Fisioter Bras. 2024;25(2):1372-1385
doi:10.62827/fb.v25i2.6h10

REVIEW

Physiotherapy in the functional capacity of patients with spinal cord injury: evidence of professional performance in the last 10 years

Fisioterapia na capacidade funcional de pacientes com lesão medular: evidências da atuação profissional nos últimos 10 anos

Tereza Cristina Pereira Barros[7], Maria Isabel de Vasconcelos Mavignier Neta[7], Victor Hugo do Vale Bastos[6], Silmar Silva Teixeira[6], Marco Orsini[1,4], Adalgiza Mafra Moreno[1,3], Bruno Garbéro Pinna[3], Julia Neiva Gonçalves Garbéro Pinna[5], Micheli Verginia Ghiggi[5]

[1]Master Program Vigilância in Health (Vigilância em Saúde), University Iguaçu (UNIG), Rio de Janeiro, RJ, Brazil

[2]University Salgado de Oliveira (Universo), Rio de Janeiro, RJ, Brazil

[3]University Iguaçu (UNIG), Nova Iguaçu, RJ, Brazil

[4]Rio de Janeiro State University (UERJ), Rio de Janeiro, RJ, Brazil

[5]Institute of Physical Education (UFF), Rio de Janeiro, RJ, Brazil

[6]Program in Biotechnology and Biomedical Sciences, Parnaíba Delta Federal University (UFDPar), Parnaíba, PI, Brazil

[7]Parnaíba Delta Federal University (UFDPar), Parnaíba, PI, Brazil

Recebido em: 29 de fevereiro de 2024; Aceito em: 18 de abril de 2024.

Correspondence: Marco Orsini, orsinimarco@hotmail.com

Como citar
Barros TCP, Neta MIVM, Bastos VHV, Teixeira SS, Orsini M, Moreno AM, Pinna BG, Pinna JNGG, Ghiggi MV. Physiotherapy in the functional capacity of patients with spinal cord injury: evidence of professional performance in the last 10 years. Fisioter Bras. 2024;25(2):1372-1385. doi:10.62827/fb.v25i2.6h10

Abstract

Objective: To identify, through a systematic literature review, the role of Neurofunctional Physiotherapy in assessing the functional capacity of spinal cord injured patients. *Methods:* The search was coordinated in the SciELO, PubMed, LILACS databases and on the Google Academic platform, selecting articles published in Portuguese, English and Spanish between 2011 and 2021. The PRISMA methodology model

was followed and the PEDro scale was used to analyze the articles found. The following instruments were considered and accepted in the review: Functional Independence Measure (FIM), Spinal Cord Independence Measure (SCIM), Modified Ashworth Scale, Walking Index for Spinal Cord Injury II (WISCI II), Medical Outcomes Study 36 - Item Short - Form Health Survey (SF-36), Berg Balance Scale, Barthel Index and American Spinal Injury Association (ASIA). *Results:* The score obtained by the PEDro scale ranged from 0 to 10, it was noted that among the studies included in the review, the average obtained was approximately 6.42. *Conclusion:* Health care for patients with spinal cord trauma is a process for reintegration into the community, as well as a means of providing an emotional boost in order to stimulate the search for and confidence in achieving a satisfactory functional recovery. The articles investigated show the effectiveness of Neurofunctional Physiotherapy in these patients. The number of visits the patient receives seems to be relevant; the more visits the better for their recovery.
Keywords: Spinal cord injury; physiotherapy; international classification of functioning; scale; assessment; functional status.

Resumo

Objetivo: Identificar, por meio de revisão sistemática de literatura, a atuação da Fisioterapia Neurofuncional na avaliação da capacidade funcional de lesados medulares. *Métodos:* A busca foi coordenada nas bases de dados SciELO e PubMed LILACS selecionando-se artigos publicados em português, inglês e espanhol no intervalo de tempo entre 2011 e 2021. O modelo de metodologia PRISMA foi seguido e foi utilizada a escala PEDro para a análise dos artigos encontrados. Na revisão foram considerados e aceitos os seguintes instrumentos: Escala de Medida de Independência Funcional (MIF), *Spinal Cord Independence Measure* (SCIM), Escala de Ashworth Modificada, *Walking Index for Spinal Cord Injury II* (WISCI II), *Medical Outcomes Study 36 - Item Short - Form Health Survey* (SF-36), Escala de equilíbrio de Berg, Índice de Barthel e *American Spinal Injury Association* (ASIA). *Resultados:* A pontuação obtida pela escala PEDro variou de 0 a 10, notou-se que dentre os estudos incluídos na revisão, a média obtida foi de aproximadamente 6,42. *Conclusão:* A atenção à saúde direcionada aos pacientes com trauma raquimedular é um processo para reinserção na comunidade, bem como um meio de proporcionar um incremento emocional, a fim de estimular a busca e a confiança em realizar uma recuperação funcional satisfatória. Os artigos investigados mostram eficácia da Fisioterapia Neurofuncional nesses pacientes. Parece relevante a quantidade de atendimentos ao paciente, quanto mais atendimentos melhor para a recuperação.
Palavras-chave: Lesão medular; fisioterapia; classificação internacional de funcionalidade; escala; avaliação; status funcional.

