CHANGES IN SPINAL ALIGNMENT AND PHYSIOTHERAPY TREATMENT APPLIED TO SCOLIOSIS: A SYSTEMATIC LITERATURE REVIEW

ABSTRACT: Nowadays, the number of people complaining of back pain is increasing, but this pain is associated with scoliosis. However, scoliosis can be defined as the spine curving sideways, forming an "S" or "C" shape. However, there are several types of scoliosis: congenital, idiopathic, neuromuscular and degenerative. The most common is idiopathic scoliosis, which mostly affects children and adolescents, while congenital scoliosis is present at birth due to malformation of the spine. Neuromuscular scoliosis, on the other hand, affects the individual's neurological or muscular condition, followed by degenerative scoliosis, which develops in adulthood or the elderly and is caused by wear and tear on the spine. The aim of this study is to understand the forms of physiotherapy treatments applied to scoliosis. Subsequently, the physiotherapeutic treatments for this pathology include techniques such as RPG (Global Postural Reeducation), Pilates and waistcoats. RPG is a method that seeks to re-educate posture through stretching and muscle strengthening, while Pilates focuses on strengthening and improving flexibility. In addition, the back brace is used to align the spine during treatment. These treatments are aimed at a wide range of people, from children to teenagers, adults and the elderly, depending on the type and severity of the scoliosis. The benefits include improved posture, pain reduction and muscle strengthening. In conclusion, the results of physiotherapy treatment for scoliosis can vary from person to person, but many patients report a significant improvement in their quality of life, a reduction in the progression of the curvature and pain relief. Finally, treatment should be personalised and monitored by qualified professionals.

KEYWORDS: Scoliosis, physiotherapy, RPG, Pilates, Milwaukee waistcoat.

INTRODUCTION

This article has the theme: Changes in Spinal Alignment and Physiotherapeutic Treatments Applied to Scoliosis: A Systematic Review of the Literature, the article will delve into the benefits and also the physiotherapeutic treatments of scoliosis, emphasizing the improvement of the patient's condition.

As mentioned by Ana and Damiana (2022), scoliosis can go unnoticed initially, with no visible symptoms. However, as the condition progresses, some signs of potential scoliosis may appear, such as inequality in the shoulders or hips, affecting the shape of the waist; tilting of the body to one side due to the abnormal curvature of the spine; more obvious collarbone; Tiredness and discomfort in the back when sitting or standing for long periods, due to the extra

pressure on the spine.

This research aimed to understand the physiotherapy treatments applied to scoliosis. Based on this research, it was identified that the most effective methods for treating scoliosis are: RPG, Pilates and the use of the Milwakee Vest. Pilates has been widely used by physiotherapists to treat various conditions. However, this method is fundamental for patients, as it provides various benefits for rehabilitation and strengthening the body. It can be adapted to meet the needs of each patient (SILVA *et al*., 2022).

Global postural re-education (GPR) is a type of physiotherapy treatment that uses posture and body stretching. This method aims to treat various conditions through an approach that considers posture and musculature in an integrated way in order to provide a more effective and safe treatment [21-23]. In addition, this technique is used to promote pain relief and improvements in posture, contributing to the individual's rehabilitation and well-being (SILVA *et al*., 2022).

However, the treatment of scoliosis can involve different approaches, including the severity of the curvature, the likelihood of progression and the patient's age. In some cases, the use of a Milwaukee brace is recommended, while in more severe cases, surgery may be necessary (PEREIRA *et al*., 2012).

THEORETICAL FRAMEWORK

The theoretical framework of this research was structured as a systematic literature review. In summary, each subtopic seeks to understand scoliosis and physiotherapy treatments. Ten main topics were then selected which emphasize the theme and which contributed to the authors' perspectives.

The structure of the spine

The spine is one of the main structures of the human body. It is a flexible, bony shaft made up of overlapping structures called vertebrae (SANTOS *et al.*, 2021, p. 82. *apud* BERVIAN, 2022, p. 2). It protects part of the central nervous system, the spinal cord, which is contained in the spinal canal. There are mobile structures in the spinal column, which are: the vertebrae and

intervertebral discs, the ligaments and the muscles, thus making the spinal column totally flexible and stable, and this whole structure promotes the support of bipedal posture (COSTA; DE OLIVEIRA, 2014, p.17 *apud* SOUZA, 2017 p.13).

However, the spine has the function of supporting the body structure, protecting the spinal cord, moving the body and walking. In order to maintain an upright position, all the regions of the spine from the occiput to the sacral region are connected and muscles and ribs are inserted. In the spine, we can observe flexion-extension, lateral-lateral inclination and rotational movements (VALENÇA, 2003, p.17 *apud* SOUZA, 2017 p.13). These movements are very important for the flexibility of the spine, which is why it is so important to have the correct posture when sitting, squatting, carrying weights, etc.

The vertebrae are joined together by intervertebral discs, which are fibrocartilaginous structures, as well as ligaments and muscles that support the spine. This entire structure is divided into the cervical spine (7 vertebrae), the thoracic spine (12 vertebrae), the lumbar spine (5 vertebrae), the sacral spine (5 fused vertebrae) and the coccygeal spine (4 fused vertebrae), totalling 33 vertebrae (ALBUQUERQUE *et al.*, 2019 p.82 *apud* BERVIAN, 2022 p.2). Therefore, all these vertebrae connect this bone structure that supports our body so that our posture is upright, that is, it is well aligned, without the need for physiotherapy treatment, however when it presents alterations in them, it needs a pre-diagnosis, that is, hypotheses that can be diagnosed by a scoliosis. However, the vertebrae support most of the weight applied to the spine, in addition to our capacity for movement and flexibility, and also play a crucial role in maintaining the body's balance (BERVIAN, 2022).

