.

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Facilitating digital access: Development of an economically viable assistive device to assist people with upper limb dysfunction in the use of smartphones

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ABSTRACT

Physical disability is the total or partial modification of one or more parts of the human body and directly interferes with physical function. This alteration consists of an impairment in the systems responsible for the body's mobility, which can make the individual depend on the help of other people to perform some activities, directly interfering with their subjective satisfaction. Thus, providing autonomy, within its potentialities, can favor the subject's self-esteem and well-being. Therefore, this research aims to develop a low-cost assistive device to improve the access and usability of smartphones by patients with physical dysfunction, being a qualitative study of a descriptive nature. The device was developed at the Assistive Technology Laboratory of the State University of Pará and its manufacture was divided into six phases. The adapted adaptation offers individuals with upper limb dysfunction a resource that aims at functionality, resistance and economic viability, assisting in the use of the smartphone and facilitating digital access. The importance of considering low-cost materials for the development of assistive devices is evidenced, with a view to democratizing access to assistive technology and resources to facilitate the performance of important activities and occupations.

Keywords: Occupational Therapy, Assistive Technology, Person with Physical Disabilities, Low Cost Technology.

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INTRODUCTION

Occupational Therapy is a health profession defined by the *American Occupational Therapy Association* (AOTA) as the therapeutic use of occupations of daily living, whose objective is to reinforce or enable the participation of people, groups or populations through its services, which are intended for the training, rehabilitation and promotion of the health and well-being of clients with needs, related or not to disability (Gomes; Teixeira; Ribeiro, 2021).

Occupations, also described as a specific client's personalized and meaningful involvement in events of daily life, are a vital part of human development and acquired experience. Therefore, being satisfactorily engaged in important, self-identified life roles promotes the acquisition of a sense of self-efficacy and self-esteem, which can be threatened whenever a person presents with a health disorder, injury, or illness that results in a physical disability (Gomes; Teixeira; Ribeiro, 2021; Trombly; Radomski, 2013).

Physical disability, in turn, is the total or partial modification of one or more parts of the human body and directly interferes with physical function. This alteration consists of an impairment in the systems responsible for the body's mobility, which are the muscular system, the osteoarticular system, and the nervous system. Injuries or pathologies that affect these systems cause physical limitations that can have different degrees and severity (Ministry of Health, 2014). In addition, disability generates inability to perform activities according to the standard expected for human beings, since it compromises structure or function at the psychological, physiological or anatomical level (Brasil, 1999).

Physical disability, being a mobility impairment, can make the person depend on the help of other people to perform some activities, which directly interferes with their subjective satisfaction. Thus, providing autonomy, within its potentialities, can favor the subject's self-esteem and well-being (Oliveira; Paraná, 2021).

Occupational Therapy is based on the belief that meaningful activity (occupation) prevents or mediates dysfunction of physical or psychological origin, so its services include the acquisition and preservation of occupational identity for clients who have or are at risk of developing a disease, injury, dysfunction, condition, disability, disability, limitation in activity, or restriction of participation. Treatment may focus on changing the person's deficient capacities and abilities, guidance on compensatory measures to perform activities and tasks, or changing the physical and social environment, in addition to the use of assistive technology (Gomes; Teixeira; Ribeiro, 2021; Trombly; Radomski, 2013).

Assistive Technology is an interdisciplinary area of knowledge that encompasses products, resources, methodologies, strategies, practices and services that aim to promote functionality, related to the activity and participation of people with disabilities, disabilities or reduced mobility, aiming at

their autonomy, independence, quality of life and social inclusionthrough the improvement of communication, mobility and environmental control, as well as learning and work skills (Brasil, 2009; Bersch, 2017).

The Federal Council of Physical Therapy and Occupational Therapy (COFFITO), through Resolution No. 458 of 2015, defines that it is the responsibility of the occupational therapist to prescribe, guide, execute and develop products, resources, methodologies, strategies, practices and services of Assistive Technology within the scope of the training of Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs), aiming to improve the occupational performance of individuals in their daily lives. favoring their physical and mental health, quality of life and social participation (Brasil, 2015).

It is also important to emphasize that rehabilitation is a health process that provides a better quality of life, helping individuals with established disabilities to achieve and maintain higher levels of physical, mental and social functioning. The rehabilitation process emphasizes training in the use of specialized equipment or techniques to promote independence rather than remedying or correcting underlying deficits (Radomski; Trombly, 2013).

The occupational therapy professional, then, plays a key role in the rehabilitation process of individuals facing health challenges, assessing their particular needs and developing personalized treatment plans. Following this model, occupational therapists establish objectives, goals, and intervention strategies to restore the patient's maximum performance in their occupational roles (Pedretti, 2005).

It is in this context, therefore, that this article proposes to present the processes of development and functional analysis of an assistive device for individuals with physical disabilities, to assist in the performance of activities that make up the leisure occupation, in addition to corroborating the certification of the importance of the use of assistive technology by the Occupational Therapy professional.

OBJECTIVES

GENERAL OBJECTIVE

To develop a low-cost assistive device to improve the access and usability of smartphones by patients with physical dysfunction.

SPECIFIC OBJECTIVES

- Describe in detail the production process of an assistive device.
- Underline the importance of considering low-cost materials for the development of devices, aiming to democratize access to assistive technology.

METHOD

This article is a qualitative descriptive one, which seeks to report the step-by-step development of an assistive device that can assist in the autonomy and independence of people with disabilities in their leisure-related activities : namely, the use of the *smartphone*.

The device was made at the Assistive Technology Laboratory (LABTA), located at the State University of Pará (UEPA), from materials such as Polyvinyl Chloride (PVC), Ethylene Vinyl Acetate (EVA), self-adhesive velcros, marker pen, scissors, rivets, contact glue, scissors, mechanical pencil, A3 paper, as well as equipment such as a thermal blower, bench drill and sander and jigsaw. In addition, the Rodrigues technique was used, in which a segment of tubular PVC is opened and modified, through heat, into a plate with a smooth surface (Rodrigues Junior, 2012).

In summary, the preparation was divided into 6 phases: removal of anthropometric measurements, design of the device, PVC cutting and molding, thermomolding, coupling and velcro and EVA lining. These steps will be further described below.

It should also be noted that, in the case of a pilot experiment, all the tests performed for its development were applied to one of the researchers, therefore, it did not require the appreciation of the Research Ethics Committee.

RESULTS

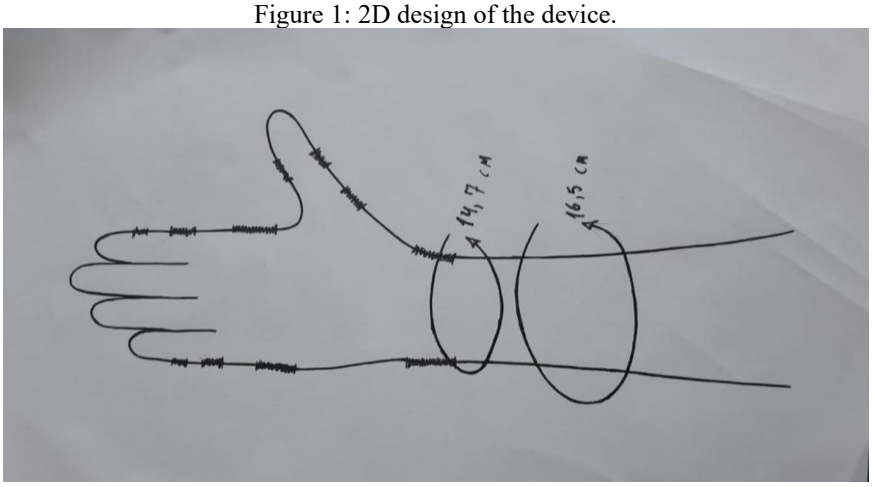
The manufacture of this device added several procedures and actions, requiring scientific knowledge and knowledge of the materials used, their properties and those resulting from the transformation processes to which they were submitted.

Its development and respective stages of production will be described in the following topics, divided for better systematization.

ANTHROPOMETRIC MEASUREMENTS:

Taking accurate measurements of the upper limb involved the use of flexible tape measures to measure the length, circumference, and width of various parts of the limb, including the forearm, wrist, hand, and fingers. These measurements were accurately recorded in order to ensure that the orthosis was manufactured according to the exact dimensions of the subject. In addition, for greater reliability with anthropometric measurements, a drawing of the hand was performed (**Figure 1**), for which it was necessary to position the limb in pronation on an A3 sheet of paper. Then, the alignment of the hand and the drawing of the contour from the apex of the third finger to the proximal third of the forearm followed, finally, delimiting its articular points to provide relief in them.

Figure 1: 2D design of the device.

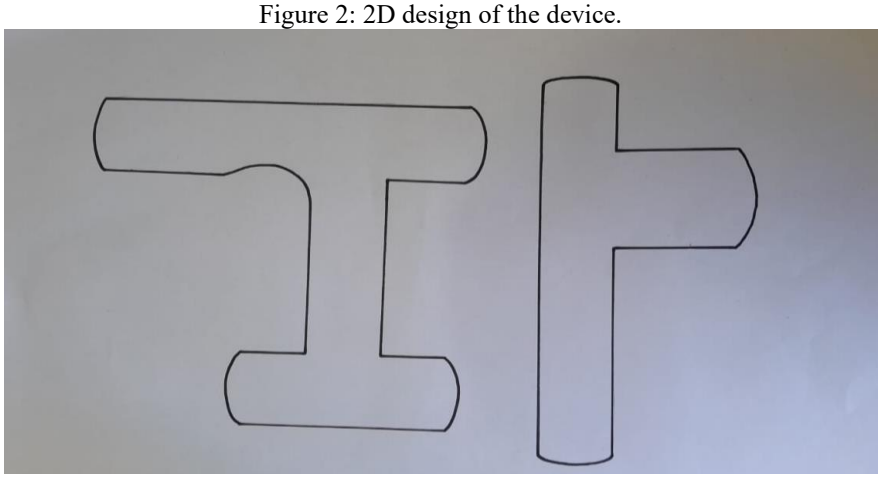


Source: Authors ' Archives

DEVICE DESIGN

Based on the measurements taken, the creative process of developing the design of the device unfolded, considering the desired function. At this time, the objective was to ensure maximum comfort, combined with practicality of use. With the aid of a mechanical pencil, the idea was transcribed into a two-dimensional model, represented on an A3 sheet of paper (**Figure 2**)

Figure 2: 2D design of the device.

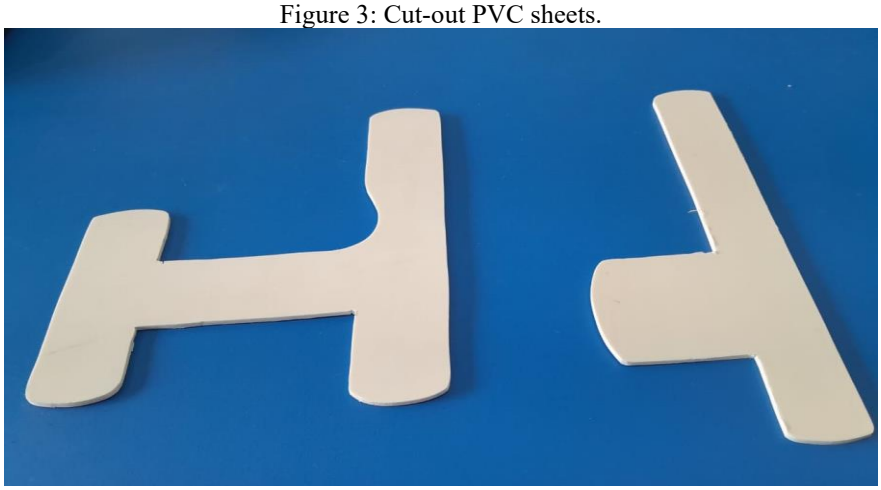


Source: Authors' archives.

PVC MOLD CUTOUT

At this stage, the design was transferred to a 150mm flat PVC board measuring 60x40cm. To cut the sheet, a jigsaw was used, responsible for contouring the limits of the design made on the piece, fixed on a surface by clamps. After that, the ends of the piece were sanded in a bench sander, resulting in a better finish (**Figure 3**).

Figure 3: Cut-out PVC sheets.



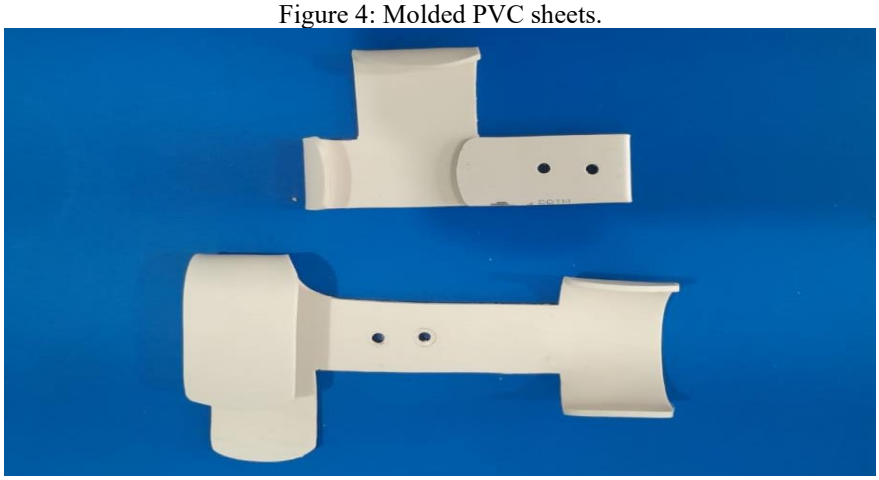
Source: Authors' archives.

THERMOCASTING

The main characteristic of the thermoplastic material is the ability to be repeatedly subjected to the heating process, changing from a solid state to a viscous liquid, and when cooling, returning to a solid state (BRASIL, 2014). Thus, for the molding of the part, the PVC sheet was subjected to heating at a temperature of 100° C, in order to make it malleable and easy plastic deforming, and pressure was applied so that it remained conformed until it cooled, according to the intended shape (**Figure 4**).

It is valid to state that the modeling process was facilitated by the capacity of reversible physical transformation of the chosen material.

Figure 4: Molded PVC sheets.



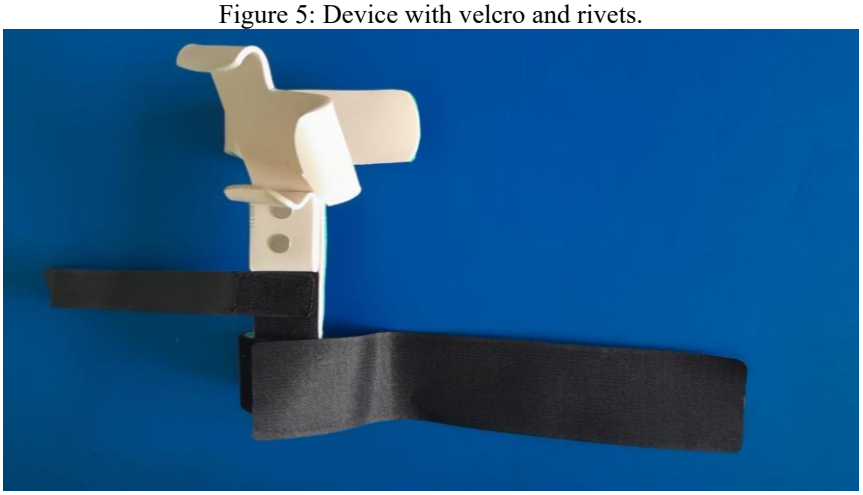
Source: Authors' archives.

COUPLING AND VELCRO

This was followed by the adjustments and addition of the components, the first being the coupling holes of the two PVC pieces, which were joined with two size five rivets. The next step was to fix the self-adhesive rough Velcro on the external areas of the device, while the soft Velcro was

positioned facing the internal area, hugging the forearm in the medial third and wrist, allowing adjustment of size, pressure and contributing to comfort (**Figure 5**)

Figure 5: Device with velcro and rivets.