Introduction

Spinal cord injury (SCI) has a limiting effect because it causes several functional irregularities in the affected individual, such as locomotive, sensitive, sexual problems, urinary and intestinal disorders [1].

Its etiology may result from traumatic occurrences, such as traffic accidents, gunshot wounds, diving in shallow waters; and non-traumatic resulting from infectious processes, tumors and congenital deficiencies [2]. The functional recovery capacity of patients with SCI is based on factors such as age, degree of injury, as well as the therapeutic approach applied during the acute phase [3].

Over the years, researchers have observed that due to the injuries generated by SCI, the individual has difficulty accepting this functional limit, affecting family members and professionals involved, such as caregivers and the multidisciplinary team [3]. The role of physiotherapy aims to provide quality of life and develop self-esteem for these patients through actions of functional independence and social inclusion, therefore reducing situations of instability related to mental and psychological health [3,4]. It is important for patients to have the appropriate stimulus, in order to allow the effectiveness of physical therapy treatment and increase adherence rates. For this, technological resources have been developed for applicability in rehabilitation, such as games and virtual reality [2].

In light of this context, this study aimed to identify, through a systematic literature review, the role of Neurofunctional Physiotherapy in assessing the functional capacity of spinal cord injuries.

Methods

This article is a systematic literature review whose objective was to identify references in the literature that allow understanding Neurofunctional Physiotherapy with regard to the concept of Spinal Cord Injury (SCI), classifications, diagnosis and treatment. Furthermore, we sought to analyze the assessment instruments used in clinical practice, the use of technologies and the relationship of influence in the quality of life item. To achieve this goal, the research questions (RQ) described in figure 1 were considered.

1	What is spinal cord injury and how is it diagnosed?
2	How is functional capacity after SCI characterized?
3	What are the evaluation instruments frequently used in Neurofunctional Physiotherapy?
4	How do these evaluative instruments influence the quality of life of spinal cord injured patients?

Figure 1 - *Research Questions*

Search strategy

In this type of work design, a compilation and analysis of data from several studies found in the literature was performed, following a strict protocol to minimize visualizations and exclude irrelevant or low-quality studies. The Scientific Electronic Library Online (SciELO), National Center for Biotechnology Information (PubMed), Latin American and Caribbean Literature in Health Sciences (LILACS) and Google Scholar databases were accessed from February 2022 to August 2022, to In the search, the following descriptors were used: “spinal cord injury”, “physiotherapy”, “International Classification of Functioning”, “scale”, “evaluation”, combined with each other using the Boolean AND descriptor.

For the construction of the systematic review, the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) protocol was used. The research was based on the following aspects (1) definition of the keywords, (2) designation of the search strings (3) search in the databases related to the theme (4) observation of the references of the chosen articles and (5) verification of the quality of the articles selected through the PEDro scale. Each section/topic of the systematic review aimed to answer the research questions mentioned in figure 1.

Selection criteria

The PRISMA methodology was applied in the review (figure 2) and in order to understandably answer the research questions, some parameters were established: (1) articles published in Portuguese, English and Spanish in the time interval between 2011 and 2021; (2) articles related to the research questions presented that had relevant data to answer them. On the other hand, the following ones were excluded from the research: self-reports, brief reports, case reports, unpublished work documents and abstracts.