Therefore, with all this physiological engagement related to the spine, scoliosis, for example, is a pathology that occurs in the spine, which occurs by type of deviation or abnormal curvature of this structure, which has aesthetic and / or physiological effects, which can have serious long-term consequences for the individual carrier (CRISTANTE *et al.*, 2021 p.82 *apud* BERVIAN, 2022 p.2). This scoliosis abnormality demonstrates how the individual's posture looks in a possible diagnosis.

Individual's posture

According to Santos (2009 *apud* SOUZA, 2017 p.21), the position and attitude of the static body or its harmonious arrangement of body parts in movement characterises the individual's posture, and for good posture it is necessary for the ligaments, capsules and muscle tone to support the upright body, also promoting the permanence in the same position for long periods, without discomfort and with little energy consumption.

Ritter (2006 *apud* SOUZA, 2017, p.21) also suggests that posture cannot only be referred to as the force exerted on certain muscle groups, it is also determined by the human being's motivations and the way in which they perceive it, stating that perception is the body's communication with the world, and that the body is the centre of action. As such, the perception of posture is the image formed by the individual of their own body. Since this body carries a whole load, often of weights, which its spine can't bear, it triggers pain, changes in the spine, in other words, a misalignment of the spine causing scoliosis for this individual.

However, proper posture is essential for the body to function properly, otherwise the muscles will stop performing their primary function, which is to maintain the body's balance, and will become unbalanced due to overloads in certain joints, causing pain and poor posture (FERST, 2003 p.21 *apud* SOUZA, 2017 p.19). However, when we maintain good posture, the muscles are able to perform their functions effectively, while incorrect posture can lead to muscle imbalances. This is technically known as scoliosis and is a pathology related to changes in the spine.

Scoliosis

Several concepts are emphasised about scoliosis, however this one is defined as a highly complex deformity of the spine characterised by a three-dimensional deviation generating generalised torsion in the spine (SEGURA *et al*., 2011 p.2 *apud* SANTOS, 2021, p.2). In order to understand how this

deviation of the spine appears in individuals and how it affects the structure of the body, we will describe scoliosis through two groups.

Scoliosis is divided into two groups: functional or non-structural scoliosis and structural or morphological scoliosis. In functional scoliosis, the curve is flexible because the deformity has not yet set in, i.e. it doesn't affect the bone structures, only the muscles. In the structural type, the curvature has already reached and is fixed in the vertebrae. In structural scoliosis, there is an elevation due to the rotation of the vertebrae which is called gibbosity (FREITAS; MEDEIROS; CÂMARA, 2020 p.2 *apud* GONÇALVES, *et al* 2023, p.2).

However, scoliosis has several degrees, i.e. it indicates the severity of this pathology, which according to Kisner and Colby (4) (1992 *apud* PETRINI, 2015, p.18) the classification is described by its severity, being: mild (between 10º and 20º); moderate (between 20º and 40º) and severe (greater than 40º or 50º). However, scoliosis has several alterations, one of which, caused by these deviations, is scoliosis, whose curvature is in the shape of a "C" or "S", the largest of which should be considered primary. The most common are right thoracic and left lumbar scoliosis (SALATE, 2019; BORGHI *et al.,* 2008, p.135 *apud*DA SILVA *et al.,* 2022, p.2).

However, the curvature can be located in different areas of the spine, and can even manifest itself in more than one area of the spine. This type of pathology can arise for genetic reasons, i.e. the person is born with this dysfunction, or they can acquire it over time due to bad posture (ARAÚJO *et al.*, 2012 p.82 *apud*BERVIAN *et al.,* 2022, p.2). Therefore, it is possible for the curvature to manifest itself in more than one region, it can be localised in the thoracic region of the spine (middle part of the back), the lumbar region (lower back), the thoracolumbar region which covers both the thoracic and lumbar regions and the cervical region of the spine (part of the neck). Scoliosis can therefore be congenital or acquired due to the various causes that contribute to the misalignment of the spine.

According to Bradford, Lonsteins and Moe (3) (1994 PETRINI, 2015, p.18), scoliosis is considered pathological when the curvature is greater than

10º, and can be classified as idiopathic, neuromuscular, congenital and adult. Similarly, idiopathic scoliosis occurs during the growth phase and is divided into: infantile, juvenile and adolescent; while neuromuscular scoliosis is related to neurological conditions (e.g. cerebral palsy); congenital scoliosis is caused by bone anomalies present at birth; while adult scoliosis develops through the natural ageing of the spine, weight overload in people's daily lives and degeneration of the intervertebral discs.

Causes

These contributing causes are conditioned by inadequate postural habits carried out throughout life, combined with the asymmetrical use of the human body during functional activities, which can lead to an imbalance in the neuromuscular system and, consequently, postural alterations. Posturais deviations can result in temporary disorders or permanent changes to the ossos and soft tissues of the spine, which can lead to major restrictions in lung function. It is a deformity that affects a large number of adolescents during the crescimento phase, emphasising the need for better consciência and the acquisition of good posturais habits (FIORELLI *et al.,* 2014, p.5 *apud*SANTOS *et al,* 2023, p.5).

Therefore, the factors observed that aggravate scoliosis and can make it chronic are the inadequate posture observed in excessive study time, as well as the prolonged use of computers that also culminate in poor body positions and imbalance (SAMOYEDEM *et al*., 2017 p.3 *apud*SANTOS *et al.,* 2021 p.3).

In short, there is a major aggravating factor in people's daily lives, which is that weight overload affects the curvatures of the spine, and these suffer from structural changes, readjustment of the bones, ligaments and rigidity in the musculature so that the stabilisation of the body is maintained, thus making a defence mechanism (SABÓIA, 2008 p.22 *apud* SOUZA, 2017 p.19). In other words, this cause is acquired in adulthood, but also in adolescence when they start working early. However, acquired scoliosis is caused by this overload and poor posture, and many authors emphasise that scoliosis can be

detected through physical appearance, due to the signs mentioned above.