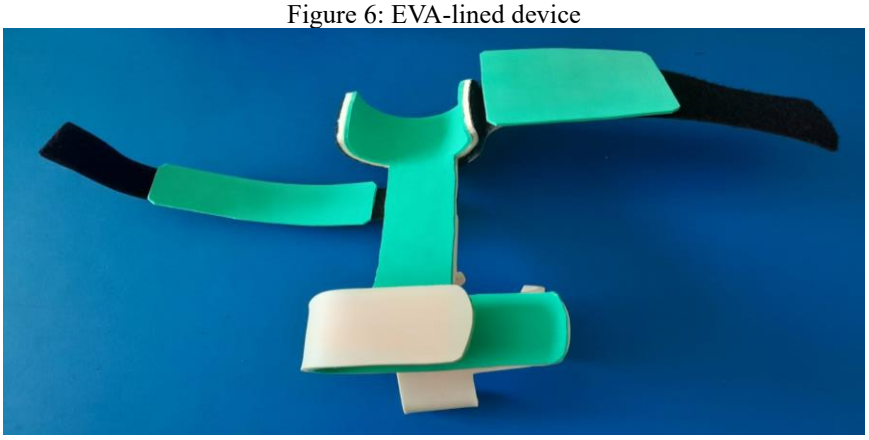
Source: Authors' archives.

EVA LINING

The fodder of the device was carried out using the mold made on paper as a reference for the demarcations in the EVA, with the use of a marker pen. One centimeter of margin was left between the drawing and the cutout to prevent errors in the gluing process. After cutting out the EVA, it was sanded on one of its sides, as well as the inside of the device where the material would be glued, in order to create small cracks that served as an anchor for the glue, ensuring the fixation of the EVA and the durability of the device.

This technique is in agreement with the Ministry of Health (2014) when it says that the use of EVA as an internal lining of orthoses and adaptations promotes the interface between comfort and protection, also allowing safe contact with the skin due to its toxicity (**figure 6**)

Figure 6: EVA-lined device



Source: Authors' archives.

DISCUSSION

For the device, we thought of an adaptation of the hand to the cell phone holder, indicated for individuals with possible loss of muscle strength in the upper limb, reduction of active movement or presence of wrist, hand and finger flexor patterns.

Considering the wide possibility of use of current *smartphones,* due to their continuous development of new functions and services (such as *instant messaging apps* , geolocation, public transport access, social networks, games, distance education, among others), the assistive device was designed with the objective of reducing limitations of use and assisting its handling by people with disabilities. ensuring a higher quality of life, independence, inclusion and social participation.

To this end, the manufacture of the device, composed of two main pieces of PVC, began. The first piece is designed for the insertion of the user's wrist and hand, being coated with EVA for added comfort.

EVA is a copolymer produced from the monomer of vinyl acetate and ethylene, and can assume different characteristics and densities. The traditional application of EVA is in the form of foam, which is achieved from expansion and crosslinking agents, as well as fillers and catalysts (Brasil, 2014).

As for the second piece, it is responsible for connecting the device, presenting an angle of 30° in relation to the first piece and 70° in relation to the support point, directing the screen to the user's face.

It is important to highlight that the use of force and the shape of the grip influence the performance of manual activities and the functionality of using objects with the hands (Paschoarelli *et al*., 2010). Therefore, as the device was developed for people with physical dysfunctions of the upper limb and who are unable to grasp, it makes it possible to support the *smartphone* in the device itself, since it has a coupler that allows the object to be fixed in the hand during its use.

In addition, the device has two adjustable Velcro loops for fixing the arm, aligning the forearm, hand and fingers, allowing their stabilization, preventing the device from sliding or falling during use and favoring the reduction of flexor or extensor patterns, harmful to the body.

It is also necessary to consider that, in the human body, there is a lever system that interferes with movement. The lever is a rigid part that can rotate on a fixed or mobile axis and, in the human body, the bone performs this role, having the function of converting a linear force into a rotational torque (Silva, 2015).

In the development of the device, these concepts were used as the basis for the arrangement and distance between the lever arm, the articular shaft and the power arm, thus allowing to take advantage of the mechanical advantage of the levers to avoid harmful pressure points. This is in line with what Silva (2020) states regarding hand support, which occurs by transferring weight by

increasing the support surface of the forearm, using the seesaw balance principle, changing the size of the lever arm for compensation and maintenance of balance.

Another point to highlight is the inclusion of assistive technology in the principles of Universal Design, which is justified by the premise that, in order to achieve functional design for all people, it is necessary to use universal reference measures as a basis. Based on these measures, the necessary adaptations to allow the use of the product by people in different conditions will be made using these same universal measures. This approach ensures that design is accessible and useful to a broad spectrum of users, promoting inclusion and equal access to assistive technologies (Marins, 2011).

In view of this, the docking system for *smartphone* devices was designed taking into account the principles of Universal Design, aiming to maximize its applicability to various people. This means that the design has been designed to be accessible and functional for as many users as possible, regardless of their specific abilities or needs, since, by following these principles, the coupling system promotes inclusivity and accessibility, contributing to a broader and more satisfying user experience for all.

Another important factor is the choice of material for the manufacture of a product, which for Pereira (2017) is essential, as it is what determines a large part of its quality, enables correct functioning, comfort, among other factors depending on the type of product. To choose the right way, some factors need to be taken into account, such as mechanical resistance, functionality, performance, among others, which guarantee the length of the customer's demands.

Low-temperature thermoplastics, such as Ezeform, are an efficient and practical choice in making upper limb orthoses due to their ability to be molded directly onto the patient's body. With a low melting point, these materials allow for a streamlined and fast manufacturing process, resulting in orthotics that fit precisely and comfortably. In addition, the fast cooling and hardening time of thermoplastics ensures practicality in the manufacturing process (Silva, 2013).

PVC has similar characteristics, but has its wide versatility attributed to its ability to adapt to a variety of molding processes. This material can be subjected to different techniques, such as injection, extrusion, calendering, flattening, among others. This processing flexibility allows for the creation of a wide range of products and applications (Silva, 2013).

Both thermoplastics, Ezeform, and PVC have advantageous characteristics in the manufacture of orthoses for upper limbs. While low-temperature thermoplastics stand out for their ability to mold directly onto the patient's body, resulting in precise and comfortable orthotics with a simplified and fast manufacturing process, PVC offers a wide versatility due to its ability to adapt to various molding processes.

A PVC pipe with 6 meters and 150 millimeters in diameter, when submitted to the Rodrigues technique, can take the form of a plate with dimensions of 60 cm x 47 cm x 2.5 mm thick, being ready for molding assistive devices. Using this method, a 6-meter PVC pipe with a price ranging from R$ 133.00 to R$ 214.00 can be converted into 10 plates for the construction of devices. The Ezeform, on the other hand, in its smaller plates 31.4 cm x 46 cm x 1.6 mm, has a price that can vary between 194.00 R$ to 205.00 R$.

In addition, when evaluating the cost-benefit of the materials mentioned, it is possible to make some considerations. PVC pipe offers an economically viable alternative costing approximately between 6.85% and 10.44% of the cost of Ezeform, depending on the exact prices. This means that PVC is about 9 to 15 times cheaper than Ezeform. On the other hand, although Ezeform has a higher cost, its dimensions are already suitable for use, which can save time and effort in the transformation of the material. That is, the choice between materials depends on the specific needs of the project, considering not only the cost but also the time and practicality involved in preparing the material for use in assistive devices.

Thus, in situations where resources are limited, PVC emerges as a practical and affordable alternative for the manufacture of assistive devices. With up to 15 times less cost compared to Ezeform, PVC offers a cost-effective solution that can be essential for organizations and individuals with tight budgets and while it requires an additional transformation process, the potential to convert one PVC pipe into multiple usable boards demonstrates its versatility and adaptability. Therefore, PVC not only represents a financially viable option, but also stands out as a pragmatic choice to maximize available resources and promote accessibility to assistive technology to disadvantaged populations.

CONCLUSION

In view of the analysis presented, we conclude that the development of a low-cost assistive device to improve the access and usability of *smartphones* by patients with physical dysfunction is, in addition to being feasible, crucial to promote the inclusion and autonomy of these individuals. The application of Occupational Therapy combined with Assistive Technology offers a holistic and patient-centered approach, seeking not only to mitigate the limitations imposed by physical disability, but also to promote meaningful engagement in activities of daily living.

The device offers individuals with upper limb dysfunction a resource that aims at functionality, endurance and economic viability, aiding in the use of the *smartphone* and facilitating digital access, so valued in the modern world. The importance of considering low-cost materials for the development of assistive devices is evidenced, with a view to democratizing access to assistive technology and resources to facilitate the performance of important activities and occupations.

When selecting materials, in environments with limited financial resources, it is essential to prioritize the financial aspect, evaluating the cost in relation to the quality and effectiveness of the device. In this scenario, PVC proves to be an economical and efficient choice, enabling the maximization of available resources and access to assistive technology for those who need it most. Thus, investing in the development and dissemination of low-cost assistive devices represents a significant step towards inclusion and improving the quality of life of people with physical disabilities.

Finally, the need for the development of research in this area is highlighted, since this article addressed only a part within the great field of Assistive Technology, describing the manufacture of a specific device and the use of alternative materials.

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Pancreatic cancer detection with self-expanding ART fuzzy neural network online training

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ABSTRACT

Pancreatic cancer is one of the most aggressive cancers and has a high mortality rate due to late diagnosis, as the first symptoms usually appear when it is at an advanced stage, making resection of the tumor impossible. With the aim of assisting in early diagnosis, this article presents the results obtained using urinary biomarkers to detect pancreatic cancer. The Self-Expanding ART Fuzzy Neural Network Online Training achieved superior results compared to other machine learning models in the different types of proposed classifications. This makes the use of our method promising to improve the diagnosis of pancreatic cancer compared to the methods still used and contributing to precision medicine.

Keywords: Pancreatic Ductal Adenocarcinoma, Adaptive Resonance Theory, Machine Learning, Fuzzy ART.

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INTRODUCTION

Pancreatic Ductal Adenocarcinoma (PDAC) is the most common pancreatic cancer, accounting for 90% of pancreatic tumors. It is also the most aggressive, with high morbidity and mortality rates. The 5-year survival rate for is approximately 8%, which is a relatively low rate compared to other types of tumors (Ardengh, Coelho, Osvaldt, 2008; Ferlay et al. 2015).

The main risk factors for ADP involve environmental and hereditary factors. Environmental factors include smoking, obesity, and diabetes mellitus, while hereditary factors include hereditary breast and ovarian cancer associated with the BRCA1 and BRCA2 genes, Peutz-Jeghers syndrome, and hereditary pancreatitis. Age is also a risk factor, as 80% of patients with Pancreatic Ductal Adenocarcinoma are diagnosed between the ages of 60 and 80 (Ardengh et al., 2008).

The most common symptoms of PAD are weakness, weight loss, lack of appetite, abdominal pain, jaundice, nausea and back pain. Due to the lack of specific symptoms, the delay in presenting the first symptoms makes early diagnosis impossible (Ardengh et al., 2008).

When cancer is diagnosed in the early stages, it is possible to start treatment to prevent the cancer from progressing. The main form of cancer treatment is surgery, without which there is no prospect of a cure. However, diagnosis tends to occur when the disease is at an advanced stage, making it impossible to resect the tumor (Cooperman, Iskandar, Wayne & Steele , 2018).

Diagnosis is typically based on common symptoms, and imaging tests like computed tomography (CT) and ultrasound, with CT being the primary diagnostic tool (Cooperman et al., 2018).

Certain genes associated with cancer show alterations in their expression levels, either being underexpressed or overexpressed, compared to non-cancer patients. These genes can serve as biomarkers for diagnosing cancer and planning appropriate therapies. There are thousands of protein-coding genes that have been identified as potential candidates for pancreatic cancer biomarkers (Harsha et al. 2009). Discovering genes specific to pancreatic cancer or creating a panel of biomarkersfor early diagnosis poses a significant challenge (Lennon et al., 2014; Capello et al., 2017; Singhi et al., 2019). Based on previous studies, we conducted simulations focusing on three protein biomarkers excreted in human urine. These biomarkers can differentiate between pancreatic cancer patients and healthy individuals. (Radon et al., 2015).

This study aims to present the results obtained using a neural network based on Adaptive Resonance Theory (ART) for online training in diagnosing patients with ADP using urinary biomarkers, creatinine, and age. The data used is available in Debernardi et al. (2020). Additionally, it includes a comparison with results from the literature and some of the most commonly used classification models.

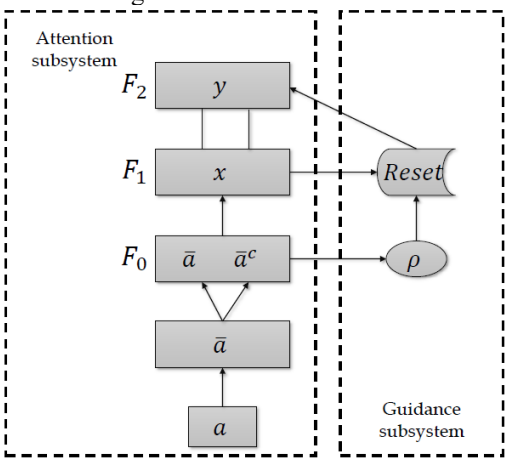
ADAPTIVE RESONANCE THEORY

This theory, proposed by Grossberg (1976), is based on the cognitive theory of how the brain categorizes, recognizes, and predicts objects. It aims to address the balance between stability and plasticity in neural networks. Plasticity allows the network to adapt and group input patterns, while stability enables the network to learn new patterns without forgetting previously acquired knowledge (Carpenter & Grossberg, 1987a).

Several networks based on this theory have been developed. The pioneering architecture using this theory was the Grossberg Network (GN) designed by Grossberg in 1976. Since then, several other networks, such as ART1 have been created (Carpenter & Grossberg, 1987a), ART2 (Carpenter & Grossberg, 1987b), ART Fuzzy (Carpenter, Grossberg & Rosen, 1991c), ARTMAP (Carpenter, Grossberg & Reynolds., 1991b) and ARTMAP Fuzzy (Carpenter, Grossberg, Markuzon & Reynolds, 1992).

In general, ART networks consist of two main subsystems (Carpenter & Grossberg, 1991a). The first subsystem is the attention subsystem, which comprises three layers of interconnected neurons. The F_0 layer is responsible for preprocessing, where input data is normalized and complemented to ensure uniform magnitude across all input vectors (Moreno, 2010). The F_1 layer receives data from the F_0 layer and propagates it to the F_2 units. The F_2 layer groups training patterns into recognition categories. The second subsystem, the guidance subsystem, resonates and resets using the surveillance parameter (ρ) to determine if an input pattern can be included in existing categories (Moreno, 2010). The basic architecture of an ART network is illustrated in Figure 1.

Figure 1. ART architecture.



All these fields are interconnected through weights, which store information by selecting categories, equalization criteria, and training (Carpenter et al., 1991c). The connections between layers F1 and F2 are non-recurrent or feedforward connections, where each neuron in F1 is connected to all neurons in F2. Conversely, layers F2 to F1 are linked by recurrent connections

(feedback), with each neuron in F2 connected to all neurons in F1 (Carpenter et al., 1991c). The key parameters in an ART neural network include:

- α: Learning rate ($\alpha > 0$), the parameter responsible for controlling the influence that new patterns on the cluster.
- β: Training rate ($0 < \beta \leq 1$) determines the speed of training. A value of $\beta = 1$ indicates fast training, while $\beta < 1$ indicates slow training.
- ρ: Surveillance parameter ($0 < \rho \leq 1$) is a control parameter that determines the level of similarity required for a new cluster to be created.

SELF-EXPANDING FUZZY ART ONLINE TRAINING

Developed by Moreno (2016), the Self-Expanding ART Fuzzy Neural Network Online Training (SEARTFOT) is built upon Carpenter and Grossberg's ART Fuzzy model from 1991. These networks utilize fuzzy set theory by Zadeh (1965), using the AND operator (Λ) as defined by:

$$(x \wedge y) = min\{x_i, y_i\} \quad (1)$$

The network proposed by Moreno (2016) is self-expanding and does not have a fixed structure. It initiates the training process by selecting the first pattern as the center of the first cluster and expands as needed. This modification enhances the network's accuracy, reduces processing time, and lowers computational costs by only comparing the similarity of active clusters. Additionally, the network features an online training module that enables continuous learning, improving efficiency in prediction and training. The integration of this module in ART networks is feasible due to their stability and plasticity. With online learning, there is no requirement to restart training when new data is introduced, allowing new patterns to be permanently added to the network's memory.