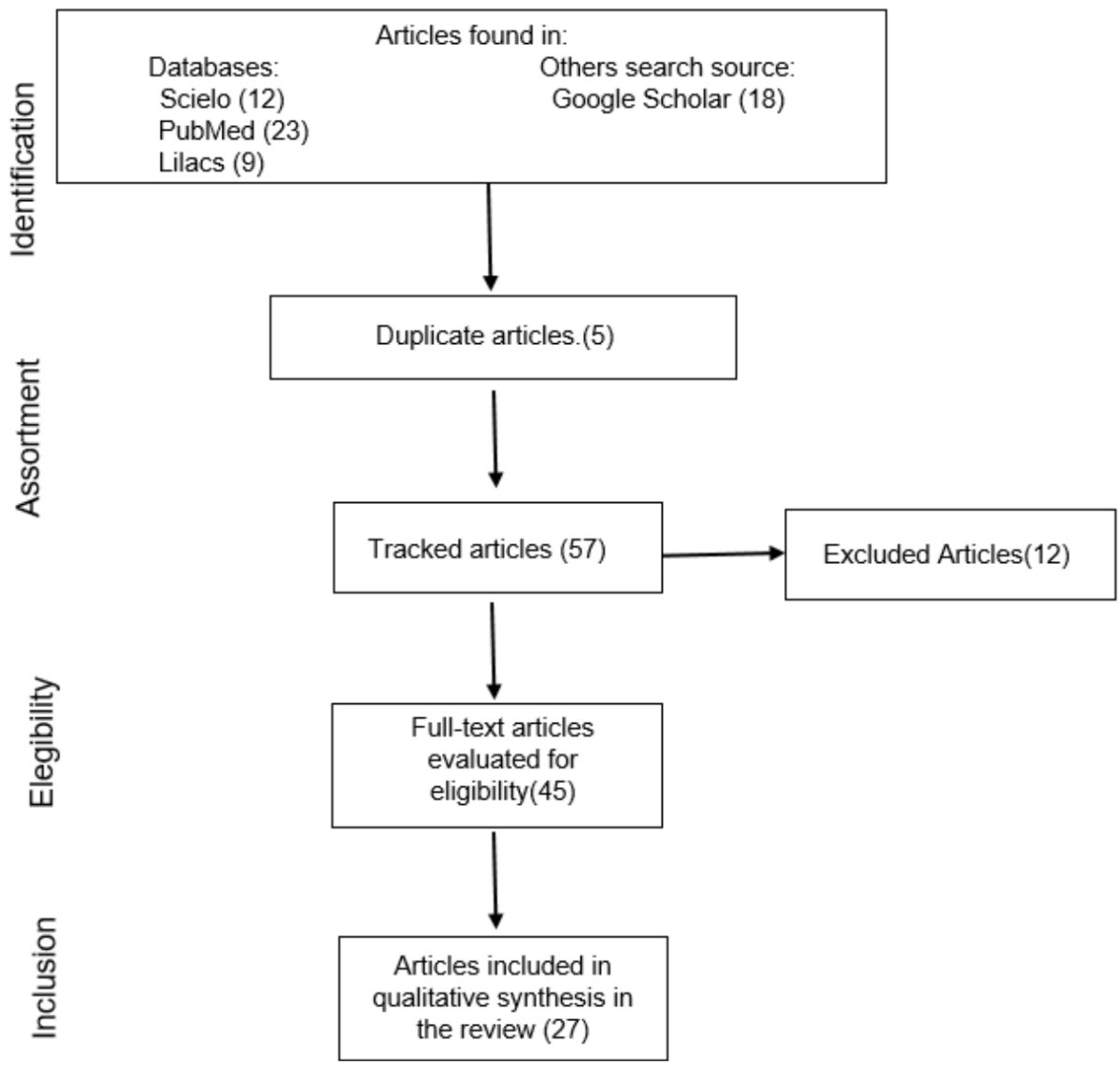

Figure 2 - *Representation of the analysis of articles according to the PRISMA methodology*

Data transmission process

Data transmission was conducted according to each research question, looking for answers through useful information identified throughout the text. This is a systematic review, whose main intention is the analysis of articles related to the practice of Neurofunctional Physiotherapy in the evaluation process of patients after spinal cord injury in the last 10 years.

Conducting the theoretical framework

The assortment of articles was carried out independently by the author of the present article, between February 2022 and August 2022, by applying the strings in the databases. subsequently, duplicate works were removed and inclusion and exclusion criteria were applied to the remaining articles, which were analyzed according to title and abstract.

Analysis of the articles by the PEDro Scale

The 57 articles found for the research were analyzed according to the PEDro Scale by three evaluators, the third being to confirm the decision criterion. This scale aims to qualify studies that present a high probability of high internal validity, in the same way that it helps guide a clinical decision [5].

Analysis instruments

To choose the evaluative instruments, which will be discussed below, the frequency with which they appeared in the set of articles selected for the study was used as criteria (represented by the graph in figure 3), as well as the influence of these instruments in the physiotherapeutic performance in relation to patients with spinal cord injury (SCI) regarding gait analysis, sensory and motor function, quality of life and level of independence when performing external activities (basic and instrumental).