Signs and symptoms

According to Siqueira *et al.*, (2020 *apud* ARAÚJO *et al.,* 2022 p.2), scoliosis is not always obvious and only becomes apparent when the curve progresses significantly. Signs that may indicate pathology are: asymmetrical shoulders or hips (waist); trunk tilted to one side due to the lateral curvature of the spine; protruding collarbone; tiredness and back pain after sitting or standing for a long time.

Some of the signs described above can be seen by appearance, while others are felt in severe pain when they are reported to doctors and physiotherapists. However, it is necessary to carry out various tests, which can be used to detect scoliosis and assess the extent of the curvature of the spine. Some of these tests are: physical examination, x-rays, radiographs and magnetic resonance imaging or computerised tomography. Imaging tests can detect all types of scoliosis, such as idiopathic, neuromuscular, congenital and adult. However, these tests are essential for correctly diagnosing the curvature and describing the degrees of scoliosis.

Scoliosis diagnosis

Early diagnosis of the pathology allows for appropriate and effective treatment that can correct postural alterations, helping to maintain functions and slowing down their progression (FARIA *et al.*, 2021 p.7 *apud* GONÇALVES, 2023 p.7). In order to make the diagnosis, it is essential that the individual seeks medical attention very early on in order to prevent the progression of this pathology, avoiding the severity of the alterations in the spine.

A true assessment is the basis for efficient treatment and also for preventing complications. That's why it's essential to diagnose through a well-done anamnesis, with physical examinations, tests and x-rays. These are the most important steps in obtaining a meaningful result (BORGES *et al.*, 2019, p.7 *apud* GONÇALVES, 2023 p.7). These results are significant for starting

treatment for the various types of scoliosis, as well as for identifying the degrees that this pathology presents in view of the test results presented by the patients.

Therefore, in clinical assessment, scoliosis can be detected by the Adams Test, in which the patient tilts their trunk forwards with their hands joined, feet together and knees straight. The difference in height in the chest or any other asymmetries can signify the presence of scoliosis (BORGES *et al.*, 2019 p.7 *apud* GONÇALVES, 2023 p.7). This assessment is carried out by the physiotherapist, since it is their responsibility to apply the various types of treatment to reduce the alterations and symptoms of scoliosis.

Types of physiotherapy treatments for scoliosis

The role of the professional physiotherapist in health networks, in their therapeutic practice, is aimed at prevention, maintenance, development and restoration of the integrity of the physical functions and systems and organs of the human body. Their actions consist of planning, guiding and applying physiotherapeutic treatments, according to the needs of each patient, also aimed at preventing pathologies (FORNAZARI, 2005, p. 29 *apud* SOUZA, 2017 p.29). However, the role of the physiotherapist is of paramount importance in treating, guiding and preventing the correct posture of all patients with spinal deviations resulting from all types of scoliosis. To this end, various types of treatment are indicated to reduce the impact that scoliosis has on the quality of life of individuals affected by this pathology. This article presents some effective treatments for scoliosis:

Milwaukee waistcoat

The treatment of scoliosis depends on various factors such as the severity of the deformity, the likelihood of progression and age. In some cases the Milwakee brace is indicated and in others (more severe) surgery (GUNTA, 2004; BEERS, 2008 p.5 *apud* PEREIRA *et al.*,2012 p.5). This waistcoat is used for children and adolescents with mild scoliosis to correct the patient's posture, and is indicated for the treatment of idiopathic scoliosis.

If detected in adolescence, the type of conservative treatment chosen is the use of body armour, which can compromise the patient's quality of life (IUNES *et al.*, 2010 p.5 *apud* PEREIRA *et al.*,2012 p.5). The brace therefore consists of vertical metal rods that extend along the spine, as well as pads and straps to provide support and stabilisation in the thoracic and cervical regions. However, it helps to correct the abnormal curvature of the spine and maintain a more appropriate posture during the growth process.

According to Schiller, Thakur and Eberson (8) (2010, *apud* PETRINI, 2015, p.3), the Milwaukee waistcoat is prescribed for full-time use and during activities. In their study, other types of brace were described, including the Charleston, Boston, Providence and Spine-cor, and the study concludes that the younger the patient and the more inhibited the curve in the brace, the less need there is for surgical treatment. However, as this treatment aims to strengthen the back muscles and improve posture, it is important that the brace is fitted correctly and used as directed by the physiotherapist to ensure treatment is effective. Therefore, wearing a full body brace will bring more health benefits to this teenager, without having to undergo surgery and lengthy physiotherapy sessions.

RPG (Global Postural Reeducation)

RPG is a method of postural re-education founded in 1980 by French physiotherapist Philippe Emanuel Souchard. The principle of this technique is to treat pathologies that have morphological, articular, neurological, traumatic, respiratory and sports disorders. According to Souchard, RPG is defined as the correction of active posturas, isotônicas excêntricas of static músculos, with caution of dynamic músculos, always in joint decoaptation and gradually, increasingly global (SOUCHARD, 2016 p.7 *apud* SANTOS *et al.*, 2023 p.7). This treatment is indicated for adult, neuromuscular and idiopathic scoliosis, i.e. for all ages.

According to Baracat (2015, *apud* ARAÚJO, 2022, p.3), physiotherapeutic intervention in patients with scoliosis is considered functionally important, in which case the aim of physiotherapy is to minimise the

impact of the disease. Its effectiveness can be seen by reducing the effects of the disease and improving the function of the spine. Physiotherapy provides techniques that can be used as assistive technologies to help people concerned about quality of life achieve better results, such as global postural re-education. Physiotherapy is therefore indicated for all scoliosis treatments that seek to correct postural deviations and body functionality.