This network has temporary and permanent categories to prevent rare data from being stored in the network's memory. Two new parameters have been introduced: the permanence parameter (NMIN) determines when a temporary category becomes permanent, and the novelty index (η) controls the updating of weights for permanent categories, filtering out irrelevant information (Moreno, 2010) to prevent memory overload. Resonance occurs when a pattern belongs to a temporary cluster, while resonance in a permanent category only happens if the input is close enough to the category's center within the parameter η. The Figure 2 shows the pseudocode for the ART Fuzzy Self-Expanding Network Online Training (SEARTFOT).

Figure 2: Pseudocode of the Self-Expanding ART Fuzzy Network Online Training.

Input: a: Input Data;
α: Learning Rate ($\alpha > 0$);
β: Training Parameter ($0 < \beta \leq 1$);
ρ: Vigilance Parameter ($0 < \rho \leq 1$);
η: Novelty Index;
$NMIN$: Parameter of permanence.
Output: y^{F_2}: Activity vector

procedure
  $Cluster_{temp} = 1, \quad \overline{\boldsymbol{a}} = \dfrac{\boldsymbol{a}}{\left|\sum_{i}^{M} a_i\right|}, \quad \overline{a}_i^c = 1 - \overline{a}_i, \quad \boldsymbol{I} = [\overline{\boldsymbol{a}} \quad \overline{\boldsymbol{a}}^c]$
  $\boldsymbol{W}_1^T = \boldsymbol{I}_1 \quad ConT_1 = 1$
  while Data for training exists **do**
    $Counter = 1$
    $Cluster_{temp} + Cluster_{def} = Categories$
    for all temporary and permanent clusters **do**
      $T_j^T = \dfrac{|\boldsymbol{I} \wedge \boldsymbol{W}_j^T|}{\alpha + |\boldsymbol{W}_j^T|}, \qquad T_j^D = \dfrac{|\boldsymbol{I} \wedge \boldsymbol{W}_j^D|}{\alpha + |\boldsymbol{W}_j^D|}$
    $flag = True$
    while flag = True **do**
      $T_J = \max\{T_j^T, T_j^D\}$
      $M_J = \dfrac{|\boldsymbol{I} \wedge \boldsymbol{W}_J^T|}{|\boldsymbol{I}|} \quad or \quad M_j = \dfrac{|\boldsymbol{I} \wedge \boldsymbol{W}_J^D|}{|\boldsymbol{I}|}$
      if $M_J \geq \rho$ **then**
        $flag = False$
        if $T_J^D > T_J^T$ **then**
          if $T_J^D > \eta$ **then**
            $\boldsymbol{W}_J^D = \beta(\boldsymbol{I} \wedge \boldsymbol{W}_J^D) + (1 - \beta)\boldsymbol{W}_J^D$
        else
          $\boldsymbol{W}_J^T = \beta(\boldsymbol{I} \wedge \boldsymbol{W}_J^T) + (1 - \beta)\boldsymbol{W}_J^T$
          $ConT_J^{new} = ConT_J^{old} + 1$
          if $ConT_J = NMIN$ **then**
            $Cluster_{def} = Cluster_{def} + 1$
            $\boldsymbol{W}_{Cluster_{def}}^D = \boldsymbol{W}_J^T$
            $Cluster_{temp} = Cluster_{temp} - 1$
            $\boldsymbol{W}_J^T = \boldsymbol{W}_{J+1}^T$
            $ConT_J = ConT_{J+1}$
      else
        if $Categories > Counter$ **then**
          $Counter^{new} = Counter^{old} + 1$
          $T_J = 0$
        else
          $Cluster_{temp}^{new} = Cluster_{temp}^{old} + 1$
          $J = Cluster_{temp}$
          $\boldsymbol{W}_J^T = \boldsymbol{I}_i$
          $flag = False$
      $y_i = \begin{cases} 1, & i \neq J, \\ 0, & i = J. \end{cases}$

METHODOLOGY

MACHINE LEARNING MODELS

In this study, we compared the results of the ARTFAEOT network with seven commonly used machine learning methods. These methods, implemented in Python using the Scikit-Learn library, included Logistic Regression (LR), K-Nearest Neighbors (KNN), Support Vector Machine (SVM), Random Forest (RF), Gradient Boosting (GB), MultiLayer Perceptron (MLP), and XGBoost (XGB). The optimal hyperparameters for each model were determined using the GridSearchCV method, which exhaustively tests all possible combinations of hyperparameters provided in a grid search.

DATASET

The data used in this article was collected and made available by Debernardi et al. (2020). It consists of 590 samples, including 183 from healthy individuals without pancreatic diseases, malignancies, or kidney disease history, 208 from patients with benign hepatobiliary diseases, and 199 from patients with autoimmune pancreatitis (ADP) at various stages (I-IV). The benign group comprised 119 cases of chronic pancreatitis, 54 samples from patients with gallbladder diseases, 20 with cystic lesions of the pancreas, and 15 cases with abdominal pain and gastrointestinal symptoms suggestive of pancreatic origin. The main attributes and sample quantities are shown in Table 1.

Table 1. Main attributes of the data set.

Attributes	Number of samples
Age	590
Diagnosis	590
Plasma CA19-9 U/ml	350
Creatinine mg/ml	590
LYVE1 ng/ml	590
REG1B ng/ml	590
TFF1 ng/ml	590
REG1A ng/ml	306

The biomarkers Plasma CA19-9 and REG1A were excluded from the simulations due to missing values.

The three remaining protein biomarkers LYVE-1, REG1B, and TFF1 are commonly downregulated in men and women with pancreatic adenocarcinoma (Radon et al., 2015). The LYVE-1 (Lymphatic Vessel Endothelial Receptor 1) protein is a transmembrane receptor for the extracellular matrix glycosaminoglycan hyaluronan (HA) and is expressed on the luminal surface cells of the lymphatic endothelium, acting as a transporter of HA, mediating its uptake for catabolism within endothelial cells (Stanly et al., 2020). It is also associated with leukocyte trafficking, tumor progression, and metastasis, so the localization of HA targeted to LYVE-1 to lymphatic tissues may

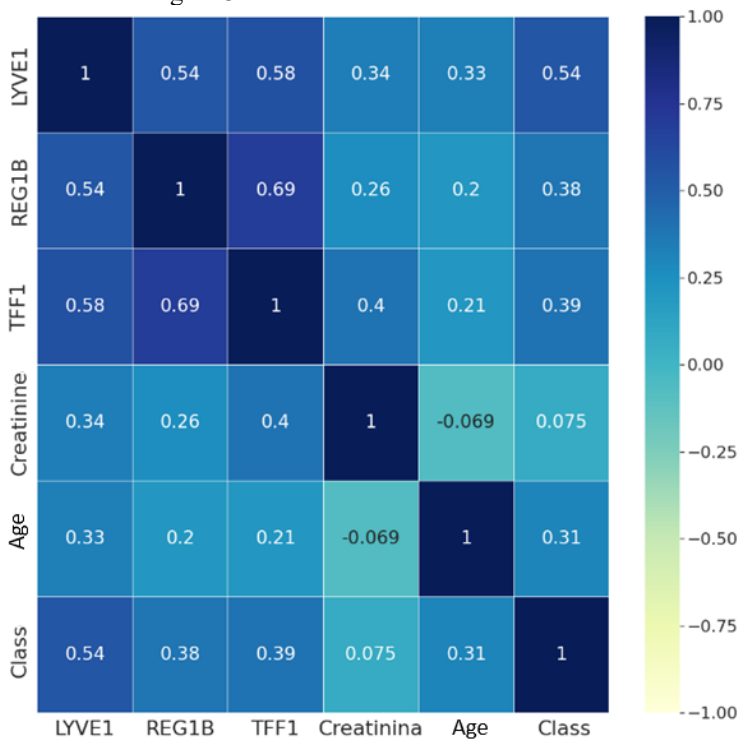
provide a substrate for tumor cell migration, contributing to metastatic spread (Jackson, 2019; Jackson, 2022).

REG1B belongs to a family of proteins encoded by Reg genes (Moriizumi et al., 1994). Its up-regulation has been identified in precursor lesions of pancreatic adenocarcinoma, leading to accelerated cell proliferation and tumor growth (Li et al., 2016). This gene encodes the glycoprotein REG1B (regenerating family member 1 beta), which is secreted by the pancreas, primarily by pancreatic acinar cells, and is involved in the regeneration of pancreatic islet cells in patients with pancreatitis (Jin et al., 2011). REG1B is a more effective biomarker than its paralog REG1A in distinguishing between control samples and stage I-IIA pancreatic adenocarcinoma samples (Debernardi et al., 2020).

The TFF1 (Trefoil factor 1) gene belongs to the Trefoil Family Factor (TFF) genes and is primarily expressed in the mucosal cells of gastric surfaces. It encodes the TFF1 protein, previously known as pS2. TFF1 functions by protecting and enhancing the viscoelasticity of mucus in the gastrointestinal epithelium, where it is co-secreted with mucins. Its expression is upregulated during inflammatory conditions like gastrointestinal ulcers and pancreatitis, playing a key role in epithelial reconstitution. Moreover, TFF1 expression is observed in premalignant conditions in various tumors and serves as a prognostic marker in breast cancer and pancreatic adenocarcinoma.

The correlation coefficient was used to determine the relationship between the variables. Figure 3 displays the heat map of the Pearson correlation matrix for each attribute. Upon observation, it is evident that the attributes did not exhibit a significant correlation.

Figure 3: Pearson's correlation coefficient.



EVALUATION METRICS

The confusion matrix, also known as the error matrix, was utilized to calculate the evaluation metrics in this article, including accuracy, sensitivity, and specificity. This matrix helps visualize the classification results by showing the number of correct classifications compared to the predicted ones. It also illustrates the relationship between two types of errors: type I error (false positive) and type II error (false negative).

Table 2. Confusion Matrix.

	True	False
Positive	TP	FN
Negative	FP	TN

on what:

- TP: positive data correctly classified;
- TN: negative data classified correctly;
- FP: negative data classified incorrectly;
- FN: positive data classified incorrectly.

The following metrics are used:

- Accuracy (ACC): assesses the overall performance of the model, which is the most common measure for quantifying the performance of models.

$$ACC = \frac{VP + VN}{VP + VN + FP + FN} \quad (2)$$

- Sensitivity (Se): indicates the model's ability to detect truly positive individuals, i.e. the probability of a test being positive in those who are actually ill.

$$Se = \frac{VP}{VP + FN} \quad (3)$$

- Specificity (Sp): this is a complementary measure to sensitivity and indicates the model's ability to detect true negatives, i.e. it indicates the probability of a test being negative in those who are not actually ill.

$$Sp = \frac{VN}{VN + FP} \quad (4)$$

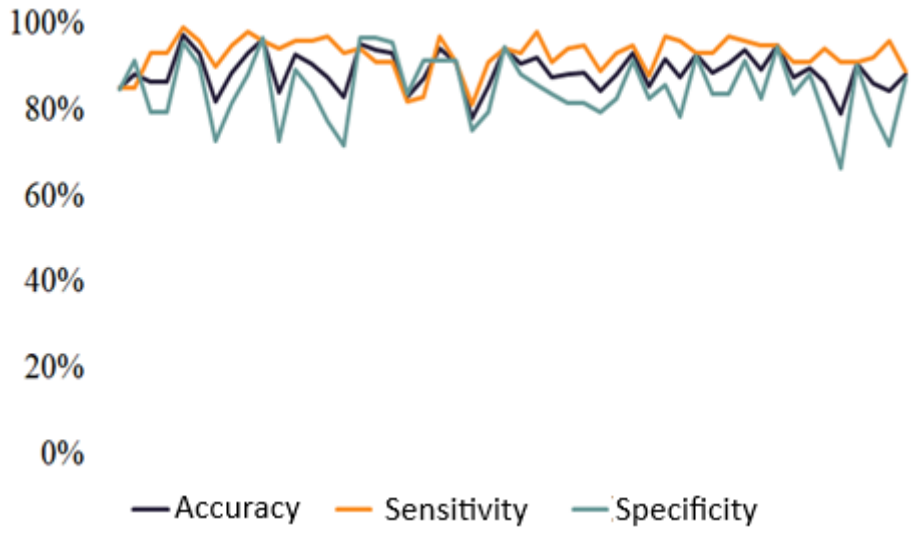
The data was partitioned using the Hold-Out repeated cross-validation method, also known as Monte Carlo cross-validation. This method involves randomly dividing the data set into two parts multiple times. Each division uses a 50-50 proportion, with one part as the training set and the other as the prediction set. The cross-validation process was repeated 50 times for all models, ensuring random shuffling and division of the data. (Dudoit & van der Laan, 2005; Borra & Di Ciaccio, 2010).

The Self-Expanding ART Fuzzy Neural Network Online Training was implemented using the Scilab computer system, version 6.0.1.

RESULTS AND DISCUSSION

The simulations were divided into three stages, following the methodology of Debernardi et al. (2020). In the first stage, the classification was performed between healthy patients (control group) and patients with ADP, with a total of 382 samples. The accuracy, sensitivity, and specificity achieved by the SEARTFOT network in the 50 iterations of the Monte Carlo cross-validation method for this stage are shown in Figure 4.

Figure 4 - Accuracy obtained by the SEARTFOT network in classifying the control and ADP groups.



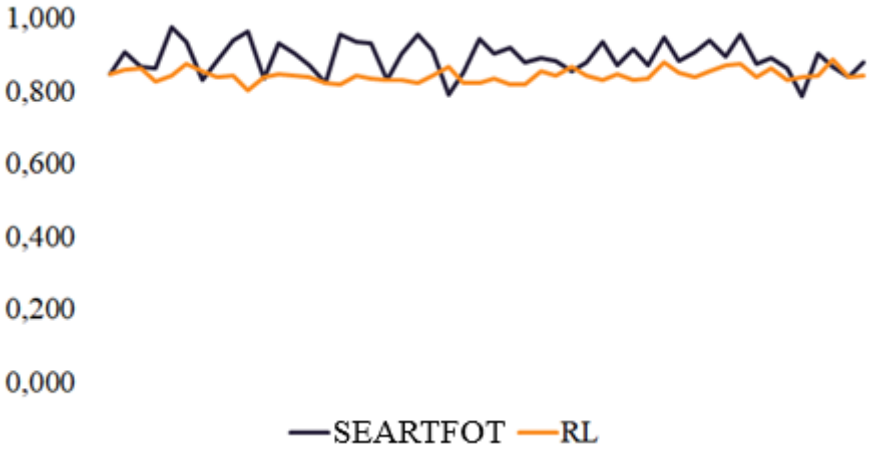
The average performance of each model is shown in Table 3. For this problem, high sensitivity is crucial to accurately diagnose cancer patients and avoid type II errors, where a cancer patient is misdiagnosed as healthy. While the SVM model had high sensitivity, its low specificity (less than 20%) indicates poor performance as it labeled most samples as cancer patients. This is evident in the Area Under the Curve (AUC) analysis, with the model achieving 0.582 ± 0.015, showing an inability to distinguish between classes.

Table 3. Results obtained by each of the models tested.