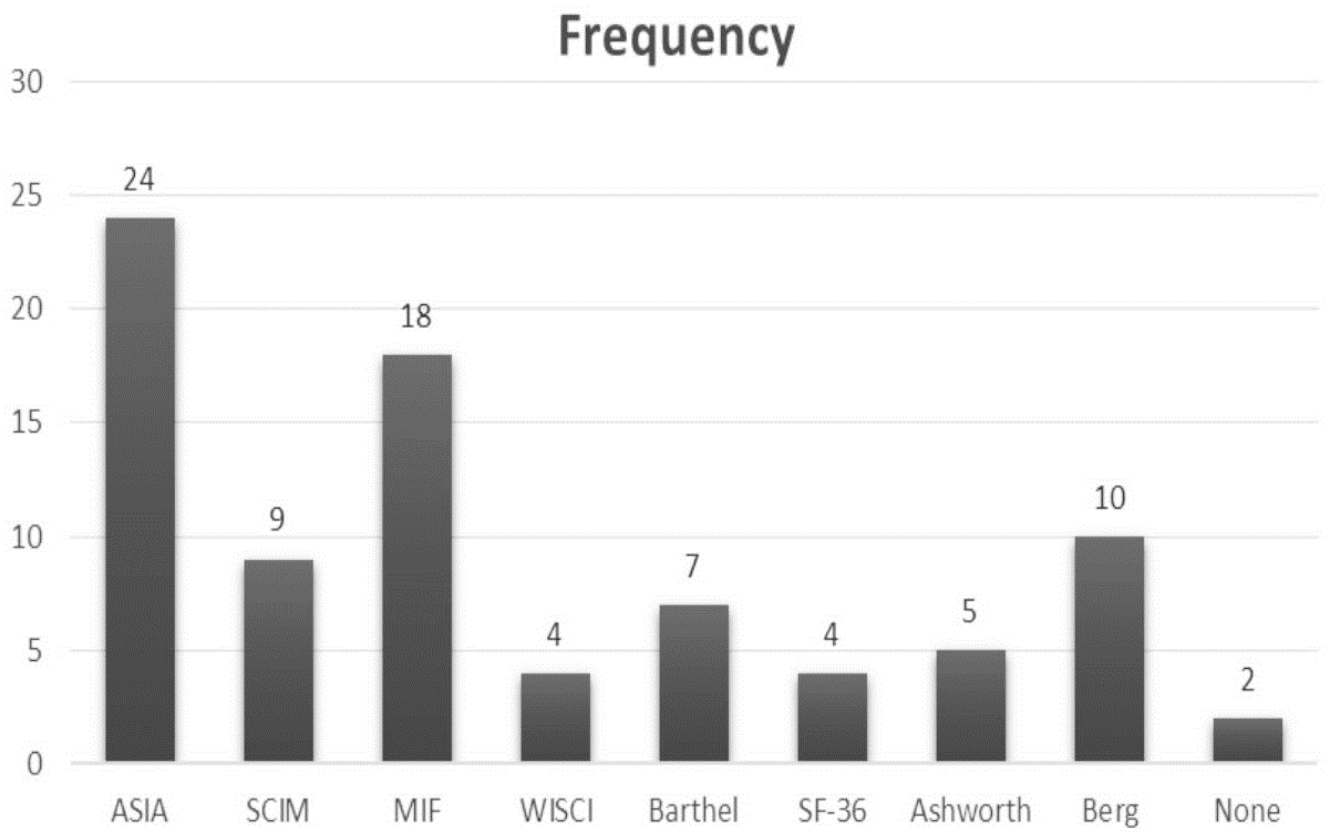

Figure 3 - *Frequency of evaluation instruments found in the scientific repertoire*

The International Classification of Functioning (ICF) applies to all people, not just those with functional limitations. The ICF describes the individual condition of being in association with the health domains - body structure and functions, activity and participation, in addition to contextualizing with personal and environmental factors, while the International Classification of Diseases (ICD-10) seeks to understand the etiology of diseases, in order to provide diagnoses or other health scenarios, complemented by ICF data [6].

Functional assessment is the ability to perform basic activities of daily living and self-care. The Functional Independence Measure Scale (FIM) multidimensionally evaluates the individual's motor and cognitive practice in the following scenarios: eating, cleaning the body, dressing the upper and lower body regions, using the bathroom and controlling excretions, transfers (bed-bathtub /shower), locomotion, comprehension, language, social interaction, problem solving and memory. Each item ranges from 1 to 7, totaling 126 points, in which the lower the level reached, the greater the functional dependence.

The Spinal Cord Independence Measure (SCIM) is an internationally validated instrument that is very useful for evaluating spinal cord injured patients. This scale measures the independence of these patients when performing basic and instrumental activities of daily living, considering three subscales and in three domains with the evaluation of 19 tasks that cover personal care, movement, and respiratory and sphincter alterations. SCIM can be applied both in adult and elderly patients, as well as in different degrees and causes of spinal cord injury [7].

The Modified Ashworth Scale is used in patients with central nervous system injury in the evaluation of spasticity, it has easy and quick applicability, however it is a subjective evaluation without standardization regarding the speed of the applied movements, that is, the quantification of the score will depend on the analysis and the evaluator's practice, because of this it is not considered a reliability scale [8]. According to studies at Thomas Jefferson University, the Walking Index for Spinal Cord Injury II (WISCI II) is used in clinical trials to measure improvements in gait in people with spinal cord injury. It is a functional limitation scale, not a disability scale. WISCI II must be used in a standardized environment with standardized equipment and definitions, which are observed and recorded by trained professionals [9].

The Medical Outcomes Study 36 - Item Short - Form Health Survey (SF-36) is an evaluative instrument for quality of life, which is simple to conduct and understand, it is multidimensional and consists of 36 items contained in 8 components: functional efficiency, vitality, biotype, pain, general health, social and emotional issues, and mental health. Its score ranges from 0 to 100 where the closer to 100, the better the patient's health status [10].

The Berg Balance Scale contains 14 evaluative items with the primary purpose of measuring the risk of falling in the elderly population, extending to other pathologies such as spinal cord injury, in order to precede any reliability and validation assessments [11].

The Barthel Index (1965) quantitatively assesses the individual's functional capacity to perform activities of daily living. In its modified version, independence in locomobility, personal hygiene and physiological actions are considered. In addition to being an evaluative instrument, it is used to predict length of stay and estimate prognosis. This index is classified as simple, valid and reliable; its score ranges from 100 to 0, where the degree of independence is defined by the highest score [8].