Since it covers a variety of techniques for correcting posturais alterations, RPG stands out for using posturas to promote stretching of the músculos in chains, avoiding assimcompensações, working on strengthening muscular and breathing, providing stretching muscular, recovery of joint amplitude, improvement of pain, improvement of consciência and body biomechanics, using posturas and estáticas, which will promote active global stretching, musculares contractions isotônicas excêntricas of the músculos andstáticos and with conservation of the dynamic músculos (SAMOYDEM; FERLA; COMERLATO, 2018, p.8 *apud* SANTOS *et al*., 2023, p.8). In short, this treatment brings several benefits to the individual's quality of life, such as: well-being, pain relief, improved injuries, ideal body posture, flexibility and muscle strengthening through postural exercises, as well as stretching techniques.

GPR is based on three principles, which are individuality, causality and globality, where it is applied that every patient is unique and that no one suffers in the same way, with no standard treatment, because the symptoms and symptoms are different, and one should not treat only the site of pain, treating the human being as a whole and not in parts (ARAÚJO *et al.,* 2022 p.9 *apud* SANTOS *et al.,* 2023, p.9). Thus, these principles of RPG are very important: individuality refers to the fact that each patient has unique physical, emotional and behavioural characteristics; in addition, this method makes it possible to create a personalised treatment programme for each patient; causality is related to the search for the causes of postural problems and not just the treatment of symptoms,Globalityrefersthe fact that the human body works as an integrated whole, not as isolated parts. This method considers the influence of different body systems (muscular, skeletal and respiratory) on posture and movement, seeking to promote global changes and not just localised

It will therefore strengthen postural tone, eliminate tension, among other things. The posturais alignments are guided by the physiotherapist, and are an individual treatment that has no age restriction, with indication for pessoas of any age group, based on técnicas and especificas in order to work on the estática musculature and correct postural alignment. In order to obtain sucesso in the treatment, it is necessary to detect the escoliose as early as possible, because in this way physiotherapy, using RPG, has a high potential for treating estática musculatura, helping with the implications of bad posture, preventing the ossos of the spine from stiffening or supporting it so that it doesn't accelerate its progression in the treatment of escoliose (ARAÚJO *et al*., 2022 p.9 *apud* SANTOS *et al*., 2023 p.9). Given the various techniques applied to the treatment of RPG by physiotherapists, there are different applications both for pain symptoms and for those without pain, meaning that care has to be personalised and differentiated for each patient, taking into account their needs and physical conditions.

For this reason, the treatment must be carried out individually according to each patient's treatment. During each session, the physiotherapist applies micro-adjustments in stretching in a series of delicated and progresive posturas (standing, sitting or lying down). The technique can be indicated without an age limit for different pathologies of the musquelético sistema, acute or chronic, with pain symptoms and also for those without pain (AZEVEDO *et al.,* 2022 p.10 *apud* SANTOS *et al.,* 2023 p.10).

We can see the importance of the posturas of RPG in promoting flexibility, improving posturais alterations, regaining musculoesquelético balance through stretching, muscular contraction and body consciência (PRADO 2019; SAMOYDEM; FERLA; COMERLATO 2018 p.10 *apud* SANTOS, *et al.,* 2023 p.10). Therefore, this treatment brings several benefits to patients and prevents future problems related to posture. In short, this method is non-invasive, it is a type of physiotherapy treatment that seeks natural alternatives to take care of postural health.

Pilates

Pilates is conceptualised as a muscle-strengthening exercise, which spread mainly in New York, using simple tools, a mattress for relaxing exercises, rehabilitation and mental training including the theories of Yoga with its variety of stretches, breathing and meditation, as well as including weight training, sports and ballet. This consists of performing the same movement in the same way repeatedly, corresponding to the anatomical exercise (FONSECA *et al.,* 2017 p.4 *apud* SANTOS *et al.,* 2021 p.4). It is indicated for the treatment of adult and idiopathic scoliosis, finally applied to all ages, since patients can perform this appropriate and individualised technique to meet their needs, and this treatment also brings numerous benefits to patients.

According to the author, the Pilates method has been widely used by physiotherapists in the treatment of various orthopaedic, rheumatological and respiratory pathologies, and is based on a concept called contrology (KOLYNIAK et al., 2004, p.5 *apud* DA SILVA et al,2022, p.5). However, Pilates treatment encompasses various pathologies. As it offers benefits to patients such as correcting posture, improving flexibility, i.e. stretching to maintain good body movement, it reduces pain and also helps to breathe correctly.

According to the author, Pilates exercises work on breathing, which activates the deeper muscles. Pilates aims to reduce the Cobb angle (BOUBEKEU; AMARAL, 2021, p.8 *apud* GONÇALVES,2023, p.8). Therefore, these physiotherapeutic treatments are effective for rehabilitating these patients, preventing injuries and improving well-being. Since each technique has its own particularities and benefits to meet individual needs, these treatments must be assessed and supervised by the physiotherapist, so that the individual has good success in the treatment of scoliosis.

MATERIALS AND METHODS

The systematic research on physiotherapy treatment applied to scoliosis was conducted with methodological rigour. Various methods were used to guarantee the validity of the study, ensuring the accuracy and reliability of the results. These meticulously designed and implemented steps not only aimed to guarantee the quality and robustness of the review carried out, but also sought

to establish a solid foundation for critical analysis, careful interpretation of the data and the eventual practical application of the findings obtained.