Method	ACC (%) ± Deviation	Se (%) ± Deviation	Sp (%) ± Deviation
ARTFAEOT	88.95 ± 4.36	92.68 ± 4.11	84.89 ± 7.41
RL	84.26 ± 1.95	80.83 ± 3.47	88.13 ± 3.54
KNN	79.51 ± 2.40	76.65 ± 3.30	82.62 ± 5.26
XGB	85.66 ± 2.00	87.30 ± 3.00	83.89 ± 4.08
RF	84.57 ± 1.72	84.34 ± 4.14	84.81 ± 3.67
GB	84.90 ± 2.20	86.64 ± 3.11	83.01 ± 4.39
SVM	59.81 ± 1.62	97.87 ± 0.94	18.41 ± 3.46
MLP	79.37 ± 2.93	79.05 ± 3.85	79.72 ± 5.12

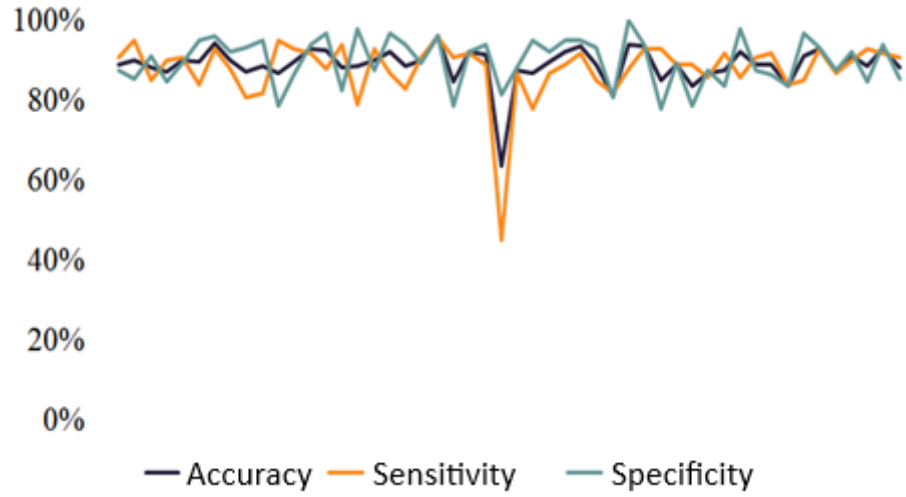
The logistic regression model showed good specificity but had a lower average AUC of 0.843 ± 0.018 compared to the SEARTFOT network, which had an average AUC of 0.892 ± 0.045. The SEARTFOT network demonstrated superior performance in distinguishing between healthy and ADP patients, surpassing all other models evaluated. Figure 5 displays the AUC values for each of the 50 iterations in the Monte Carlo validation method.

Figure 5: AUC obtained by the SEARTFOT network and RL in the classification between the control group and ADP.



The second stage involved classifying patients with benign hepatobiliary diseases (benign group) and patients with ADP, totaling 407 samples. The accuracy, sensitivity, and specificity achieved by the SEARTFOT network in the 50 iterations of the Monte Carlo cross-validation method for this stage are shown in Figure 6.

Figure 6. Accuracy obtained by the SEARTFOT network in classifying the benign and ADP groups.



The accuracy, sensitivity, and specificity results for classifying patients with benign hepatobiliary diseases and ADP using the methods in this study are presented in Table 4. The SEARTFOT network consistently outperformed other methods, particularly in terms of AUC, achieving a value of 0.891 ± 0.047. This outperformed the AUC of 0.849 obtained by the PancRISK (Logistic Regression) method used by Debernardi et al. (2020). Figure 7 illustrates the AUC values for the SEARTFOT and RL models across 50 iterations of the Monte Carlo cross-validation method.

Figure 7: AUC obtained by the SEARTFOT network and RL in the classification between benign and ADP groups.

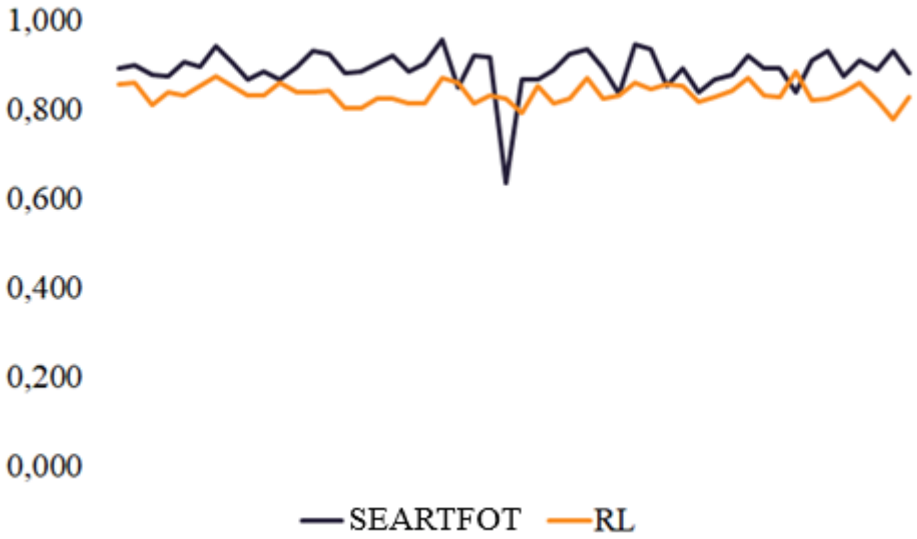


Table 4: Results obtained from the models tested.

Method	ACC (%) ± deviation	Se (%) ± deviation	Sp (%) ± deviation
SEARTFOT	89.06 ± 4.72	88.04 ± 7.53	90.04 ± 5.89
RL	75.40 ± 2.09	72.34 ± 5.13	78.35 ± 4.23
KNN	69.24 ± 2.67	67.30 ± 5.37	71.10 ± 5.12
XGB	75.41± 2.56	74.82 ± 5.60	75.98 ± 4.70
RF	75.20 ± 2.19	74.24 ± 4.91	76.12 ± 5.19
GB	73.13 ± 2.47	72.36 ± 5.37	73.87 ± 3.94
SVM	65.28 ± 2.39	54.16 ± 7.59	75.96 ± 6.74
MLP	73.45 ± 3.98	69.50 ± 6.19	77.25 ± 5.12

Table 5 compares the results of the SEARTFOT network with the best results from Debernardi et al. (2020). The network in this study achieved higher sensitivity compared to the PancRISK (Logistic Regression) model. It is important to note that a test with high sensitivity is preferred.

Table 5. Comparison of classification results between patients in the control group and ADP.

	Method	Se (%)	Sp (%)
This work	SEARTFOT	92.68	84.89
Debernardi et al. (2020)	PancRISK (Logistic Regression)	85.00	82.80

When comparing the results obtained by the SEARTFOT network with PancRISK (Logistic Regression) used by Debernardi et al. (2020) for classifying patients with benign hepatobiliary diseases and ADP, the network in this study demonstrated superior average performance. It achieved a sensitivity of 88.04% and specificity of 90.04%, as shown in Table 6.

Table 6. Comparison of classification results between patients with benign hepatobiliary diseases and ADP.

	Method	Se (%)	Sp (%)
This work	SEARTFOT	88.04	90.04
Debernardi et al. (2020)	PancRISK (Logistic Regression)	72.50	80.00

The third stage involved classifying patients with chronic pancreatitis (CP) and autoimmune pancreatitis (ADP), using 318 samples (119 CP and 199 ADP). The network's performance exceeded that of Debernardi et al. (2020), as shown in Table 7.

Table 7. Comparison of classification results between patients with CP and ADP.

	Method	Se (%)	Sp (%)
This work	SEARTFOT	84.20	86.50
Debernardi et al. (2020)	PancRISK (Logistic Regression)	80.00	67.60

CONCLUSION

In this study, various machine-learning models were used to identify patients with pancreatic cancer. The ART Fuzzy Self-Expanding Online Training network outperformed other models, achieving an average accuracy of 88.95% ± 4.36% in distinguishing between cancer patients and

healthy individuals. When differentiating between cancer patients and those with benign hepatobiliary diseases, the network achieved an average accuracy of 89.06% ± 4.72%, demonstrating its effectiveness in pancreatic cancer detection.

The ART Fuzzy Self-Expanding Online Training network and biomarkers showed promising results for this issue, indicating their potential to aid medical professionals in decision-making and enabling efficient and early diagnosis.

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The role of society in public leisure spaces: An experience report

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Silvia Borges[1]

ABSTRACT

Public leisure spaces are favorable places for health promotion, enabling people to acquire healthy habits. Squares, parks, cultural centers, streets, are examples of public spaces that provide opportunities for the practice of physical activities, leisure, sports, cultural development, conviviality and exchanges between the most diverse groups that make up the community. Objective: To describe how educational actions developed with the community contributed to the revitalization of a public leisure space. Methods: This report was based on the experiences of a group of community members from the Coroado III neighborhood, East Zone, in the city of Manaus-AM, who used a public space for the practice of physical activities, sports and leisure. Conversation circles, environmental education, cleaning actions with the active participation of the visitors of the place, photographic record and bibliographic survey of the literature related to the theme were carried out. Results: The actions resulted in the revitalization of the place, with improvements in the structure, elimination of garbage sources and awareness of environmental conservation, and contributed to promote the increase of individuals who started to frequent the neighborhood's leisure space. Conclusion: The collaboration and engagement of the community were essential to ensure the revitalization of the neighborhood's public leisure space, a place so significant to its regulars, the buracão field.

Keywords: Public spaces, Physical activities, Leisure, Community, Health promotion.

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INTRODUCTION

In recent years, there has been an evident increase in the demand for public leisure spaces in cities, as communities seek to balance the fast pace of urban life and the need for relaxation and leisure.

And what are public leisure spaces? They are spaces for citizenship, places of encounters, relationships, conviviality and exchanges between the most diverse groups that make up the community, they are also places conducive to boosting collective forces, as they allow the encounter between subjects with common interests (Araújo, 2019; Oliveira, 2010; Tschoke *et al.,* 2011). It is also a favorable environment for health promotion, due to the function of revitalizing and promoting well-being in the urban environment, enabling people to acquire healthy habits, as they enable physical activity, sports practice, play and cultural development (Rechia *et al*., 2006, *apud* Tschoke *et al.,* 2011; Silva *et al*., 2013). Squares, parks, forests, cultural centers and streets are examples of public leisure spaces, and constitute the central setting for these activities.

For several authors, the inadequacy and/or non-existence of public spaces for leisure contributes to the enclosure of people, who end up spending their available time in the domestic environment, and makes the inhabitants of the city increasingly distant from the right to the city as a place for the reproduction of life (Isayama *et al*., 2006; Oliveira, 2010).

Considering the importance of these spaces, this experience report aims to describe how educational actions developed with the community contributed to the revitalization of a public leisure space in the Coroado III neighborhood.

METHODOLOGY

This report was based on the experiences lived in 2019, with a group of community members from the Coroado III neighborhood, East Zone, in the municipality of Manaus-AM, who used a public space for the practice of physical activities and leisure.

To achieve the objectives of this report, the following methodological steps were followed: (1) active participation of the community members in the cleaning and awareness activities developed; (2) photographic record of the cleaning actions; (3) bibliographic survey of the literature related to the theme of public leisure spaces and; (4) analysis of the facts described.

The space delimited for the activity was the soccer field better known by the residents of the Coroado neighborhood as the "buracão field".

The methodological procedures mentioned took place simultaneously with the development of conversation circles, environmental education and the practice of physical activities with the visitors of the place, with meetings held every Monday and Wednesday, except holidays, lasting about 15 minutes, prior to the practice of physical activities.

RESULTS AND DISCUSSION

In recent decades, there has been a growing appreciation of public leisure spaces, and the recognition of their importance in playing a fundamental role in individual and community development, contributing to quality of life and well-being, improving social relations and often becoming a space for expression and involvement. This is understandable, since, "the space for leisure is the urban space. Cities are the great spaces and leisure facilities " (Marcelino, 2006, p.66). And yet, according to the same author, "in a peripheral country like Brazil, the vast majority of the population does not have the financial conditions to enjoy paid leisure spaces" (Marcellino, 2006, p.78). Thus, many individuals seek in public spaces the opportunity for leisure and physical activity, as they are free places, easily accessible and highly valued by the community, and, according to Baroni (2024), they are fundamental for social integration and urban balance.

According to Leonella et al. (2020, p. 2) "public space offers the possibility for people to interact with each other, to bring diversity together, to be able to cross paths with neighbors on a street or square, to be enjoyed by children and young people".

And based on these considerations, Mota presents his analysis of leisure outside the domestic environment:

> The small but important portion of leisure time spent outside the domestic environment is occupied with a multiplicity of gestures and displacements in the daily life of the city, summarized in the interest of enjoying the city itself. Here are some examples: walking through the streets (including the new version of the streets, the *shopping malls*), squares and parks, the look of the shop windows; o Stopping at bars, restaurants; going to the cinema, the theatre, the bookstore, the museum, the art gallery, the record store, the course or study group of your choice, the *concert*, the ball, the party, the club (or the beach), the cultural centre, the sports centre, the gym, dance, music [...] (Mota, 2012, p.43).

Coroado is a neighborhood located in the East Zone of the city of Manaus, capital of the state of Amazonas, has an area of 1,142.23 hectares, distributed in three areas: Coroado I, II, III. It arose from a popular invasion of the lands of the Federal University of Amazonas in the 1970s (Pessoa, 2014), and, according to estimates by the Brazilian Institute of Geography and Statistics (IBGE), its population in 2021 was 64289 people, most of whom are: entrepreneurs, workers in the Manaus Industrial District or owners of their own business. It was the first neighborhood established in the East Zone of Manaus, and since its foundation, it has sought economic and social improvements (Soares *et al.*, 2021). It presents diverse realities in its social and economic context, and from the commitment of its founders, the process of modernization of the area began. Thus, the first schools, churches, covered market, supermarkets, health centers, sports court, police station and a bus line to serve the community emerged. Urban infrastructure is scarce, with unpaved streets and poor sanitation services. As for the free public spaces (such as squares and parks) in the neighborhood, they are notably scarce, and the few that do exist are abandoned and unmaintained.

It's a challenging situation when public spaces don't get the proper attention and upkeep. Thus, understanding the public space, the "buracão field", as the most frequented leisure space in the Coroado III neighborhood, the initiative was to motivate the community to revitalize the place.

The "hole field" is a soccer field with uncovered dirt soil, a grandstand with five flights of stairs, surrounded by a fence, with two soccer goalposts, without demarcation, without drainage system, measuring approximately 30 meters wide and 60 meters long, used daily by residents of the neighborhood for walking. racing, leisure, football championships, and eventually for festive events.

When starting the practice of physical activities for the community of Coroado III, it was found that the place had inadequate conditions for safe practice. What was seen was a scenario of degradation, with a lot of garbage scattered in the stands and on the field. Disposable cups, animal feces, plastic and glass bottles, cardboard, food packaging, as well as a specific place at one end of the field with a large amount of accumulated garbage, called by the community the "junk dump", which housed (household waste, construction debris, local business disposal, furniture, plastics, cardboard and dead animal carcasses), generating a bad smell and the appearance of urban pests (insects and rodents), which in general carry disease-transmitting microorganisms, especially because they are in constant contact with garbage. It is worth noting that garbage accumulated in a careless and carefree way causes impacts on human health itself, "bringing a series of problems not only to the ecosystem, but also to society" (TODA MATÉRIA, 2013).

And knowing that the public space "is a place of representation of the social life and quality of life of its inhabitants" (Rosa, 2017 *apud* Lionella, 2020, p.2), it was necessary that some premises were respected to promote the health of visitors, such as: a cleaner and more enjoyable environment.

Figure 1. Recycle bin next to the Figure 2 field. Field Grandstand



Source: The author (2019) Source: The author (2019)

The main challenge was to eliminate the source of pollution and empower the population to adapt the space. Then, the development of strategies to improve the conditions of the place began,

involving the community members in a joint work of awareness to transform the "field of the hole" into a healthy and minimally conducive space for the realization of physical, sports and leisure activities of the community, because a planned place is synonymous with comfort, salubrity and integration. Based on this view, it's safe to say that the better the location, the better the chances it has of attracting people.

The search for and maintenance of these public spaces suitable for the practice of physical activities are essential to encourage an active and healthy lifestyle in the community, in this regard Moraes Filho *et al*., (2021, p.5) report that "urban public spaces, being intended for the community, require constant investments in infrastructure, safety, and quality". Arana and Xavier (2017) point out that the provision of urban public spaces would be associated with health benefits for the local population, encouraging, for example, the regularity of bodily practices, and that living in more natural environments has positively influenced people's perception of health.

The participation of the community is essential to stimulate a behavior of revitalization and preservation of the place, so action was needed. According to Isayama *et al*. (2006, p.88) "Actions grounded, in a critical way, but in action, making it happen, without needing life to stop, or major structural changes happening, so that only in this way can change begin".

An awareness work was then initiated with the community about the importance of cleaning the place for a safe practice. Daily, prior to the practice of physical activities, the site was cleaned with the collaboration of the community members, sweeping and gathering all the garbage found. Subsequently, dialoguing and seeking support with the leadership of the neighborhood soccer league, with the surrounding merchants, and with the municipal government for the removal of the "junk dump" and conservation of the site.