The American Spinal Injury Association (ASIA) scale, created in 1984 and underwent changes over the years until 2002, assesses the patient through sensory and motor scales. In the sensitive one, two types of sensitivity are stimulated: pain (through a delicate pin) and touch (in which the patient is touched with a tuft of cotton). The patient will describe the sensation as absent, normal or diminished and in deep pressure, he will classify it as absent or present. The total for the sensitive index corresponds to 112 points (56 for each type of sensitivity). On the motor scale, muscle strength is graded in degrees from 0 to 5, in which grade 3 corresponds to the normality of the muscle to be tested. Each hemibody totals 50 points, whose score varies from 0 to 5, characterizing, respectively, from paralysis to total counterresistance [12].

Results

As for the degree of injury, SCI affects the cervical and thoracic regions more regularly, with this the patient will develop different levels of dependence according to the injured site. If it reaches the C1-C4 region, the patient will have a condition of tetraplegia (partial or complete paralysis of the four limbs and trunk) at a high level, while at C5-C8 it will present the same condition at a lower level, that is, the first form of injury brings more severe complications [3, 2, 13, 7].

Studies carried out on the topic described that there is a higher incidence of spinal cord injuries in the age group between 10-32 years. Among the various difficulties reported by patients in relation to routine actions are: lack of accessibility in public environments, crowded means of transport, need for adaptations at home, which predisposes to the issue of resorting to companions [3].

When the injury occurs in the thoracic, lumbar or sacral region, there is paralysis of the lower limbs and trunk called paraplegia, that means, the person has a partial loss of motor and sensory skills. Those with injuries in the cervical region have tetraplegia that can partially or totally affect the upper and lower limbs and the trunk. Paraplegic individuals manage to maintain a certain level of independence, while quadriplegics can demonstrate greater functional independence through the use of appropriate and adapted orthopedic equipment [2, 7].

SCI rehabilitation occurs from the moment the diagnosis is discovered until the individual's social reintegration [14]. Clinical management of the patient is driven by performance and measurement of present functional changes that may be significantly important. Through statistical analogies between the mean changes observed, the possible treatments to be applied originate [15]. For the professionals involved, it is challenging to keep up to date and explore new therapeutic resources such as the use of stem cells and robotics. It should be noted that in order to apply these new resources, high-quality evidence must be available in order to offer the patient a reliable recovery service [16].

Researchers have reported that the locomotion subdomain showed high levels of dependence, which is the most associated with quality of life [17]. The practice of physical exercises in spinal cord injured patients promotes the improvement of physical and cardiorespiratory capacities, in which there is progress in terms of coordination, resistance and muscle strength, being a reducing factor of cases of urinary tract infection, in addition to bedsores and hospitalizations [13, 3]. According

to the research carried out by the researchers, it was noted that through the association between virtual games and the practice of physical exercises, therapeutic objectives can be achieved, since the movements performed by the patient are converted to virtual reality [2].

It was observed that those patients who adhered to physiotherapy during the hospital phase achieved functional improvements and increased life expectancy. In this way, the relevance of the applicability of evaluative scales is portrayed, which quantify and qualify the evolutions achieved by each patient. Unfortunately, there are still obstacles to collecting and displaying authentic data, so some scales need adjustments according to the clinical condition of the patient being treated [18].

The ASIA (specifies spinal cord injury) and SCIM (defines the level of autonomy) scales, according to the literature, are considered the most appropriate in terms of supervising the effects of the rehabilitation process in people with SCI. It was noticed the need to optimize the patient's recovery in a timely manner, in order to improve the functional performance of this patient as well as reduce rehabilitation costs [19]. When practicing self-care, the aim is to provide the patient with a daily stimulus of the feeling of capacity, demonstrating the importance of their collaborative participation during the treatment, thus granting autonomy in routine activities in accordance with the patient's clinical condition [20].

As explained in the table 1, the score obtained by the PEDro scale ranged from 0 to 10 depending on the type and quality of the study analyzed. It was noted that among the studies included for the production of the review, the highest score acquired was 10 and the average obtained was approximately 6.42.

Table 1 - *Analysis of articles according to the PEDro scale*

2020	Pereira et al.	Validation study	8
2011	Corrêa; Lopes Neto; Llapa-Rodriguez	Descriptive research with a quantitative approach	8
2021	Arriola; López; Camarot	Longitudinal, retrospective, descriptive and analytical	7
2020	Fattal et al.	Case report	7
2021	Possover, M.	Prospective Case series	7
2012	Forrest et al.	Prospective observational cohort	7
2015	Schoeller et al.	Descriptive, exploratory qualitative research	7
2011	Joppert et al.	Prospective observational	7
2016	Juvenal; Savordelli	Descriptive	7
2012	Branco	Retrospective and longitudinal analysis	7
2013	Gouveia et al.	Transversal, descriptive and analytical with a quantitative approach	7