Definition of inclusion and exclusion criteria

During this stage of the process, a thorough analysis of the inclusion and exclusion criteria was carried out. We chose to keep articles published after 2011 that explored physiotherapy treatments for scoliosis, such as Global Postural Reeducation (GPR), Pilates and the Milwakee Vest. These choices were based on the comprehensive approach of these themes and the efficacy demonstrated in their respective treatments. On the other hand, materials that did not deal with the subject objectively, lacked clarity in the information presented or could not be found in their entirety were deliberately excluded.

Systematic literature search

The search was carried out using renowned databases such as Pubmed and Google Scholar, where 20 relevant articles were selected. Using keywords such as scoliosis, treatment, physiotherapy, pilates, RPG and waistcoat, the search was refined to cover specific and significant studies related to the topic. The diversity of these keywords allowed for a comprehensive and in-depth approach to the available scientific literature, contributing to a more complete and informative review of the topic in question.

Study selection

After carefully analysing the established inclusion and exclusion criteria, a careful selection was made, in which only the articles that met the predefined requirements were kept. These criteria included the year the articles were published, the nature of the systematic review they were submitted to and the reliability of the results presented. Based on this rigorous screening process, only studies that fully complied with these parameters were retained, thus guaranteeing the quality and relevance of the data analysed. This careful

filtering and selection stage ensured the consistency and validity of the information contained in the articles chosen, contributing to the soundness and reliability of the study in question. The rigorous selection of articles took into account not only the date of publication, but also the methodology used, the coherence of the results and their contribution to the subject being analysed. This selection process, based on well-defined criteria, was fundamental to guaranteeing the accuracy and relevance of the studies included in the research. The careful selection of these articles is essential for building a solid knowledge base and for the reliability of the findings presented in the study in question.

Synthesising the Results and Preparing the Systematic Review

After extracting the data, the research results were summarised, the information was compared and a systematic review was carried out to guarantee the reliability of the results. This led to the creation of a methodology to guide the systematic review of physiotherapy treatments for scoliosis. The approach was taken in order to obtain confidence in the results, so that there is an understanding of the subject, and the guarantee of conclusions as the treatment is presented.

RESULTS

Throughout the articles searched, it was identified that all were related to the keyword "scoliosis", and 35 searches were identified, since 20 articles were selected. The articles analysed in the Google Scholar (18 articles) and Scielo (2 articles) databases were read in detail, with the criterion established for reading only articles that were published between 2011 and 2023 and were about scoliosis and physiotherapy treatments.

These articles were written and published in the states of Rondônia (1), São Paulo (7), Rio Grande do Sul (2), Rio de Janeiro (1), Mato Grosso (1), Minas Gerais (1), Alagoas (1) and Portugal (1). The methodologies employed were quantitative descriptive (1), literature review (13), integrative review (2),

case report (1), treatment protocol proposal (1), dissertative case study (1) and bibliography with quantitative method (1).

In general, research has shown that scoliosis is an alteration of the spine, and that the number of people with pain associated with this pathology is growing significantly. However, these articles have shown many benefits for the patient, including the possibilities of physiotherapeutic treatments, such as RPG, Pilates and the Milwaukee waistcoat. Through the research, it was observed that the majority of publications related to the topic were carried out in the years 2012 (3), 2014 (1), 2015 (2), 2017 (1), 2018 (2), 2019 (1), 2020 (2), 2021 (1), 2022 (3) and 2023 (4). As shown in table 1 below:

Table 1. Presentations of scientific publications on changes in spinal alignment and physiotherapy treatment applied to scoliosis with authors' names, years of publication, journal names, methodological approaches and main findings (continued).

AUTHOR	YEAR	SOURCE	TYPE OF PUBLICATION	PLACE OF STUDY	RELATIONSHIP WITH THE RESEARCH OBJECTIVES	METHODOLOGICAL APPROACH	MAIN FINDINGS
Aleixo and Neves *et al.*	2023	Portuguese Journal of Traumatology	Article	Portugal	Yes	Literature Review	Due to the progressive increase in the age of the population, degenerative scoliosis is becoming increasingly common, significantly limiting the quality of life of affected patients.
Zucolotto *et al.*	2023	Brazilian journal Of Health Review	Article	São Paulo	Yes	Systematic Literature Review	As a result, specialised physiotherapy treatment has proved to be a valuable tool in postural re-education, but it is all about muscle strengthening and making the patient aware of their condition.
Santos *et al.*	2023	Multidisciplinary Journal of the Northeast of Minas Gerais, v 5, 2023\05	Article	Minas Gerais	Yes	Bibliography\ with the Qualitative Method	It can be concluded that techniques involving muscle stretching and strengthening, with RPG aiming to rebalance the muscle groups, are the most suitable.
Gonçalves *et al.*	2023	Ibero-American Journal of Humanity, Science and Education REASE	Article	São Paulo	Yes	Literature Review	Physiotherapy treatment is of the utmost importance in terms of preventing and improving the quality of life of people with scoliosis.
Da Silva *et al.*	2022	Faculty of Science	Article	São Paulo	Yes	Exploratory literature review	It can be concluded that the RPG and Pilates techniques

							have proven to be effective in terms of curvature variations. However, various orthoses have been used in the conservative treatment of scoliosis, such as the Milwaukee waistcoat.
Araújo *et al.*	2022	Brazilian Journal Of Development	Article	Amazonas	Yes	Literature Review	The importance of physiotherapy using RPG specifically for the treatment of patients with scoliosis can be seen.
Bervian and Souza *et al.*	2022	AJES Health Journal, Volume 8, 16 July\December 202	Article	Mato Grosso	Yes	Literature Review\ with a Qualitative Approach	This study concludes that Pilates as a conservative treatment is of paramount importance, as it helps with the progression of scoliosis and improves flexibility and posture.
Santos *et al.*	2021	Brazilian Journal Of Development	Article	Goiás	Yes	Literature review\of a qualitative nature Described	Pilates had a positive impact on reducing the degree of non-structural scoliosis in several groups. This is a very promising finding for sufferers.
Freitas *et al.*	2020	Journal Bahiana	Literature Magazine	Rio Grande do Sul	Yes	Literature Review	This is achieved through different techniques and exercises for treating the spine.
De Sá *et al.*	2020	Journal Of Medicine and. Health pronotion. 2020,5 (2): 130-138	Article	Paraíba	Yes	Literature Review	It can be concluded from this study that the treatment of scoliosis is generally based on postural re-education, which can be done using the Pilates method, as well as the exercises employed, especially the RPG techniques being used as a form of treatment.