Figure 3. Communal cleaning 4. Communal cleaning



Source: The author (2019)

As a result, it was possible to keep the place clean, definitively eliminate the "junk bin", trash cans were installed around the football field, the bleachers were renovated and painted. Based on observations, it was found that the subjects were able to analyze and criticize issues related to society and their own conduct. The search for the right to an appropriate place was also part of the discussion, improving the environment of the countryside, seeking means in the community itself and also resorting to the public power through the elaboration of a claim document, which resulted in improvements. "When there are quality public spaces, they interfere positively for good urban development and for the quality of life of the population" (Leonella et al., 2020, p.2). The studies by Hino *et al.,* (2019) indicate that the availability and proximity of public leisure spaces to homes are associated with higher levels of physical activity of moderate and vigorous intensities performed by adults.

Figure 5. Figure 6. Renovated and clean grandstand



Source: The author (2019)

Figure 7. Installed trash cans



Source: The author (2019)

One of the great challenges of today is to create and maintain healthy spaces, enabling its visitors to regularly practice physical activity and leisure. Thus, it is necessary to consider that the more options and quality in the spaces, the greater the interest of the population in frequenting these

environments. According to Silva (2016, p. 252) "the quality of these places can interfere with use and enable or prevent individuals from acquiring healthy habits".

Mota and Zacarias (2008, p.109) say, "we pass so quickly through the things of nature and society that we do not notice how beautiful are the works of the people who transform the environment [...]".

FINAL THOUGHTS

Public leisure spaces play an essential role in improving the physical and mental well-being of citizens, while also contributing to strengthening social bonds and a sense of belonging**.**

The present report shows that there is a great demand for these spaces as facilitators of the practice of physical and leisure activities, especially a safe, healthy environment close to the home.

Another important point to be highlighted was the performance of the community, which united demonstrated all its transformative power, managing to revitalize such a significant place for its visitors. And so to point out that improving the structure of the place and conserving the environment can be one of the factors that has helped to encourage the increase of individuals who started to frequent the neighborhood's leisure space.

It is then up to the government to implement effective strategies to offer the population quality public spaces, aimed at leisure and the practice of physical activities, keeping them clean and free of damage, so that they can be used to promote the health and quality of life of the population.

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The social participation of workers in the national workers' health policy: Construction process, advances and challenges

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ABSTRACT

Workers' Health (WHS) policies in Brazil have a history marked by advances and setbacks, where the country has made significant progress in building a universal health system (SUS), and which includes WTS as one of its priorities. . There are still many challenges to be overcome, such as lack of resources, inadequate decentralization and resistance from business sectors. OBJECTIVE: To expand knowledge about the field of ST in Brazil and verify whether there has been progress in its implementation in Brazil and what challenges still need to be faced for its full consolidation. METHODOLOGY: The method of this study was an integrative literature review (RIL), with research carried out in the SciELO and Lilacs databases , with a total of 8 articles. RESULTS: The articles that were part of this study highlight the advances, challenges and perspectives for the future of ST. Regarding advances, we have the approval of the National Workers' Health Policy (PNST) in 2011, which established the guidelines for AIST in Brazil, the creation of the National Workers' Health Surveillance System (SINAN-T) , in 2015, and the implementation of ST programs in some states and municipalities. In relation to the challenges, it is worth highlighting the lack of financial, human and technological resources; lack of coordination of ST between the different sectors; lack of worker participation. FINAL CONSIDERATIONS: To overcome these challenges, there needs to be a joint effort between the government, workers and companies in addition to strengthening the decentralization of this policy.

Keywords: Workers' health, Advances, Social participation.

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INTRODUCTION

Workers' health aims to promote the protection, promotion, recovery and rehabilitation of the health of workers who are subject to risks and injuries related to work activities (BRASIL, 1990, 2012). It is a complex and very challenging field of practices and knowledge, because it has technical, political, social and economic dimensions that are interconnected and because it is necessarily intersectoral .

For Minayo -Gomez and Thedim -Costa (1997), even with the conceptual advances brought by Occupational Health, actions focusing on the relationship between health and work remained hegemonic of the principles of Occupational Medicine and Occupational Health, which today , are overcome by the biologicist character , focusing on the prevention of occupational risks. For the authors, interventions in the workplace have always been under the responsibility of the Health Sector since the beginning of the 20th century, with emphasis on the Carlos Chagas Reform [7]that took place in 1923. However, this function became the responsibility of the Ministry of Labor , Industry and Commerce in 1930, after its creation (LACMAN *et al* ., 2020).

According to Hoefel and Severo (2011), this theoretical and practical conception was overcome in the 20th century, after the Second World War, by a new form of political action called Occupational Health, focusing on the conception of multicausal health, with interventions in the environment of work, with the aim of overcoming centrality with the involvement of other health professionals.

Still citing Heofel and Severo (2011), in the real field, the integration of workers is little expressed and, although Occupational Health represents an evolution when talking about the conception and practice of occupational medicine, it still maintains the worker as object of the actions, not giving him the right to participate in the preparation of intervention actions in the process of living and becoming ill at work. Occupational Health practices are focused on the treatment and prevention of diseases, maintaining the central objective of promoting the rapid return of workers to their *place* of work. Interventions in worker health must always seek to transform production processes, making them promoters of health and not illness and death, in order to guarantee comprehensive health care for workers, in addition to considering their insertion in production processes.

Since then, workers' health has represented a historical rupture in the conception of health practices in this field, emerging as a demand from workers themselves for the right to participate in the formulation of actions aimed at their care, thus overcoming action centered on the disease and

[7] Public health, in the 1920s, acquired new importance in the discourse of power. There are attempts to extend its services across the country. The Carlos Chagas reform, of 1923, attempts to expand health care by the central power, constituting one of the Union's strategies for expanding national power within the ongoing political crisis, signaled by the lieutenants, from 1922 onwards (BRAVO, 2000).

incorporating health promotion actions and significant advances in the addition of new professionals in the process of caring for workers.

The Brazilian Health Reform movement was influenced by the processes developed in Italy in the early 1970s, with regard to the construction of public health policies. The first protection initiatives were carried out in Italy and Brazil, each country in its own time. For the working class as a way of confronting problems arising from the mode of production (SOUZA LIMA et al., 2009). In the 1970s, Italian workers organized themselves (health professionals, health service technicians and researchers), bringing to light discussions about working conditions that lead to disease, as well as the need to change them. Workers, since then, have taken over the leadership of the struggle for better working conditions, under the principle of "non-delegation".

According to Souza Lima *et al* . (2009), this movement had repercussions in Brazil in the mid-1970s, which was a historical period marked by the resurgence of social movements and the process of reorganization of society in a scenario of important movements for the end of the military dictatorship and redemocratization of the country. At this time in question, the bases of the Health Movement were formed, which had the support of workers, in particular, organizations linked to the premises of the "new unionism" and theoretical-conceptual formulations that were produced by the field of Public Health, the which favored the inclusion of worker health issues in the Brazilian Health Reform agenda. In this way, the Workers' Health movement in Brazil took shape in the late 1970s, implementing actions to defend the right to decent and healthy work; and assisting the participation of workers in decisions regarding the organization and management of production processes and in the search for ensuring comprehensive health care. In the meantime, the implementation of differentiated attention to workers' health, in the public health services network, contributed to the establishment of Workers' Health in Brazil.

This study aims to expand knowledge about the field of Workers' Health in Brazil and verify whether there have been advances in its implementation in Brazil and what challenges still need to be faced for its full consolidation **.**

METHODOLOGY

The present study used an integrative literature review (RIL) method, which aims to gather and summarize scientific knowledge on the topic in question, allowing the search, evaluation and synthesis of available evidence to contribute to the development of knowledge regarding the topic (MENDES; SILVEIRA; GALVÃO, 2008).

To prepare this integrative review, the following steps were taken: definition of the guiding question (problem) and research objective; establishment of inclusion and exclusion criteria for publications (sample selection); literature search; analysis and categorization of studies, presentation

and discussion of results. As a way of guiding the research, the following question was taken as a guide: What are the advances in worker participation in the PNSTT Policy with a focus on social participation?

A search for publications indexed in the following databases was carried out in November 2023: Latin American and Caribbean Literature in Health Sciences (LILACS) and electronic libraryScientific ElectronicLibrary Online (SciELO), using the descriptors " Worker's health", "Advances", "Social participation".

The inclusion criteria were: research that addressed the topic in question, published in Portuguese, that had a full summary, in article format, in the period from 2018 to 2023. Exclusion criteria: works that did not present full summaries in the databases, published in a foreign language, published before 2018. The abstracts were read and analyzed, and the productions that met the inclusion criteria were selected to compose this study. After this stage, they were read in full.

RESULTS

27 studies were found, of which 01 was repeated, being published in both SciELO and LILACS . Thus, of the 26 publications chosen, 08 were able to participate in this study because they addressed the proposed topic. Below is Table 1, with an overview of the chosen publications:

SciELO databases .

DATA BASE	NUMBER OF ITEMS CHOSEN	NUMBER OF ITEMS EXCLUDED	TOTAL
SciELO	06	08	**14**
LILACS	02	10	**12**
TOTAL	**08**	**18**	**26**

As a result of searching for articles, 01 publications from 2018 (10%), 03 from 2019 (20%), 02 from 2020 (0%), 01 from 2021 (20%) and 01 article published in 2022 (10%) were found. , as shown in Table 2 below.

Table 2. Distribution of articles chosen for the study according to periodicals, by magazine and year of publication.

MAGAZINE	PUBLICATION YEAR
SciELO	
RSBO - Brazilian Magazine of Occupational Health	2018
CRH notebook	2019
Health Debate	2019
REBEN - Brazilian Nursing Magazine	2020
RSBO - Brazilian Magazine of Occupational Health	2021
Science & Public Health	2022
LILACS	
Public Health Notebooks	2019
Science & Public Health	2020

In Table 3, the objectives and methodology used in each article that made up this integrative literature review study were listed. Attention was drawn to 04 articles (40%) that did not present the methodology used neither in the abstract nor in the body of the article. Lakatos and Marconi (1987, 2021) explain that determining the methodology is fundamental in a study, as it answers several questions that underpinned the research: How?, With what?, Where?, When?.

Table 3. Distribution of articles by objective and methodology.

AUTHOR(S)	GOAL	METHODOLOGY
Jackson Filho *et al* . (2018)	Reflect on the role of intervention in worker health, its objects and modalities in the current context, characterized by the recently enacted labor reform and outsourcing law, new forms of management and transformations in production and service technologies .	Not defined in the abstract and body of the article.
Gomez, Vasconcellos and Machado (2018)	Initially address the process that preceded the insertion of ST into the SUS.	Not defined in the abstract and body of the article.
GOHN (2018)	It will focus on the first level – the theoretical conceptual –, aiming to rescue the foundations of the theories used by researchers, both to explain the theme of participation in civil society, via social movements and collectives, and the meanings used to explain society's participation in policies public, in interaction with the State and its management bodies.	Not defined in the abstract and body of the article.
Araújo, Pinho and Mason (2019)	Describe the initial trajectories of teacher health investigations in the Brazilian context; discuss elements that consolidated consensus regarding the characterization of work and the main health problems in this group; and systematize its main advances and challenges.	Not defined in the abstract and body of the article.
Lacaz *et al* . (2019)	Discuss whether what was understood as the narrow social basis of the Health Reform could have been overcome and faced with greater rapprochement between both movements, in a kind of political-programmatic synergy.	Bibliographic and documentary analysis, with special attention to the fragility of the social basis of the Health Reform.
Santana, Sarquis and Miranda (2020)	Reflect on psychosocial risks and their impacts on the health of healthcare workers in light of the economic context and the Brazilian Labor Reform	Reflective study about the Brazilian Labor Reform and its impacts on the health of healthcare workers.
Silva (2021)	Reflect on topics in the field of Workers' Health (WHS) that contribute to the lack of effectiveness of their actions and to the detriment of their comprehensive care.	Essay based on documentary and literature review.
Hurtado *et al* . (2022)	Analyze the development of Brazilian policies in Workers' Health based on historical contradictions	Scoping review that includes 64 theoretical, empirical studies and gray literature published between 1991 and 2019.

health is a field of activity that aims to promote, protect and restore workers' health through the prevention and control of occupational risks. In Brazil, workers' health is a right guaranteed by the Federal Constitution of 1988 and is regulated by Law No. 8,080/1990, which created the Unified Health System (SUS). With the creation of the SUS, worker health became a responsibility of the

State. The SUS included Workers' Health as one of its guidelines and created the PNSTT in 2011. The PNSTT established guidelines for comprehensive care in Workers' Health in Brazil (GOMES; VASCONCELLOS; MACHADO, 2018) .

As for the challenges, there are still some to be overcome for the consolidation of Occupational Health in Brazil in the view of these authors, citing the lack of financial, human and technological resources, which are not always available, the lack of coordination of Occupational Health worker between different sectors, such as health, work, education and social assistance and lack of participation of workers in issues of interest to the class (GOMES, VASCONCELLOS E MACHADO, 2018).

According to Gohn (2018), theories on social participation seek to understand the ways in which individuals and groups get involved in decisions that affect their lives. For the author, these theories are important for understanding social inequalities, as social participation can be a mechanism to promote inclusion and equity. However, there are challenges to be overcome in understanding social inequalities, based on theories on social participation. One of these challenges is that these theories are often generalist, and do not take into account the specificities of social inequalities.

Gohn (2018) explains that it is necessary to think about some strategies to promote social participation and reduce social inequalities, such as the development of public policies that promote equal access to institutions and resources. These policies include regulation of the labor market, investments in education and health, support for civil society organizations and the promotion of culture, encouragement of social participation, recognition of the diversity of social subjects. Promoting social participation is a complex challenge, but it is essential for building a more fair and equitable society, which can be achieved through education, communication and social mobilization.

Intervention in worker health is a complex process, which involves the identification, assessment and reduction of risks to workers' health. However, there are several challenges that make this intervention difficult to carry out. One of the main challenges is the complexity of health problems for workers, which can be caused by a variety of factors, including physical, chemical, biological, ergonomic and psychosocial risks. Identifying and evaluating these factors is a complex challenge, which requires specialized knowledge (JACKSON et al., 2018).

It is also pertinent to mention the difficulty in accessing health services, emphasizing that many workers do not have access to this type of service or have very limited access, and this makes the diagnosis and treatment of health problems of the worker difficult. /The. Furthermore, resistance from employers is still a major challenge, as many resist changes that would be good for the working class in the workplace, and this involves the cost of changes, fear of losing productivity, retaliation from employers and lack of knowledge about the benefits of prevention (JACKSON et al., 2018).

Jackson et al. (2018) present some strategies that can be used to overcome the challenges for intervention in worker health, namely: development of public policies to promote health and safety at work with a focus on regulating working conditions work, investments in education and support for research in Occupational Health; participation of workers in promoting worker health. Workers must participate in collective actions, unions and associations, to defend their rights and promote the necessary changes in working conditions; cooperation between employers and workers aimed at promoting worker health, adopting measures to improve working conditions and implementing actions to prevent work accidents and illnesses. Overcoming the challenges for intervention in worker health is essential to guarantee the health and safety of these workers.

Santana, Sarquis and Miranda (2018) discuss the Brazilian Labor Reform, enacted in 2017, which brought several changes to labor relations, including changes to the rules on working hours, outsourcing, teleworking and collective bargaining. These changes can have an impact on the health of workers, who are exposed to a series of ergonomic, psychosocial and relationship risks). In these authors' understanding, the Labor Reform can increase workers' exposure to psychosocial risks, since flexible working hours can lead to increased work overload, and increased outsourcing can lead to loss of job stability and the reduction of collective bargaining, which can make it difficult to defend workers' rights.

Santana, Sarquis and Miranda (2018) also report on the main psychosocial risks at work, listing some: emotional demands, which refers to the need to deal with emergency situations. An example of this are health workers who provide care to patients with serious and/or terminal illnesses, as dealing with death can greatly affect the mental health of these workers; control over work, that is, the lack of autonomy at work, as well as the lack of participation in decisions about work and even the lack of recognition for the work performed can contribute to stress and dissatisfaction among workers; social relationships, as conflicts at work, lack of social support from colleagues and lack of support from management can contribute to workers' anxiety and isolation.