2019	Batista et al.	Cross-sectional study	6
2021	Jiang; Sun; Meng	Retrospective	6
2021	Houston et al.	Exploratory qualitative	6
2012	Harkema et al.	Prospective observational cohort	6
2018	Soledad et al.	Retrospective descriptive observational	6
2021	Medeiros	Methodological research	6
2011	Pereira	Quantitative case series	6
2021	Sousa et al.	Research by data collection	6
2015	Bazán, P. L.	Prospective evaluation	5
2016	Chompoonimit; Nualnetr	Quasi-experimental study	5
2018	Lampart et al.	Retrospective Graphic Analysis	5
2019	Carvalho et al.	Retrospective cohort	5
2017	Simim	Case study	5
2021	Sousa et al.	Cross-sectional analytical observational	5
2013	McDonough et al.	Self-report	4
2015	Rocha	Case report	4
2011	Vidinha et al.	Retrospective	3
2017	Capelari et al.	Literature review	0
2014	Aquarone; Faro	Integrative review	0
2021	McHugh et al.	Systematic Review	0
2014	Alves; Matsukura	Literature review	0
2015	Coelho	Systematic Review	0
2011	Cabral; Mejia	Literature review	0

Discussion

The present study aimed to analyze post-SCI functional capacity and the role of physiotherapy in the patient's quality of life. The researchers, through their clinical practice, used SCIM II because version

III requires more complexity due to the issue of measuring the concentration of excreted urine. This scale, when applied to patients waiting for arthrodesis surgery, shows a sudden functional loss as a result of the demand for rest or some factor related to the preoperative process. In the same study, it is noticed that as the ASIA does not assess the pattern of muscle strength, there are different classifications between the motor index and the functional capacity of the patient [19].

The FIM is "a reliable and sensitive instrument to changes related to self-care skills, locomotion, surgical interventions and research" [16]. Among the analyzed studies, the authors highlighted the FIM and the Barthel Index as general scales when considering functionality [21]. The studies report the ability of the ICF to help physiotherapy with regard to recording functional data, choosing interventions and recording the results obtained, in order to develop clinical practice. It was observed that, when performing physical therapy treatments, patients acquire positive developments in motricity, so the long wait in the hospital phase brings functional damage to these individuals [18].

Locomotor training brings benefits to individuals with partial and total spinal cord injury, in which it is possible to notice progress in walking even for those with low motor scores. For patients with more severe conditions, the use of robotic technology allows for longer training [22]. Studies show that by increasing the ability to perform physical exercises, patients have described improvements in quality of life in view of less fatigue at the end of daily activities, in addition to being able to maintain these actions for a longer time, acquiring more self-confidence [23].

The lack of physical exercise in these neurological patients has negative effects on the cardiorespiratory system. It was noticed that when using the cycle ergometer in rehabilitation, there was a reduction in respiratory alterations secondary to the injury, when applied after the clinical stabilization of the case - acute or chronic [13]. It is important to emphasize that the well-being of people with SCI is significantly associated with social and occupational insertion, as well as mobility [24]. When evaluating the quality of life of patients, it is essential to meet the individual needs of each one, especially when using certain instruments in different cultures [25].

Complementing rehabilitation with the use of virtual reality (VR) can provide more attractive treatments for those with SCI, especially those with quadriplegia, as it allows these people to interact with a stimulated and unstable environment, offering the user mastery of movements, activating as many regions as possible. As necessary based on the applied therapy and allowing the patient to choose during this process which games, characters and levels they prefer. In addition, virtual reality facilitates contact with other people, thus ensuring the improvement of self-esteem, positive experiences and socialization [15].

Berg's balance scale is more sensitive to distinguish those patients who walk in the community without assistance to perform this action [26]. This scale proved to be valid when used simultaneously with other instruments such as WISCI and SCIM, however, it was not well related to the number of falls and was not considered discriminatory in terms of predicting falls in spinal cord injured patients [11].

The articles analyzed and included in the review presented, as a scientific repertoire, approaches regarding physical therapy practice in multidisciplinary actions in different areas of health, which involved outpatient clinics, clinics, hospitals, rehabilitation centers, as well as research carried out by other educational institutions. In the graph (figure 2) it can be seen that among the 57 articles found, five

evaluative instruments were most used, namely: ASIA, FIM, ICF, Berg and SCIM. With this, the importance of functional analysis of the condition of patients with spinal cord injury is highlighted, as well as the participation of physiotherapy in the recovery process in order to guarantee, in a way, independence for these patients during their routine, both personal and professional.

Conclusion

Health care directed to patients with spinal cord injury is an important process for reintegration into the community, as well as a means of providing them with an emotional boost, in order to encourage the search for and confidence in carrying out an effective and satisfactory rehabilitation. In addition, it is worth mentioning how essential it is to provide the patient with treatment based on their individualities, in order to show that there is not only the "patient" to be treated, but that there is a human being in need of care (emotional, physical, psychosocial). Through this, the value of multidisciplinarity is portrayed during the health services provided in the public and private sectors.

Among the limitations presented in the study, there is the issue of the reduced number of articles that relate the functionality and independence of patients with spinal cord injury. Spinal cord injury and physiotherapeutic participation during rehabilitation is still little known and, in a way, not adequately explored, either because of the lack of incentives in the area or because of the difficulty in keeping patients with this clinical condition in constant monitoring and treatment. With this, it is necessary to carry out new scientific productions that take into account the different contexts that may affect the assiduity and collaboration of these patients throughout rehabilitation.