Cristante *et al.*	2020	Brazilian Journal of Orthopaedics	Update Article	São Paulo	Yes	Scientific Literature Review	It can be concluded from the above that the different methods that are effective in treating scoliosis are: Chiropractic, pilates, RPG (global postural re-education), so these studies are in fact improved from a methodological point of view and are therefore necessary from the perspective of practice.
Vasconcellos *et al.*	2019	Diversity Journal	Article	Alagoas	Yes	Bibliographical review	In conclusion, the Pilates method has positive effects in relation to the treatment of scoliosis, because through the exercises performed, lumbar-pelvic and abdominal stabilisation can be achieved, as well as flexibility and strengthening of the stabilising muscles of the spine.
Samoydem *et al.*	2018	Caixa Alta Perspectiva, Erechin.v.42, Special edition, p, 23-24 March, 2018	Article	Rio Grande do Sul	Yes	Case studies\ experimental, descriptive, of the intervention type, with a qualitative approach	The studies showed that the RPG method was an effective tool for reducing the scoliotic curve, and improving flexibility.
Borges *et al.*	2018	Brazilian Journal Of Health	Article	Goiás	Yes	Literature Review	It can be concluded that idiopathic scoliosis is a lateral deviation of the spine that progresses from 10° depending on the severity of each patient and can cause other

							alterations. However, there is a wide variety of waistcoats (orthoses), among the most common being the Milwaukee waistcoat. This brace can only be used on patients with minor deformities.
Souza *et al.*	2017	Faculty of Education and Environment	Monograph	Rondônia	Yes	Literature Review	The studies have shown that intervention at this stage in children and adolescents is important so that the alterations do not evolve into adulthood.
Vieira *et al.*	2015	Fisioterapia e Pesquisa [S. 1], v.22, n.1, p 69-75. 2015	Article	Paraná	Yes	Cross-sectional Prevalence Study	The scoliotic posture may be related to growth, since most of the curvatures were "C" shaped.
Petrini *et al.*	2015	Scientific Journal of the Faculty of Education and Environment	Article	São Paulo	Yes	Literature Review	In view of the above, the different physiotherapy methods found for the treatment of scoliosis - RPG, Pilates - are effective in treating the scoliotic curve, but depending on the type of scoliosis, the characteristics of the individual, as well as the patient's adherence and suitability for treatment. It is noteworthy that the Milwaukee waistcoat is prescribed for full-time use during activities and used for new patients to inhibit this curve.
Oliveira *et al*.	2014	Funec Scientific Multidisciplinary	Article	Rio de Janeiro	Yes	Case Reports	The exercises proposed were effective for the structural and

		Journal					functional components of the skeletal muscle systems.
Faria *et al*.	2012	Electronic Health Journal	Review article	São Paulo	Yes	Integrative Review	The physiotherapy techniques that make the greatest contribution to reducing or controlling idiopathic scoliosis.
Pereira *et al.*	2012	Electronic Scientific Journal of Application Sciences of the Fac.	Article	São Paulo	Yes	Treatment Protocol Proposal	Preventing the progression of spinal deformity by balancing it and correcting the lateral curve that occurs in scoliosis.

Table 1 shows that this is a systematic review of physiotherapy treatments for scoliosis. There is a distinction between the studies in terms of the methodological design selected, of these treatments of RPG, Pilates and Milwaukee waistcoat, the benefits of which are: correction of body posture, relieving muscle pain, improving flexibility, stabilising the spine and aiding recovery from injuries, however, to improve the quality of life of patients and minimise the scoliotic curve, and prevent its progression.

According to Gonçalves *et al.*, (2023) physiotherapy treatment is of paramount importance in preventing and bringing benefits to the quality of life of people with scoliosis. (2015) stated that scoliotic posture may be related to growth, since most of the curvatures were "C" shaped.

However, according to Souza (2017), studies have shown that intervention at this stage in children and adolescents is important so that deformities do not develop in adulthood. (2012) pointed out that physiotherapy techniques make a greater contribution to reducing and/or controlling adolescent idiopathic scoliosis. (2018) stated that idiopathic scoliosis is a lateral deviation that progresses from 10 degrees, depending on the severity of the case it can cause other changes in the individual. However, the waistcoat (orthosis) has a wide variety, among the most common is the Milwaukee waistcoat, this waistcoat can only be used in patients with minor deformities.

It should be noted that authors emphasise that idiopathic scoliosis is more common in adolescents and can progress during the growth period. However, treatment can vary according to the severity of the curvature and the patient's age.

(2023) pointed out that due to the progressive increase in the age of the population, degenerative scoliosis is becoming increasingly common, significantly limiting the quality of life of affected patients. However, Pereira *et al.* (2012) stated that it prevents the progression of spinal deformity by balancing it and correcting the lateral curve that occurs in scoliosis.

However, some authors emphasise the physiotherapeutic treatments applied to scoliosis in the alignment of the spine.

These authors emphasise RPG (Global Postural Reeducation). (2022) noted the importance of physiotherapy using GPR specifically for the treatment of patients with scoliosis.Samoyedem et al. (2018) emphasised that the studies showed that the RPG method was an effective tool for promoting a reduction in the scoliotic curve and improving flexibility.