Silva (2021) discusses the limitations, advances and challenges of AIST in Brazil, citing the following limitations such as lack of resources, lack of coordination between different sectors, lack of social participation. Regarding advances regarding AIST in Brazil, the author cites the Approval of the National Workers' Health Policy (PNSTT), in 2011, which established the guidelines for AIST in Brazil and the creation of the National Health System. Worker Health Surveillance (SINAN-T), in 2015. SINAN-T is a tool that allows the monitoring of worker health problems; implementation of worker health programs in some states and municipalities: some Brazilian states and municipalities have implemented worker health programs that have achieved positive results.

When it comes to challenges for AIST in Brazil, Silva (2021) cites the strengthening of coordination between sectors, in order to guarantee an integral and multi-professional approach,

guaranteeing the participation of workers, it is necessary to guarantee the participation of workers in the definition and implementation of worker health policies and actions, in order to ensure that these actions meet their needs; investments in primary health care: primary health care is the most appropriate level of care for the promotion and prevention of workers' health, and it is necessary to invest in its qualification and expansion.

Araújo, Pinho and Mason (2019) deal with the trajectories of investigations into the work and health of teachers in Brazil, highlighting the advances and challenges that still need to be overcome. Investigations into the work and health of teachers in Brazil began to develop in the 1980s, focusing on the physical and ergonomic risks associated with teaching work. In the 1990s, investigations began to focus on psychosocial risks, such as work overload, stress, anxiety and depression. In recent years, investigations have focused on analyzing the social determinants of teachers' health, such as working conditions, professional training and educational policies.

In the authors' understanding, there have been many advances in investigations into the work and health of teachers in Brazil as evidence of the health risks associated with teaching work, demonstrating that it is associated with a series of health risks (physical, ergonomic and psychosocial) ; development of explanatory models of the relationship between work and health, with explanatory models of the relationship between work and health, which allow a better understanding of the factors that contribute to teachers becoming ill; identification of effective interventions to promote the health of teachers, to promote the health of these workers, such as professional training, ergonomics and participatory work management (ARAÚJO; PINHO E MASON, 2019).

Lacaz et al. (2019) discuss the relationship between the Health Reform Movement (MRS) and the Workers' Health Union Movement (MSST), arguing that the two movements have common objectives, but different approaches and, therefore, are unable to articulate themselves. effectively. The MRS, according to the authors, is a social movement from the 1970s, which emerged with the objective of promoting the reform of the Brazilian health system, in defense of a universal, public and quality health system, with a focus on PHC. The MSST is a trade union movement from the 1980s with the aim of defending the rights of health workers, always fighting for better working conditions, fair wages and professional recognition.

In the view of these authors, the disagreement between the MRS and the MSST is a serious problem for Brazilian public health, as the lack of coordination between the two movements makes it very difficult to defend the rights of health workers and the promotion of a universal, public and quality healthcare system. Lacaz et al. (2019) point out some suggestions for articulation between the MRS and the MSST: recognition of common objectives, with emphasis on the defense of public health and the rights of health workers; construction of a joint agenda and struggles, which encompasses the interests of both movements; strengthening the dialogue between these two

movements, with the intention of overcoming differences in approach and building an effective partnership, highlighting that the articulation between the MRS and the MSST can contribute to the promotion of Brazilian public health and the defense of workers' rights/ those of health.

Workers' health policies in Brazil have a history marked by advances and setbacks, where the country has made significant progress in building a universal health system, known as SUS, and which includes workers' health as a of your priorities. However, there are still many challenges to be overcome, such as the lack of resources, inadequate decentralization and resistance from business sectors (HURTADO et al., 2022).

The authors point out that to overcome these challenges, there needs to be a joint effort between the government, workers and companies, with the government increasing resources for worker health, strengthening the decentralization of this policy. Workers must organize and demand compliance with occupational health and safety standards and companies must assume social responsibility and invest in the health of their workers (HURTADO et al., 2022).

Some possibilities for developing worker health policies in Brazil, for Hurtado et al. (2022) include investments in education and training of workers; strengthening worker health surveillance; promotion of worker health; worker participation. In summary, worker health policies in Brazil are still under construction, requiring a joint effort from all sectors involved to ensure that this policy is fully effective and contributes to improving the health and safety of Brazilian workers. .

DISCUSSION

The articles that were part of this study address worker health in Brazil, highlighting advances, challenges and perspectives for the future. Regarding advances, we have the approval of the National Workers' Health Policy (PNSTT) in 2011, which established the guidelines for AIST in Brazil, the creation of the National Workers' Health Surveillance System (SINAN-T) , in 2015, and the implementation of worker health programs in some states and municipalities.

In relation to the challenges, it is worth highlighting the lack of financial, human and technological resources; lack of articulation of worker health between the different sectors; lack of worker participation.

As perspectives for solidifying actions in Workers' Health we have: strengthening the coordination between government, workers and companies; investments in education and training of workers; strengthening worker health surveillance; actions to promote worker health, with the participation of the community, workers and businesspeople; strengthening workers' participation in issues at Federal, State and Municipal levels relevant to worker health.

The importance of workers' participation in promoting workers' health stands out here. Workers are the main stakeholders in improving working conditions and reducing occupational risks. Therefore, it is important that they organize themselves and participate in worker health actions.

FINAL CONSIDERATIONS

Occupational health is an important area for promoting the health and safety of workers. In Brazil, there have been some advances in recent years, but there are still challenges to be overcome. It is necessary to strengthen coordination between the sectors responsible for worker health, guarantee the participation of workers and invest in resources for the implementation of worker health actions.

This study presented, through an integrative literature review, a comprehensive view of workers' health in Brazil, highlighting significant advances and perspectives for the future, but there are still some challenges to be overcome, for example, lack of financial and human resources, inadequate decentralization and resistance from business sectors. To overcome these challenges, there needs to be a joint effort between the government, workers and companies, with the Government increasing the allocation of resources to Workers' Health, in addition to strengthening the decentralization of this policy.

Nothing is built alone and therefore, workers must organize themselves to demand compliance with occupational health and safety standards, with companies assuming social responsibility and investing in the health of their workers.

The prospects for the future are positive, but there still needs to be a commitment from all sectors involved, to ensure that worker health is fully effective and contributes to improving the health and safety of employees. Brazilian workers.

The study achieved the proposed objective, even with few studies available in the databases consulted. The texts listed highlighted the importance of coordination between the different sectors involved in worker health, but with the exception that TS is still a complex issue, which involves different sectors, such as Government, companies, unions and civil society organizations. , but it is important that everyone works together to promote the health and safety of workers.

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Anxiety and its relationship with the integrative practice of aromatherapy

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ABSTRACT

Anxiety is one of the most concerning health issues today, with approximately 264 million people worldwide suffering from some form of anxiety disorder. Symptoms can range from nervousness and restlessness to debilitating panic attacks. The World Health Organization (WHO) points out that Brazil is the country with the highest number of anxious people: 9.3% of the population, this percentage represents about 18.6 million Brazilians (WHO, 2023).

Keywords: Integrative practices, Anxiety, Aromatherapy, Mental health.

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INTRODUCTION

Anxiety is one of the most concerning health issues today, with approximately 264 million people worldwide suffering from some form of anxiety disorder. Symptoms can range from nervousness and restlessness to debilitating panic attacks. The World Health Organization (WHO) points out that Brazil is the country with the highest number of anxious people: 9.3% of the population, this percentage represents about 18.6 million Brazilians (WHO, 2023).

This percentage has also increased due to the COVID-19 pandemic, the prevalence of pathological anxiety is 19.4% of patients, due to social isolation. The main factors associated with isolation were women between 18 and 20 years old, living abroad and reduced physical activity due to the pandemic.

With the restrictions, the population has made adaptations to improve its quality of life and thus becoming a central concern in contemporary society, as the daily demands and pressures of the modern world significantly impact people's physical and mental well-being. In this context, anxiety emerges as a prevalent challenge, affecting individuals in different age groups and socioeconomic contexts (SOUZA, 2021).

Throughout history, reports of manifestations of anxiety can be found in diverse cultures and periods. However, the understanding and formal categorization of anxiety as a specific disorder has evolved over time (TELES, 2023).

In the nineteenth century, anxiety began to be more widely studied and categorized as a medical condition. However, the understanding of anxiety as we understand it today really gained prominence in the twentieth century, with the development of psychoanalysis and the contribution of thinkers such as Sigmund Freud. Beginning in the late twentieth and early twenty-first centuries, there has been a significant increase in awareness of anxiety disorders. The classification of specific conditions, such as generalized anxiety disorder (GAD), panic disorder, obsessive-compulsive disorder (OCD), and post-traumatic stress disorder (PTSD), allowed for a more targeted approach to treatments (GONÇALVES, 2023).

Given this historical context, the search for complementary therapeutic approaches to anxiety is understandable. Aromatherapy emerges as a practice that uses essential oils to assist in the management of anxiety symptoms (TELES, 2023).

Conventional pharmacological treatments used to combat anxiety mostly have intense adverse effects, tolerance and drug dependence. Several studies involving Integrative and Complementary Health Practices have been carried out in search of safe and effective non-pharmacological therapeutic alternatives for the treatment of anxiety (GNATTA, 2010). Among these practices, Aromatherapy, a therapeutic technique that aims to promote the physical, mental, and emotional health of the individual through the use of essential oils from aromatic plants, has had its

use significantly increased in recent years in treatments to reduce anxiety and improve quality of life (SOUZA, 2021).

In the contemporary scenario, where stress is a constant, people are increasingly interested in holistic approaches that complement conventional treatments. Aromatherapy offers a non-invasive alternative, based on the influence of aromas on the mind and body (BOARETO, 2020).

By integrating essential oils such as lavender, chamomile, bergamot, and orange, aromatherapy seeks to provide natural relief from anxiety. These aromas stimulate the nervous system, promoting relaxation, reducing tension, and contributing to emotional balance.

Lavender, for example, is known for its relaxing properties and can be used to promote a state of calm. Chamomile is often associated with relieving tension and stimulating restful sleep. Bergamot oil is recognized for its potential to lift spirits and reduce anxiety, while orange oil can have invigorating effects and calm the mind. The relationship between anxiety and aromatherapy is based on the influence of odors on the nervous system and emotions. It is believed that essential oils, when inhaled or applied topically, can activate areas of the brain associated with emotions and emotional balance (DIAS, 2019).

The integration of aromatherapy into anxiety management reflects the ongoing search for holistic strategies that consider physical and emotional well-being in an integrated manner.

Considering this problem, it is important to establish other therapeutic offers in health systems, which go beyond the biomedical model (SOUSA et al., 2017). To this end, in 2006, the Ministry of Health (MS) approved the National Policy on Integrative and Complementary Practices (PNPIC) (BRASIL, 2018) with the inclusion of 5 integrative practices and, in 2017 and 2018, 24 more ICPs were approved in the SUS, including Aromatherapy.

Among these practices, several studies have been carried out with the aim of investigating the application of Aromatherapy, which refers to the use of aroma of oils and herbs (TABARI, 2021). It has the purpose of modifying a person's mood or behavior and improving their physical, mental, and emotional well-being.

Integrative Practices can be elements of support for the treatment and prevention of health problems and complications of patients with anxiety, also constituting a device for forming and strengthening the bond between individuals (BRASIL, 2017).

From an academic point of view, a priori there are two pillars that underlie the importance of investigating the issue of quality of life, anxiety and its relationship with the practice of aromatherapy. The first, more general, is related to the knowledge shared by researchers about contextual influences on interventions to improve the quality of life of patients with anxiety, using the PICs that is provided for in the National Policy for Integrative and Complementary Practices

(PNPIC). And it is of great relevance to search for evidence that proves the efficacy and safety of PICs in the context of interventions.

The word "anxiety" originates from the Latin anxietas, which means "anguish." Anxiety is considered normal when it consists of an adaptive response of the body in order to promote performance. However, when the intensity or frequency of the response does not correspond to the situation that triggered it, it is considered pathological (CASTILLO et al., 2000; XIMENES; NEVES, 2018).

According to the World Health Organization (WHO, 2020) and the Pan American Health Organization (PAHO) indicate that mental health is the most neglected area with almost 1 billion people in the world living with mental disorders. These values are alarmingly sufficient to classify Brazil as the most depressed country in Latin America and the most anxious in the world, demonstrating the urgency with which a health intervention must be carried out in the nation in order to promote the reduction of these rates (WHO, 2020).

Anxiety, in turn, is understood by the presence of feelings of fear, anguish, excessive thoughts about the future, which can cause excitability or even sadness. Anxiety is part of human life, and depending on the intensity with which it is felt and the way it is managed, it can be considered beneficial or harmful (SCHÖNHOFEN, NEIVA-SILVA, ALMEIDA, VIEIRA, & DEMENECH, 2020).

In the contemporary scenario, anxiety emerges as one of the most common and impactful psychological experiences, affecting people of all ages and backgrounds. This emotional state, characterized by apprehension, nervousness, and excessive worry, transcends cultural and socioeconomic boundaries, becoming a significant reality in the lives of millions of individuals. With deep roots in the evolutionary "fight or flight" response, anxiety plays a crucial adaptive role, preparing the body to face challenges.

However, when this natural response becomes dysregulated, turning into a persistent and disproportionate state, anxiety disorders arise, constituting a global mental health challenge. By understanding the complexity of this phenomenon, it becomes possible to outline effective prevention, intervention, and support strategies, seeking to promote emotional balance and a better quality of life for those who face this challenge.

Anxiety, intrinsically linked to human survival, has evolved as an adaptive response to alert the body to potential threats. However, in a modern world marked by constant stimuli and varying pressures, anxiety can take many forms, from everyday worries to clinically significant mental disorders.

The manifestations of anxiety span a broad spectrum, which vary from person to person, including cognitive, emotional, and physical symptoms. Here are some of the most common manifestations of anxiety:

Physical Symptoms: Palpitations or rapid heartbeat; Muscle tension and body aches; Tremors or feeling weak; Rapid breathing or shortness of breath; Excessive sweating; Gastrointestinal disorders, such as abdominal pain or nausea. Emotional Symptoms: Constant nervousness; Feeling of apprehension or fear; Irritability; Difficulty concentrating; Feeling out of control; Excessive worry. Behavioral Symptoms: Difficulty coping with day-to-day tasks; Insomnia or sleep problems; Compulsive behaviors; Difficulty relaxing. Cognitive Symptoms: Constant worry about the future; Difficulty in turning off the mind; Negative self-evaluation; Difficulty making decisions. Social Symptoms: Social isolation; Difficulty interacting with others; Fear of judgment or criticism Difficulty expressing emotions. Triggers: Several factors can trigger or contribute to the development of anxiety. Chronic stress, traumatic events, genetic predisposition, brain chemical imbalances, and underlying health conditions are some elements that can play a significant role. In addition, social, financial, and environmental concerns can intensify anxious symptoms. These symptoms can develop into disorders that are mental health conditions characterized by excessive and persistent levels of anxiety, fear, or worry. They are characterized when it transcends the spectrum from normal to pathological when it interferes with daily activities and general well-being. Common disorders include Generalized Anxiety Disorder (GAD), Panic Disorder, Obsessive-Compulsive Disorder (OCD), Specific Phobias, and Post-Traumatic Stress Disorder (PTSD).

The disorder has a profound impact on quality of life. It can affect interpersonal relationships, academic and professional performance, sleep, and physical health. Additionally, anxiety can be a barrier to seeking opportunities and fulfilling potentials, creating an adverse cycle of emotional challenges.

Thus, the approach and implementation of anxiety treatment involves a multifaceted approach, which may include psychotherapy, anti-anxiety medications, cognitive-behavioral therapies, and self-care strategies. In addition, practices such as aromatherapy, physical exercise, and mindfulness have been shown to be beneficial in managing anxious symptoms.

Treatment strategies for anxiety are numerous and the Mental Health Policy, enacted by Law 10.216 in April 2001, provides for the protection of these rights related to effective and individualized treatment when necessary for these patients, thus improving symptoms and providing a better quality of life for individuals (BRASIL, 2001).

The mental health policy approach to anxiety is essential to deal with the most prevalent and impactful mental health problems worldwide (BRASIL, 2001).