In this sense, Neurofunctional Physiotherapy can guide patients with spinal cord trauma towards a functional life. Adapting the home, workplace and leisure time are tasks that will help. Following the International Classification of Functioning model to assess and treat, as well as performing functional tasks are points that should be considered by the physiotherapist. The more physiotherapy consultations (and at all stages of health) the better the patient's chances of recovery. Finally, other professionals are needed, such as doctors, speech therapists, psychologists, music therapists, among others.

Conflicts of interest

We declare no conflicts of interest.

Funding sources

No funding sources was received.

Authors contribution

Bibliographical Survey: Pinna, BG; Pinna, JNGG; Textual review: Pinna, BG; Pinna, JNGG; Ghiggi MV. Analysis and interpretation of data: Orsini, M.; Moreno, AM; Statistical analysis: Orsini, M; Moreno, AM; Manuscript writing: Orsini, M.; Moreno, AM; Critical review of the manuscript for important intellectual content: Orsini, M; Moreno, A.M; Pinna, BG; Pinna, JNGG; Mafra, A.

References

1. Rabeh SAN, Nogueira PC, Caliri MHL. Bowel function and the relationship with functional independence of individuals with spinal cord injury. Coluna/Columna [Internet]. 2013 [cited 2022 Dec 21];12(2):153–6. Available from: https://doi.org/10.1590/S1808-18512013000200013

2. De Paula S, Griebeler KC, Bez MR, da Rocha CFK. Effects of exergames on trunk balance control in paraplegic patients. Fisioter Mov. 2020;33 [cited 2022 Dec 21]. Available from: http://dx.doi.org/10.1590/1980-5918.033.AO36

3. Schoeller SD, Grumann ARS, Martini AC, Forner S, Sader LT, Nogueira GC. Knowing to care: characterization of individuals with spinal cord injury treated at a rehabilitation center. Fisioter Mov [Internet]. 2015 Mar;28(1):77–83 [cited 2022 Dec 21]. Available from: http://dx.doi.org.10.1590/0103-5150.028.001.AO08

4. Jiang L, Sun L, Meng Q. Identification and relationship of quality of life and self-care ability among Chinese patients with traumatic spinal cord injuries: a cross-sectional analysis. Braz J Med Biol Res [Internet]. 2021;54(12) [cited 2022 Dec 21]. Available from: https://doi.org/10.1590/1414-431X2021e11530

5. PEDro Scale - PEDro [Internet]. PEDro. 2020 [cited 2022 Dec 21]. Available from: https://pedro.org.au/portuguese/resources/pedro-scale/

6. World Health Organization (WHO). CIF - Classificação Internacional da Funcionalidade, Incapacidade e Saúde Organização Mundial da Saúde [Internet] [cited 2022 Dec 22]. Available from: http://www.periciamedicadf.com.br/cif2/cif_portugues.pdf

7. Kawanishi CY, Greguol M. Validation of a test battery to assess functional autonomy of adults with spinal cord injury. Rev Bras Educ Fís Esporte [Internet]. 2014 Mar [cited 2022 Dec 21];28(1):41–55. Available from: https://www.scielo.br/j/rbefe/a/ybdkmzxJqBwk9DZfLXGtZSk/?lang=pt

8. Pasin Neto H, Rossi MF, Bonvino MA, Mazzei LG, Tiezzi TBS, Tenenbaum AGB, et al. Escalas e testes funcionais em Fisioterapia ortopédica, neurológica e respiratória [Internet]. Sorocaba. 2021 [cited 2022 Dec 22]. Available from: http://uniso.br/assets/docs/publicacoes/eduniso/publicacoes/escalas-e-testes-funcionais-em-fisioterapia.pdf

9. Thomas JU. Instructions for the Use of the Walking Index for Spinal Cord Injury II (WISCI II) [Internet]. 2005 [cited 2022 Dec 22]. Available from: http://www.spinalcordcenter.org/research/wisci_guide.pdf

10. Ciconelli RM, Ferraz MB, Santos W, Meinão I, Quaresma MR. Tradução para a língua portuguesa e validação do questionário genérico de avaliação de qualidade de vida SF-36 (Brasil SF-36). Rev Bras Reumatol. 1999 [cited 2022 Dec 22]. Available from: https://www.ufjf.br/renato_nunes/files/2014/03/Valida%C3%A7%C3%A3o-do-Question%C3%A1rio-de-qualidade-de-Vida-SF-36.pdf

11. Datta S, Lorenz DJ, Harkema SJ. Dynamic Longitudinal Evaluation of the Utility of the Berg Balance Scale in Individuals With Motor Incomplete Spinal Cord Injury. Arch Phys Med Rehabil [Internet]. 2012 Sep [cited 2022 Dec 21];93(9):1565–73. Available from: https://doi.org/10.1016/j.apmr.2012.01.026

12. Botelho R. Exame neurológico em trauma vertebral [Internet]. [cited 2023 Jan 22]. Available from: https://www.aolatam.org/ftp/edudatabase/open-files/aos_da_n1m3t2_botelho_prt.pdf