Thus, according to Santos *et al.* (2023), it was concluded that techniques involving stretching and strengthening such as RPG, aimed at providing a rebalancing of muscle groups, are the most suitable. In line with this, according to Zucolotto*et al.* (2023) specialised physiotherapy treatment has proved to be a valuable tool in postural re-education; however, it involves muscle strengthening and making the patient aware of their condition.

In this sense, the authors discussed another method, which is Pilates. (2019) concluded that the Pilates method has positive effects in relation to the treatment of scoliosis because through the exercises performed one can acquire lumbar-pelvic and abdominal stabilisation, as well as flexibility and muscle strengthening. Bervian and Souza *et al.* (2022) stated that this study concluded that Pilates as a conservative treatment is extremely important because it helps with the progression of scoliosis and improves flexibility and posture. Santos *et al.* (2021) concluded that Pilates had a positive impact on reducing the degree of non-structural scoliosis in several groups. This is a very promising finding for those who suffer from it.

This research on the importance of these physiotherapeutic treatments, in a literature review approach, with this perspectives several authors, in which each one contributes in a unique way to understanding these techniques.

According to these authors, they discussed these three types of treatment: RPG, Pilates and Milwaukee waistcoat, which are important to apply in the treatment of scoliosis. According to Petrini *et al.* (2015) the different physiotherapy methods found for the treatment of scoliosis, RPG, Pilates are effective in treating the scoliotic curve, but depend on the type of scoliosis, the characteristics of the individual, as well as the patient's adherence and suitability for treatment, and the Milwaukee waistcoat is used full-time during activities, as it is indicated for new patients to inhibit the curve. However,

according to Da Silva *et al.* (2022), it was concluded that the techniques of RPG and Pilates proved to be effective with regard to variations in curvature. In addition, various orthoses have been used in the conservative treatment of scoliosis, such as the Milwaukee waistcoat.

According to de Sá *et al.* (2020), the treatment of scoliosis in general is based on postural re-education, which can be done using the Pilates method, as well as exercises and especially RPG techniques, which are used as a form of treatment.

According to Cristante*et al.* (2020), the different methods that are effective in the treatment of scoliosis are chiropractic and Pilates and RPG, so these studies are in fact improved from a methodological point of view and are therefore necessary from a practical perspective.

However, it was noted that the author above presents several techniques such as chiropractic, but he did mention that Pilates and RPG are effective in treating scoliosis, as they have several benefits for individuals.

Oliveira *et al.*, (2014) questioned, however, that it was observed that the proposed exercises were effective for the structural and functional components of the musculoskeletal systems. Freitas *et al.* (2020) stated that these results were achieved through different techniques and exercises for treating the spine. However, the authors emphasised that there are other techniques that are effective in treating scoliosis.

Therefore, a joint analysis of these studies revealed a convergence of perspectives on the effectiveness of physiotherapy treatments related to scoliosis. Diverse authors with their methodological approaches and specific themes presented their vision of each physiotherapy treatment and its benefits. Most of the authors addressed the importance of physiotherapy treatments such as RPG, Pilates and the Milwaukee waistcoat in the treatment of scoliosis, and that these techniques generally bring benefits to the patient, as each of these treatments has its specific importance in rehabilitation and improving the quality of life of individuals.

DISCUSSION

For the discussion of this research, the articles were analysed in relation to spinal alterations and scoliosis. The different categories were addressed, highlighting the benefits, the fundamental techniques in the treatment of scoliosis, as well as the physiotherapeutic treatment of pilates, postural re-education and the Milwaukee waistcoat, in addition to the less common techniques in the treatment of scoliosis and the importance of the physiotherapist's role in the treatment of scoliosis, however, it can be inferred in each subsection below:

Benefits and fundamental techniques in the treatment of scoliosis

According to Borges (2018), scoliosis is defined as a deviation of the spine, i.e. an abnormality that affects the cervical region. It is also a deformity of the spine, affecting the well-being of patients. The articles found different physiotherapy methods and techniques to improve quality of life, reduce pain, correct posture, improve spinal and joint stability and restore muscle strength. However, it is of paramount importance to prevent and avoid its progression, but Petrini *et al*. (2015, p.28) stated that the therapeutic approach should be specified in accordance with the abnormal conditions such as: type of curvature, aetiology, patient's age, severity and symptoms.

However, early diagnosis of scoliosis is essential to examine conservative treatments that are appropriate for each case, and for Cardoso *et al*., (2011, p.4) *apud* Da Silva (2022, p.4) the results found in the literature review showed that the most widely used methods for treating scoliosis were RPG (Global Postural Reeducation) and Pilates. According to Da Silva *et al*., (2022) and Petrini *et al*., (2015) it was stated that these treatments prove to be effective with regard to variations in curvature. (2022) as well as being effective in treating the scoliotic curve, but they depend on the type of scoliosis, the characteristics of the individual, as well as the patient's adherence to and suitability of the treatment (PETRINI *et al.,* 2015).

Pilates physiotherapy treatment

Other articles examined, according to Santos et al (2021), Bervian (2022) and Souza (2017), Vasconcellos (2019) stood out as being the most important is pilates for having a positive impact on reducing the degree of structural scoliosis, in various groups observed. Santos (2021) and Bervian and Souza (2022) concluded that Pilates as a conservative treatment is of paramount importance, as it helps to reduce scoliosis and improves flexibility and posture. But for Vasconcellos (2019) Pilates, through the exercises performed, can provide lumbar-pelvic abdominal stabilisation, as well as flexibility and strengthening of the spinal stabiliser muscles.