Complementary integrative practices are increasingly being used in the treatment of various pathologies such as tension headache, anxiety, depression according to Kai Song who carried out a meta-analysis carried out in 2020 on the effectiveness of complementary therapies in patients who suffered from stroke and had depression after stroke, 46% of patients used complementary therapy and 16% reported that they felt effectively psychologically relaxed with the use of therapy, corroborating the effect of the therapies.

In recent years, integrative practices are increasingly being sought to improve symptoms and consequently provide a better quality of life, due to people's routine, tension pathologies only grow and thus making it difficult to carry out daily activities. With these tensions and anxieties, the tendency is to search for pharmacological treatments that can cause adverse effects. According to Zhai Xixi (2021) in their meta-analysis, they observed that non-pharmacological treatments mainly include psychotherapy, behavioral therapy, acupuncture therapy, and other integrative practices, usually combined with other pharmacological treatments, their efficacy was confirmed. Research has shown that integrative therapies, alone or in combination, can reduce headache activity in nearly 50% of cases.

Guo et al. (2020) in their study identified that aromatherapy significantly reduced anxiety in adults who were waiting for surgical procedures, these effects are beneficial, cause well-being to the patient and thus have an effective method with fewer side effects.

Aromatherapy is currently recognized and used in many industrialized countries as an extremely effective method of therapy. When it comes to knowledge and advancement in the area, England and France are the countries that stand out the most, with serious and quality work. It is worth mentioning that in England there is an Aromatherapy Council and in France there are colleges that have the discipline "Aromatherapy" in their medical courses. Brazil is positioned as the 3rd largest exporter of essential oils in the world. According to the United Nations Commodity Trade Statistics Database, the largest consumers of essential oils in the world are the USA (40%), the European Union – EU (30%), with France being the leading country in imports and Japan (7%), along with the United Kingdom, Germany, Switzerland, Ireland, China, Singapore and Spain, thus observing the growth of the widespread practice in the world (BRITO, 2013).

Rodriguez et al. (2015) observed that Integrative and Complementary Health Practices (ICPs), such as aromatherapy, are increasingly being used as key tools to reduce anxiety levels, due to the more efficient method and obtaining fewer adverse effects and thus providing a better quality of life to individuals who make use of the practice. In this context, the use of ICPs is very promising, "due to the mode of care that, in this case, focuses attention on the individual as a whole and not only on the disease, providing a holistic approach to care" standing out mainly for its low cost, fewer side effects and accessibility (GNATTA; DAY; SILVA, 2011).

In order to expand the clinical approach and therapeutic options offered to users of the Unified Health System (SUS), the National Policy for Integrative and Complementary Health Practices (PNPICS) was implemented, through Ordinance 971, of May 3, 2006, and Traditional Chinese Medicine/Acupuncture, Homeopathic Medicine, Phytotherapy and Thermalism were inserted in the SUS (BRASIL, 2006). After the results obtained in several states, fourteen other activities were incorporated into the PNPIC through Ordinance 849 of March 27, 2017. They are: Art Therapy, Ayurveda, Biodance, Circular Dance, Meditation, Music Therapy, Naturopathy, Osteopathy, Chiropractic, Reflexotherapy, Reiki, Shantala, Integrative Community Therapy and Yoga.

Almost a year later, on March 21, 2018, the Ministry of Health published Ordinance No. 702, amending Consolidation Ordinance No. 2/GM/MS, of September 28, 2017, to include new practices in the PNPIC. They are: Aromatherapy, Art Therapy, Bioenergetics, Family Constellation, among others. Thus, to date, 29 integrative practices can be offered in the SUS, including Aromatherapy. This reality makes Brazil a leading position in the provision of these therapies (BRASIL, 2018).

Among the practices, aromatherapy is the one that uses essential oils extracted from aromatic plants for the treatment of clinical symptoms and the promotion of the well-being and health of the individual by integrating body, state of mind and mind. It is admitted that the benefits of aromatherapy are due to the characteristic and particular chemical constituents of essential oils, many of which have an action in relieving stress and anxiety. The name of the aromatherapy practice comes from the combination of the words aroma, which means aroma or smell, and therapy, which means treatment (DIAS, 2019).

In this sense, it is possible to glimpse, in the search for non-pharmacological strategies to cope with anxiety and improve quality of life, which is one of the benefits of Integrative and Complementary Health Practices (ICPs). It is noted that complementary therapies approach the subject holistically and are represented by safe, non-invasive and cost-effective techniques, listed in the co-responsibility between the professional and the user. Lavender oil is a widely used essential oil that is extracted from the Lavandula angustifolia plant, known as true lavender or English lavender. This oil is used in alternative therapies to promote beneficial effects in relation to anxiety. Lavandula angustifolia is the scientific name of the lavender plant, from which the oil for aromatherapy is extracted, working in a holistic and scientifically proven way to offer the essential oils to individuals (Patsalis et al., 2022).

The form of extraction of this oil is obtained by steam distillation of the flowers of the lavender plant, the flowers are harvested when they are in full bloom, and water vapor is used to extract the volatile components. The oil also has a floral, sweet and fresh aroma and has relaxing, soothing properties which is why it is widely used in aromatherapy (Giuliani et al., 2020).

Among the variety of medicinal plants, the genus of Lavandula belongs to the Lamiaceae family, with 28 different species it has stood out for centuries in the cosmetic industry and for its therapeutic effects (Cavanagh, Wilkinson, 2002). Its therapeutic effects vary according to the concentration of the compounds present in its species, such as camphor, terpinen-4-ol, linalool, linalyl acetate, beta-ocimene, and 1,8-cinelol (Ali et al., 2015; Bouazama et al., 2017; Justus et al., 2018)

Studies have proven that using aromatherapy with lavender oil generates anxiety reduction, sedative, antidepressant, calming, antispasmodic, analgesic, antibacterial and antifungal effects. Human studies using this oil have shown reduced levels of anxiety and stress in different contexts (Ebrahimi et al., 2022; Genc & Saritas, 2020).

As anxiety generates an activation of the sympathetic autonomic nervous system, causing agitation and stress, and can be perceived through tachycardia, tachypnea, sweating, among others, lavender has an inhibitory action on the hypothalamic-pituitary-adrenal axis, thus reducing the release of cortisol, the stress hormone. On the other hand, it promotes the release of serotonin that acts on the feeling of pleasure and well-being (Karimzadeh et al., 2021).

In general, lavender oil is appreciated not only for its physical properties but also for its positive impact on emotional and mental well-being. By integrating lavender oil into self-care and aromatherapy practices, many people find significant benefits for their health and emotional balance.

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Non-pharmacological therapeutic approaches for the treatment of insomnia: An integrative review

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ABSTRACT

The advances made in medicine, through studies and research, can offer more and more effective treatments for various types of illness, both with the use of drugs and non-pharmacological treatments. With regard to insomnia, a disease characterized by difficulty sleeping and loss of circadian cycle quality, for a long time it was treated, in most cases, only with the use of drugs that remedied this condition, but did not act on the core of the disease and the real cause, only alleviating the symptoms. In addition, many drugs for the treatment of insomnia are addictive, leading patients to use them constantly. The integrative review aimed to identify non-pharmacological treatment for insomnia, pointing out various methods used with patients, analyzing the treatment process, efficacy, clinical applicability and safety. Trustworthy and credible websites such as PubMed, LILACS and VHL were used to collect data and research sources, using the descriptors "Sleep Onset and Maintenance Disorder and Non-Pharmacological". In this way, relevant data, experiences and evidence were obtained for the analysis of non-pharmacological treatments for insomnia, among the various methods found. In conclusion, non-pharmacological therapeutic approaches represent a vital component in the treatment of insomnia, offering substantial benefits without the risks associated with prolonged use of medication. Their incorporation as part of an integrated and personalized treatment plan can significantly improve the quality of life of individuals affected by insomnia.

Keywords: Sleep onset disorders, Sleep Maintenance, Non-Medication.

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INTRODUCTION

At first, when a person is faced with an illness, one of the main thoughts that arises is what medication they will use to treat themselves, however, there are several non-pharmacological methods that are used to correct illnesses and, referring to insomnia, this article will discuss some non-pharmacological treatments, such as acupuncture, medicinal plants, physical exercise and cognitive-behavioral therapy. In relation to physical activity, studies carried out with patients who didn't practice any sport and sought treatment for insomnia, were recommended to start practicing some physical activity, after some time, engaged in sports, new tests were carried out and noted an improvement in the insomnia condition of patients who opted for this type of treatment[1].

With regard to the use of medicinal plants, a number of advantages have been noted in their use, such as improvement in the condition of insomnia without any use of drugs that cause chemical dependency, but with medical supervision to guide which plants should be used and the effects on the patient's body, taking extreme care with the patient's health[2]. Cognitive-behavioral therapy combines cognitive, behavioral and emotional techniques for the treatment of insomnia, and is recommended for treatments without comorbidities, both in acute and chronic cases, with good efficacy that can last up to a year[3,4].

However, there are some techniques that help to treat insomnia while maintaining patients' health, methods that will be explained in detail throughout this article, clarifying and bringing recent studies that prove these methods. The integrative review aimed to identify non-pharmacological treatment for insomnia, pointing out various methods used with patients, analyzing the treatment process, efficacy, clinical applicability and safety.

MATERIALS AND METHODS

This study is an integrative review, a type of systematic bibliographic review, which is defined as a careful search and evaluation of what is being debated in the literature on a specific topic. It was therefore carried out in six processes: 1) determining the topic and choosing the central research question; 2) establishing inclusion and exclusion criteria; 3) establishing the data to be extracted from the selected studies; 4) categorizing the studies; 5) analyzing the studies included in the integrative review and interpreting them; 6) demonstrating the review1.

At the start of the process, the central question that guided the current research was determined: "What are the non-pharmacological treatment strategies for treating insomnia?".

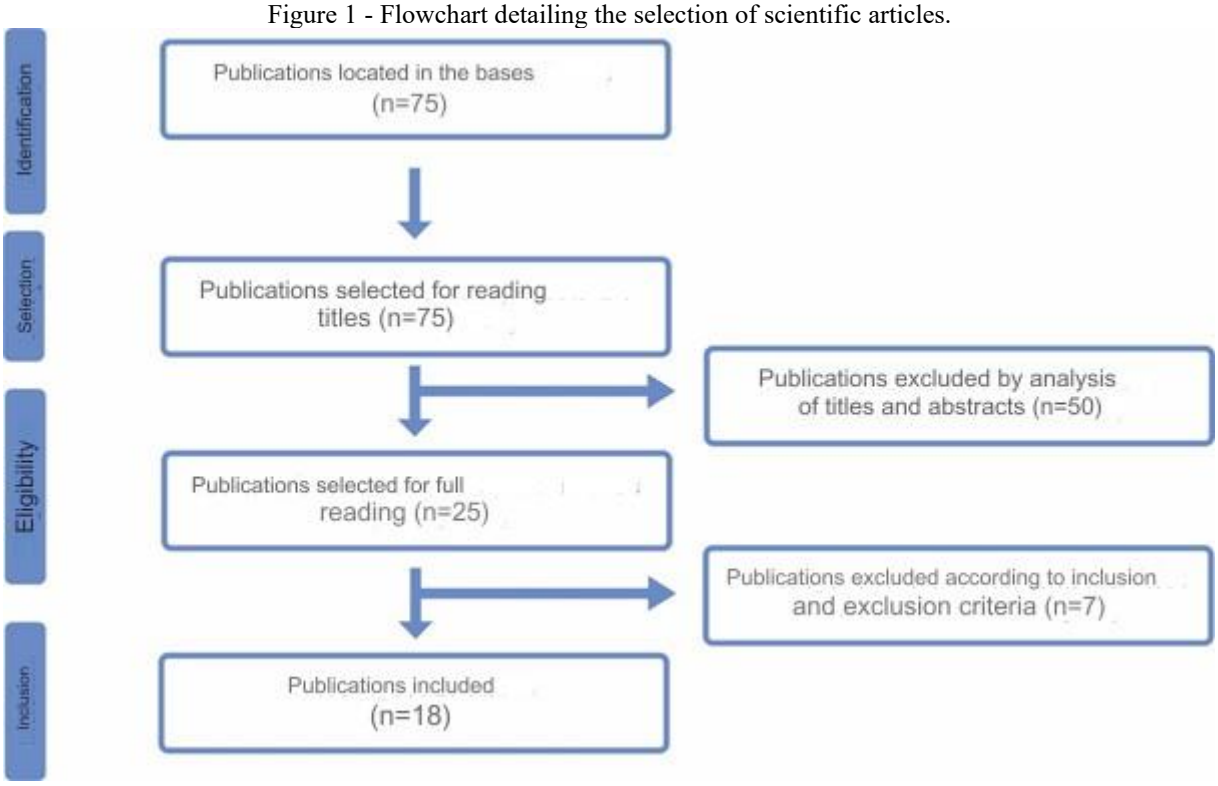
In order to answer this question, a search was made for studies related to the idealized result using Health Sciences Descriptors created by the Virtual Health Library. The descriptors used were: Sleep Onset and Maintenance Disorders. The search was carried out during the month of March 2024, using the following databases: Virtual Health Library (VHL), Scientific Electronic Library

Online (SciELO), National Library of Medicine (PubMed) and Latin American and Caribbean Health Sciences Literature (LILACS).

Thus, the inclusion criteria were restricted to research written in Portuguese and English, published between 2019 and 2024, which represented the current subject, and were accessible electronically in their complete form. The exclusion criteria were studies which were not in English or Portuguese, which were published before 2019 and those which did not provide a range of information about sleep onset and maintenance disorders, as they did not fit the criteria listed.

After the initial selection of research, 75 were identified and evaluated based on the established criteria, by reviewing the titles and abstracts of the articles. As a result of this process, 25 articles were chosen to proceed to the next stage of the survey. These articles were then carefully examined, again taking into account the inclusion and exclusion criteria. As a result, seven studies did not meet the inclusion criteria and were excluded. Therefore, 18 articles were selected for the final assessment and compilation of the review in question. In addition, the data from these selected studies was filed to ensure that the most relevant information was collected (Figure 1).

Figure 1 - Flowchart detailing the selection of scientific articles.



RESULTS

Among the 18 scientific articles that were obtained from searches on the VHL, Pub Med and SciELO platforms, the Portuguese language predominated (77% n=14) and the predominant year of publication was 2019 (33.3% n=6), followed by 2023 (22.2% n=4). Of the 18 studies included in this review, 100% (n=18) deal with the non-pharmacological treatment of insomnia, which includes

acupuncture, medicinal plants, physical exercise and cognitive-behavioral therapy. In addition, 89% (n=16) of the studies looked at adults diagnosed with insomnia without other comorbidities. The remainder (11.1%; n=2) included a person with an anxiety disorder and the other study included people with hypertension (Table 1).

Table 1 - Overview of the studies included in this integrative review on therapeutic approaches for the treatment of insomnia.

AUTHOR/YEAR	MAIN FINDINGS
Davidson et al. (2019)[5]	In general, Cognitive-Behavioral Therapy for Insomnia (CBT-I) is gradually being integrated into primary healthcare systems that promote interdisciplinary teamwork. This review highlighted some variation in intervention components, sleep disorder screening and CBT-I training of healthcare providers - all of which are potential moderators that require further investigation. Future studies should use standardized sleep measures, assess daytime symptoms, and examine the impact of gradual hypnotic reduction interventions delivered as part of CBT-I programs for primary care patients.
Espien et al. (2019)[6]	The results of this conclusive study suggest that Digital Cognitive-Behavioral Therapy (DBT) is not only effective in reducing insomnia symptoms, but also demonstrates wide-ranging positive effects, including improved functional health, psychological well-being and sleep-related quality of life in people who screen positive for insomnia disorder. In addition, the reduction of insomnia symptoms plays a mediating role in these benefits. These results indicate that CBTd benefits both the daytime and nighttime aspects of insomnia, further reinforcing the clinical guidelines' recommendation that CBT is the preferred treatment for insomnia.
Passos et al. (2019)[1]	The results indicate that there was a significant reduction in total scores from the first to the second collection, reflecting an improvement in sleep quality for all participants, regardless of the regularity of physical activity.
Bichara et al. (2019)[7]	Participation in the workshops gave the population access to simple and practical information to improve sleep quality. The implementation of non-pharmacological measures for insomnia not only reduces the use of potentially inappropriate medication and the costs associated with complications such as falls and fractures, but also relieves the health system financially Ferreira; Yoshitome, 2010; Cassoni, 2011; Leira Pereira et al., 2012; Friestino; Freitas, 2016) apud Bichara et al.[7] However, the lack of adherence of health units to the project limited the target audience's access to this information. In addition, understanding the information on the leaflets may have been hampered by the high illiteracy rate and visual problems in part of the population.
Souza et al. (2019)[8]	Adolescents undergoing treatment for insomnia using Cognitive-Behavioral Therapy (CBT) techniques showed significant improvements in several aspects, such as reduced anxiety (60%), faster sleep onset (60%), increased sleep quality (80%), reduced daytime sleepiness (60%) and relaxation (10%). According to Blake et al. (2017), adolescents showed changes in planning, decreased worry, muscle tension and autonomic activity after treatment for anxiety and insomnia. The main treatments identified in the studies include mindfulness (60%), sleep hygiene (60%), stimulus control (60%), sleep hygiene and education (40%), psychotherapy (40%), cognitive restructuring (20%) and drug treatment (20%). According to Blake et al. (2016), there is still much to be explored about CBT interventions in adolescent sleep.
Loio et al. (2020)[9]	Cognitive therapy aims to instruct patients to change their negative thoughts and prepare them to face their fears. Stimulus control therapy focuses on extinguishing inappropriate behaviors before bedtime, while sleep restriction therapy establishes a restricted sleep schedule to improve sleep.