13. Juvenal EAO, Savordelli CL. Effectiveness of the cycle ergometer in cardiovascular conditioning of spinal cord injured patients [Internet]. Rev Soc Bras Clin Med. 2016 [cited 2022 Dec 21]. Available from: https://docs.bvsalud.org/biblioref/2016/10/2127/151-155.pdf

14. Sousa AB, Aquino BS, Sousa DR, Bento DS, Silva KMM, Gener MES. Translation and cross-cultural adaptation of Neurological Impairment Scale to Brazilian population. Facit Business and Technology

Journal. 2021 [cited 2022 Dec 22]. Available from: http://revistas.faculdadefacit.edu.br/index.php/JNT/article/view/1258/826

15. Dimbwadyo-Terrer I, Gil-Agudo A, Segura-Fragoso A, de los Reyes-Guzmán A, Trincado-Alonso F, Piazza S, et al. Effectiveness of the Virtual Reality System Toyra on Upper Limb Function in People with Tetraplegia: A Pilot Randomized Clinical Trial. BioMed Research International. 2016;2016:1–12 [cited 2022 Dec 21]. Available from: https://doi.org/10.1155/2016/6397828

16. Palácio PRC. Avaliação da independência funcional e da qualidade de vida dos indivíduos com lesão medular após serem submetidos à fotobiomodulação. Tese (Mestrado) - Universidade Nove de Julho (UNINOVE), São Paulo, 2017 [cited 2022 Dec 22]. Available from: https://bibliotecatede.uninove.br/bitstream/tede/1876/2/Paulo%20Roberto%20da%20Costa%20Pal%c3%a1cio.pdf

17. Gouveia SSV, Gouveia GPM, Vasconcelos SS, Bezerra Filho JG. Translation and cross-cultural adaptation of Neurological Impairment Scale to brazilian population. Fisioterapia Brasil. 2013 [cited 2022 Dec 22]. Available from: Vista do Avaliação funcional dos acidentados de trânsito atendidos em um serviço de fisioterapia (convergenceseditorial.com.br)

18. Cabral CR, Mejia DPM. Principais protocolos e testes para avaliação da funcionalidade em lesionados medular (dissertação). 2011 [cited 2022 Dec 22]. Available from: https://portalbiocursos.com.br/ohs/data/docs/197/83Principais_protocolos_e_testes_para_avaliaYYo_da_funcionalidade_em_lesionados_medular.pdf

19. Joppert D, Orsini M, Mello MP, Bastos VH, Machado D, Silva, et al. ASIA Impairment Scale (AIS) and Spinal Cord Independence Measure (SCIM) as clinical and functional indicators for outcome assessment in rehabilitation of spinal cord injuries during hospital care. Rev. Bras Neurol [Internet]. 2022 [cited 2022 Dec 21];16–32. Available from: https://pesquisa.bvsalud.org/portal/resource/pt/lil-621073

20. BRASIL. Ministério da Saúde, Secretaria de Atenção à Saúde. Diretrizes de Atenção à Pessoa com Lesão Medular. Brasília. 2013 [cited 2022 Dec 22]. Available from: https://bvsms.saude.gov.br/bvs/publicacoes/diretrizes_atencao_pessoa_lesao_medular.pdf

21. Coelho JN. A funcionalidade dos indivíduos com lesão medular de etiologia não traumática – uma proposta para o uso da Classificação Internacional de Funcionalidade, Incapacidade e Saúde. Tese (Mestrado) - Universidade de São Paulo (USP), Ribeirão Preto, 2015 [cited 2022 Dec 22]. Available from: https://teses.usp.br/teses/disponiveis/17/17142/tde20072016113108/publico/JULIANANOGUEIRACOELHOCorrig.pdf

22. Wirz M, Mach O, Maier D, Benito-Penalva J, Taylor J, Esclarin A, et al. Effectiveness of Automated Locomotor Training in Patients with Acute Incomplete Spinal Cord Injury: A Randomized, Controlled, Multicenter Trial. Journal of Neurotrauma [Internet]. 2017 May 15 [cited 2022 Dec 21];34(10):1891–6. Available from: https://www.liebertpub.com/doi/epdf/10.1089/neu.2016.4643

23. Akkurt H, Karapolat HU, Kirazli Y, Kose T. The effects of upper extremity aerobic exercise in patients with spinal cord injury: a randomized controlled study. Eur J Phys Rehabil Med [Internet]. 2017 May [cited 2022 Dec 21];53(2). Available from: https://pubmed.ncbi.nlm.nih.gov/27824234/

24. Corrêa LS, Lopes-Neto D, Llapa-Rodriguez EO. Quality of life of persons with traumatic spinal cord injuries. Cogitare Enferm [Internet]. 2015 [cited 2022 Dec 22];20(4). Available from: https://revistas.ufpr.br/cogitare/article/view/41403/26631

25. Aquarone RL, Faro ACM e. Scales on Quality of Life in patients with spinal cord injury: integrative review. Einstein (São Paulo). 2014 Jun; 12(2):245–50 [cited 2022 Dec 21]. Available from: https://www.scielo.br/j/eins/a/pvB7P3pQHVZ6F5YBnYWTSmM/?lang=pt&format=pdf