According to Emery *et al.,* (2010) Yu *et al.,* (2011) *apud* Santos *et al., (*2021, p.5), pilates exercise has been reported to correct body postures, strengthening the muscles needed to maintain correct positions, body flexibility and balance through spinal segment exercise; this can help improve quality of life, improving mental health and can positively influence other aspects of life. These benefits are significant for this treatment, as they are fundamental for rehabilitation and injury prevention, and this method can be adapted to meet the specific needs of each patient.

Physiotherapy Treatment for Global Postural Reeducation

Another method applied is global postural re-education, which is also effective in treating scoliosis. However, Samoyedem's (2018) treatment showed that the RPG method promoted a reduction in the scoliotic curve and improved flexibility, as did Santos (2023), whose RPG is effective with techniques involving stretching and strengthening, providing a balance of muscle groups.

According to Araújo *et al.* (2022), the benefits of this method were fundamental because the technique improves the patient's pain. However, muscle stability is important for the body, both in terms of positioning and stimulating good posture in everyday life. Since this treatment is essential for physiotherapy patients, it aims to diagnose and treat the causes and help improve the patient's quality of life.

Physiotherapy Treatment of the Milwaukee Vest

However, another technique used to treat scoliosis is the Milwaukee brace. According to Haje*et al*., (2008), Elias *et al*., (1993) *apud* Da Silva *et al.*, (2022 p.136) cited that various orthoses have been used in the conservative treatment of scoliosis, for example, the Milwaukee waistcoat and this use of this orthosis has been effective in controlling the progression of curves and reducing scoliosis in individuals who have followed the protocol correctly. According to Borges *et al.* (2018)*, the waistcoat* has a wide variety, the most common being the Milwaukee waistcoat. The waistcoat used will be chosen by the doctor and the patient, but it will really be determined by the patient's curvature, however, this orthosis can only be used in patients with deformities of less than 40 degrees of curvature. And the authors Schiller, Thakur and Eberson (2010) *apud* Petrini *et al*., (2015 p.19-20) emphasized that the Milwaukee brace is prescribed for full-time use and during activities. It can be concluded that the younger the patient and the more inhibited the curve in the brace, the less the need for surgical treatment.

The authors stressed the importance of this method, which has many benefits for patients, such as: the ability to correct the curvature of the spine and promote proper alignment, help stabilize it, improve mobility and prevent the progression of scoliosis during the growth period. This orthosis can be applied in cases of minor injuries, and this technique is used more with adolescents and young people with idiopathic scoliosis. In addition, these are the most commonly used in the treatment of scoliosis according to the articles researched on changes in the curvature of the spine.

Less common techniques for treating scoliosis

However, some literature found few studies related to kinesiotherapy and chiropractic, but according to Mordecai and Dabke (2012) *apud* De Sá *et al*., (2020 p.136) stated that kinesiotherapy is one of the resources most used by physiotherapists, which applies appropriate movements and postures as in the

treatment of a particular musculoskeletal problem.

On the other hand, another treatment presented that is not often emphasised in the articles is surgical treatment. According to Haldemans (2012) *apud* Cristante*et al*., (2020 p.5) the main indications for surgery were limitations in activities of daily living, pain, neurological symptoms, confirmation of curve progression and failure of conservative treatment. According to the author Sengupta (2012) *apud* Cristante*et al.,* (2020 p.5) most studies on adult deformities comparing clinical and surgical treatment favoured surgical intervention. Patients who underwent surgery showed a statistically significant improvement in quality of life, pain, and less chance of clinical deterioration compared to those who received conservative treatment. This type of treatment is also used in more severe cases, which occur at 45 degrees and above. One of the target groups is adults, i.e. adult degenerative scoliosis. It is important to follow up with a doctor.

The importance of physiotherapists in the treatment of scoliosis

According to the author, the role of the professional physiotherapist in the health networks, in his therapeutic exercise is aimed at the prevention, maintenance, development and restoration of the integrity of the physical functions and systems and organs of the human body. Their actions consist of planning, guiding and applying physiotherapeutic treatments, according to the needs of each patient, also aimed at preventing pathologies (FORNAZARI, 2005, p.29) *apud* SOUZA (2017, p.29).

Bearing in mind that physiotherapy treatment using Pilates techniques, global postural reeducation and the Milwaukee waistcoat are recommended and effective according to the studies presented, as long as they are diagnosed early. However, these treatments are necessary in order to improve patient outcomes and bring benefits. In addition, physiotherapy offers specific therapeutic techniques to improve the clinical condition, since the patient will undergo a detailed and specific assessment, the physiotherapist carries out an anamnesis which is the collection of detailed information about the patient's personal data, medical history, including symptoms, injuries or other relevant

medical conditions, a series of assessments (tests) take place such as: postural assessment, mobility, muscle and specific tests for scoliosis, to obtain accurate information about the patient's condition and develop a personalised treatment plan. Based on the results of the assessment, the physiotherapist develops an individualised treatment plan according to each individual's needs, however the physiotherapist can offer essential support to the patient throughout the rehabilitation process.

CONCLUSION

Based on the systematic review of the literature on spinal alignment changes and physiotherapy treatment applied to scoliosis, it can be concluded that physiotherapy plays a significant role in the management of scoliosis, helping to improve posture, strengthen muscles and reduce the progression of the curvature. However, more studies are needed to assess the long-term effectiveness of different physiotherapy approaches and to develop more personalised and effective protocols for the treatment of scoliosis.

Scoliosis is a condition in which the spine curves sideways. Physiotherapy is often used to help manage scoliosis, with approaches such as RPG (Global Postural Reeducation) and Pilates being useful. In some cases, the use of braces may also be recommended to help stabilise the spine. In conclusion, a personalised treatment plan involving physiotherapy, RPG, Pilates and possibly the use of body armour can be beneficial for patients with scoliosis, depending on the severity and individual needs.

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