	Relaxation is used to reduce somatic tension and control the mind, while sleep hygiene is key to improving insomnia in the long term. Phototherapy promotes sleep by synchronizing the biological clock with natural light. Acupuncture and herbal medicine are alternatives for improving sleep, although there are gaps in the research on their effectiveness.
Neves et al. (2020)[10]	Based on the results of this study, it is possible to state that patients with hypertension who exercise regularly have less severe symptoms of insomnia and depression, as well as a better quality of life in terms of functional capacity and vitality, compared to those who are physically inactive. In addition, it was observed that the less severe the participants' insomnia complaints, the better their mood profile and quality of life. Future research of an experimental nature, investigating the effects of long-term physical exercise on the sleep and mood of patients with hypertension, is needed to confirm the conclusion that regular physical exercise can lead to a reduction in the severity of insomnia complaints and, consequently, improvements in the mood and quality of life of these patients.
Rogério et al. (2021) [2]	Insomnia is common in Brazil and the use of sedative medicinal plants is popular. A study analyzed the popular and scientific names, indications and risks of plants such as lemon balm, passion fruit, valerian, hops and lavender. Chamomile is safe and effective, unlike hypericum, kava-kava and valerian, which require a prescription due to adverse effects. More research is needed on the use of these plants for insomnia, emphasizing the importance of guidance on their proper use for health and economic benefits.
Sobral et al. (2021)[4]	Cognitive-Behavioral Therapy for Insomnia (CBT-I) is recommended as a first-line treatment for insomnia without comorbidities, in both acute and chronic cases, with positive results that can last up to a year. When there are comorbidities, its effectiveness varies: while in association with anxiety the results tend to be lower, in the presence of depression they are more promising. CBT-I also stands out for offering better outcomes in daytime symptoms and the absence of side effects, and is preferred by the majority of patients. Comparative studies between CBT-I and pharmacological treatment with benzodiazepines show comparable efficacy in the short term, but in the long term the therapy is considerably superior. The combination of CBT-I with zolpidem as medication has more favorable results in the acute phase of treatment, but CBT-I alone shows better results in the maintenance phase, especially when associated with discontinuation of medication, resulting in a reduction in symptoms in 60% of cases and remission of the condition in 40%. In addition, there is clear evidence of a reduction in the severity and frequency of migraines associated with insomnia in patients treated with CBT-I. Despite its proven effectiveness, CBT-I is still underused and often inaccessible in Primary Health Care in Brazil. Studies suggest the benefits of non-pharmacological treatment, including CBT-I and acupuncture, but the lack of access to these therapies in PHC hinders their use, despite their essential role in the proper management of insomnia. It is essential that family doctors are aware of the best therapeutic options, avoiding inappropriate prescriptions of psychotropic drugs and referring cases of secondary insomnia for specialized evaluation.
Neves Júnior et al. (2021)[11]	Cognitive-Behavioral Therapy (CBT) is a brief, structured therapeutic approach that aims to solve current problems and modify dysfunctional thoughts and behaviors. According to Beck et al.[12], the cognitive model suggests that dysfunctional thinking is common to various psychological disorders, and by learning to evaluate their thoughts more realistically, people can improve their emotional and behavioral state. By offering psychoeducation, CBT seeks to make patients understand the mechanisms of their condition, actively involving them in the therapeutic process. In anxiety disorders, CBT seeks to readjust cognition to influence emotions and behavior. For example, in insomnia, CBT aims to identify and confront specific dysfunctional thoughts related to the sleep disorder, addressing beliefs and behaviors that interfere with sleep quality through strategies such as stimulus control therapy, sleep restriction, sleep hygiene, relaxation training and cognitive therapy. When treating insomnia, the therapist

	focuses not only on changing lifestyle habits that affect sleep, but also on readjusting the patient's thoughts to promote effective improvement.
Lopes et al. (2022)[13]	Nineteen clinical studies were analyzed which indicated that moderate-intensity aerobic and neuromotor exercise is beneficial for sleep quality as assessed by subjective scales. While objective sleep parameters such as total duration, latency and efficiency did not show evident improvements, the results showed that the weekly frequency of exercise sessions is directly related to improvements, being more significant with a greater weekly time investment. Notably, exercise programs with shorter follow-up (<15 weeks) showed more improvements, in contrast to the loss of benefits over time due to dropouts and irregularities in practice. One study highlighted that exercise carried out in the morning had superior advantages in terms of sleep quality compared to exercise carried out in the evening. Finally, it was observed that exercise benefits sleep quality in patients with diseases only when adapted to the patient's individual energy capacity.
Forma et al. (2022)[14]	The recommendation by the American College of Physicians and the American Academy of Sleep Medicine (AASM) for Cognitive-Behavioral Therapy for Insomnia (CBT-I) as a first-choice treatment is not only based on the proven benefits of CBT-I, but also on its superior safety profile compared to pharmacological agents. Many medications present safety concerns, such as rebound insomnia, next-day sedation, increased errors in driving tests, addiction and increased risk of falls and confusion (especially in the elderly). On the other hand, CBT-I has a more favorable safety profile compared to medication, as well as a greater likelihood of remission of chronic insomnia symptoms. However, its use is limited by the systemic barriers mentioned above. To address the challenges related to access to CBT by qualified professionals, alternative forms of delivery have been developed, such as telephone-based interventions and, more recently, online platforms and mobile apps, which have the potential to broaden access to CBT-I and increase the availability of guideline-based interventions for chronic insomnia.
Benz et al. (2023)[15]	This exhaustive survey analyzes insomnia symptoms as a risk factor for various physical disorders in a systematic way and with a pre-registered protocol. The results show that insomnia symptoms increase the risk of developing cardiovascular disease, hypertension and thyroid cancer. In addition, these symptoms may contribute to a greater susceptibility to obesity, cognitive decline and dementia, although the conclusions are divergent and inconclusive in this respect. On the other hand, there does not seem to be an association between insomnia symptoms and an increased risk of mortality. This issue is extremely important, as such findings suggest that early and effective treatment of insomnia symptoms can play a crucial role in prevention, as appropriately proposed. Several international clinical guidelines recommend Cognitive-Behavioral Therapy for Insomnia (CBT-I) as the main approach to treating insomnia disorder. However, this therapy is still underutilized in many countries, including those that do not value psychological interventions in primary care. A significant effort to improve the implementation and dissemination of this intervention could not only reduce the high prevalence of insomnia, but also decrease the risk of negative health impacts.
Zhao et al. (2023)[16]	The aim of this systematic review was to identify and assess the quantity and quality of complementary and alternative therapy (CAM) recommendations in clinical practice guidelines for the treatment of insomnia. The intention is to help clinical professionals, especially those with little experience of CAM, to identify reliable, evidence-based therapeutic options. However, it was found that there are few high-quality CAM recommendations in these guidelines, which hinders communication and decision-making between patients and healthcare professionals. Despite this, the use of CAM is significant, with a substantial portion of the population turning to these therapies, especially in Asian countries. Melatonin, valerian and acupuncture are the most commonly used CAM therapies for insomnia, although some guidelines advise against the use of kava. In addition, other therapies popular with insomniacs, such as mental relaxation imagery, St. John's wort and spiritual healing, were not addressed

	in the guidelines reviewed. This gap between clinical use and clear recommendations in the guidelines can make it difficult for healthcare professionals to understand the benefits and risks of different CAM modalities, hindering shared decision-making with patients. This highlights the importance of considering patients' preferences and bridging the gap between clinical use and the guidance in guidelines.
Simon et al. (2023)[17]	Currently, Cognitive-Behavioral Therapy for Insomnia (CBT-I) is poorly accessible in healthcare systems. Alternatives such as self-help therapy, like iCBT-I and guided bibliotherapy, can help increase the availability of CBT-I. Medium to large effects observed in iCBT-I and guided bibliotherapy suggest that these self-help approaches may be a viable alternative when face-to-face therapy options are not available. Thus, self-help interventions can complement care and reach patients who would otherwise not have access to CBT-I or would refuse treatment in conventional settings. Although this study did not show superiority between the different settings, face-to-face CBT-I, in particular face-to-face (F2F), groups and telehealth, showed the greatest effects. Given the magnitude of these effects and the solid evidence base for face-to-face CBT, this approach should be considered as the first treatment option. Therefore, it is crucial to improve the availability of face-to-face CBT as a priority to improve global health related to insomnia.
Campos et al. (2023)[18]	Despite the short-term efficacy of both pharmacotherapy and CBT-I in the treatment of insomnia, recent studies suggest that CBT-I is the preferred treatment due to its more consistent medium- and long-term results and lower risk of adverse effects, with pharmacotherapy being considered when it is not possible to access or adhere to CBT-I, or in the event of therapeutic failure. Unfortunately, in primary care practice, sleep hygiene and pharmacotherapy are widely used to the detriment of CBT-I due to their scarcity in public services, resulting in a clear gap between recommended best practices and the reality of clinical care.
Bezerra et al. (2024)[3]	Cognitive-Behavioral Therapy for Insomnia (CBT-I) is a highly effective approach that combines cognitive, behavioral and educational techniques to treat chronic insomnia. By modifying negative thought patterns and promoting healthy sleep habits, CBT-I improves sleep quality and reduces dependence on sleep medications. This integrated and personalized approach is seen as the future of insomnia treatment, seeking more effective and lasting results to improve the quality of life of those suffering from sleep disorders.

DISCUSSION

Due to the magnitude of studies on insomnia and its symptoms, some authors have sought to understand the relationship between insomnia and the risk of developing physical disorders. Simon et al. (2023)[17] analyzed the risks of developing cardiovascular diseases (myocardial infarction; coronary heart disease and others); hypertension and thyroid cancer due to insomnia, and the data obtained confirmed the relationship. The study analyzed the risk of dementia and obesity, but did not obtain complete data. The risk of mortality was also observed, but was disregarded. Forma et al. (2022)[14] states that insomnia is also related to the risk of depression, Alzheimer's and chronic pain, as well as hypertension and cardiovascular diseases. Thus, with the advances in studies on insomnia and its symptoms, it has been necessary to observe and analyze treatments for sleep disorders.

The forms of treatment for insomnia analyzed were Cognitive Behavioral Therapy, the use of physical exercise and medicinal plants. Several studies have shown the importance of cognitive behavioral therapy (CBT) for the treatment of insomnia. Bezerra et al. (2024)[3], Sobral et al. (2021)[4];

Neves et al. (2020)[10] , Souza et al. (2019)[8] , Forma et al. (2022)[14]; Davidson et al. (2019)[5]; Espien et al. (2019)[6] state that CBT is the best long-term therapy and is considered first-line treatment for people without comorbidities, seeking to offer a better quality of life for the individual and without dependence on drugs or side effects. Bichara et al. (2019)[7]; Campos et al. (2023)[18]; Sobral et al. (2021)[4] point out that even with the quality of CBT-I, its supply is still not optimal due to the lack of adherence to CBT-I in health units, reducing the adequacy of this therapy, which is why the use of drugs in areas with scarce public resources is more recurrent. Bichara et al. (2019)[7] the author also brings up the idea of the importance of using CBT to reduce spending on medication and provide peace of mind for the financial health system.

Another non-drug treatment for insomnia analyzed was the use of physical exercise. Passos et al. (2019)[1]; Lopes et al. (2022)[13]; Neves et al. (2020)[10] The authors report that physical exercise helps to improve sleep and quality of life, improving functional capacity and vitality. The author Neves et al. (2020)[10] states that patients with hypertension and insomnia who exercise regularly have fewer symptoms than patients with the same comorbidities who do not exercise.

The last form of non-drug therapy analyzed is the use of medicinal plants to control insomnia. It is known that in Brazil the use of medicinal herbs has been present for many centuries and the use of this form of care is present in everyday life, so there is a need to analyze the types of plants that can help with sleep disorders. Thus, the author Rogério et al. (2021)[2] presents the herbs most used by Brazilians and their qualities and risks, the herb that brought the most quality to the care of sleep disorders was chamomile. However, there are still not many studies relating herbs to the treatment of insomnia, making it difficult for professionals to prescribe their use to their patients. Thus, the author Zhao et al. (2023)[16] did not obtain concrete data on the use of plants as an alternative therapy for sleep disorders.

The conclusion drawn from the authors used is that the best therapy to use is CBT and physical activity because it helps efficiently and responsibly, improving the quality of life of individuals.

The author Sobral et al. (2021)[4] relates CBT-I therapy with the use of benzodiazepines, which showed considerable results in the short term, but CBT in the medium and long term was the best way to treat insomnia. Thus, CBT needs improvements in investment in health to expand and improve its quality, but it remains the best form of non-pharmacological therapeutic approach.

According to the authors Passos et al. (2019)[1]; Lopes et al. (2022)[13]; Neves et al. (2020)[10], physical activity helps completely and improves not only the quality of sleep, but the quality of life as a whole.

The use of medicinal plants is positive, but there have not yet been many studies on the subject, as cited by the author Zhao et al. (2023)[16] the lack of information hinders communication and decision-making between patients and health professionals.

CONCLUDING REMARKS

This article extensively reviewed the current literature on non-pharmacological therapeutic approaches for the treatment of insomnia, emphasizing the efficacy and applicability of various modalities, including cognitive-behavioral therapy for insomnia (CBT-I), relaxation techniques, sleep restriction therapy, sleep hygiene, among others. The studies reviewed consistently demonstrate that these interventions show promising results in the management of insomnia, offering safe and effective alternatives to pharmacological treatment. CBT-I stood out as the most effective approach, due to its more consistent medium- and long-term results and lower risk of adverse effects, contributing significantly to improved sleep quality, reduced sleep latency time, increased sleep efficiency and reduced wake time after sleep onset. Relaxation techniques, including mindfulness meditation and autogenic training, have also been shown to be beneficial, helping to reduce anxiety and promote relaxation, facilitating sleep induction. However, sleep hygiene and pharmacotherapy end up being the most used practices to the detriment of CBT-I due to their scarcity in public services, which leads to a gap between recommended practices and clinical reality. It is important to stress, however, the need to individualize treatment, taking into account the particularities and preferences of each patient, as well as the possibility of combining different therapeutic approaches to optimize results. In addition, the implementation of health education on sleep hygiene in community and clinical settings can serve as an effective preventative measure, minimizing the incidence of insomnia in the general population. In addition, the implementation of non-pharmacological measures reduces the inappropriate use of medication and the associated costs, which relieves the health system financially.

Finally, there is a need for more high-quality research to explore the potential of new non-pharmacological therapeutic approaches and evaluate the long-term effectiveness of existing interventions. Future research should also focus on developing strategies to facilitate patient access to these therapies, considering the current barriers related to costs, availability of qualified professionals and lack of awareness about non-pharmacological alternatives.

In conclusion, non-pharmacological therapeutic approaches represent a vital component in the treatment of insomnia, offering substantial benefits without the risks associated with prolonged use of medication. Their incorporation as part of an integrated and personalized treatment plan can significantly improve the quality of life of individuals affected by insomnia.

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