Factors affecting independence among individuals with spinal cord injuries in Brazil: a cross-sectional study

Fatores que impactam a independência de indivíduos com lesão medular no Brasil: estudo transversal

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Abstract

Introduction: The spinal cord injury (SCI) affects functional independence. There are few studies that evaluate functional independence among individuals with SCI in Brazil. **Objective:** To evaluate the functional independence of individuals with SCI in Brazil, and explore the association between functional independence and personal, social, injury, and bladder and bowel-related factors. **Methods:** Data of 121 individuals with SCI about functional independence, personal, demographic, injury, bladder, and bowel factors were collected by interview and analyzed. It was used Spearman's rank correlation coefficient and the Mann-Whitney U test with $p < 0.01$ for correlations and $p < 0.05$ for post hoc tests significance level. **Results:** The region of the neurological level had the most substantial correlation with functional independence (0.370 to 0.570, $p \leq 0.001$), followed by sex (0.270, $p = 0.003$), American Spinal Injury Association (ASIA) Impairment Scale (AIS) classification (0.345, $p = 0.001$), and patterns in the bowel (-0.295, $p = 0.001$) and bladder functions (-0.281 to -0.334, $p \leq 0.002$). **Conclusion:** The region of the neurological level emerged as the most significant non-modifiable factor influencing functional independence. Furthermore, factors like sex, AIS classification, and bladder and bowel patterns, while demonstrating weaker associations, remain pertinent to functional independence.

Keywords: Spinal cord injury. Rehabilitation. Functional status.

Resumo

Introdução: *Lesões da medula espinhal (LME) afetam a independência funcional. Poucos estudos avaliam a independência funcional nessa população no Brasil.* ***Objetivo:*** *Avaliar a independência funcional de indivíduos com LME no Brasil e explorar a associação entre a independência funcional e fatores pessoais, sociais, da lesão, vesicais e intestinais.* ***Métodos:*** *Dados de 121 indivíduos com LME sobre independência funcional, fatores pessoais, demográficos, de lesão, bexiga e intestino foram coletados por entrevista e analisados. Utilizou-se o coeficiente de correlação de Spearman e o teste U de Mann-Whitney com nível de significância de $p < 0,01$ para as correlações e $p < 0,05$ para os testes post hoc.* ***Resultados:*** *A região do nível neurológico teve a correlação mais substancial com a independência funcional (0,370 a 0,570, $p \leq 0,001$), seguida pelo sexo (0,270, $p = 0,003$), classificação da American Spinal Injury Association (ASIA) Impairment Scale (AIS) (0,345, $p = 0,001$) e padrões intestinais (-0,295, $p = 0,001$) e de bexiga (-0,281 a -0,334, $p \leq 0,002$).* ***Conclusão:*** *A região do nível neurológico emergiu como o fator não modificável mais significativo que influencia a independência funcional. Fatores como sexo, classificação da AIS e padrões de bexiga e intestino, embora demonstrem associações mais fracas, continuam relevantes para a independência funcional.*

Palavras-chave: *Traumatismos da medula espinal. Reabilitação. Estado funcional.*

Introduction

Spinal cord injury or disease (SCI/D) is a neurological condition that leads to various physical complications. The extent and severity of the injury determine which body functions are partially or completely affected and which remain with intact function. When the individual has some function in sacral spinal cord level the injury is classified as incomplete, and when any function is preserved in sacral level is classified as complete injury. Lumbar injuries affect the lower extremities and sphincters, thoracic injuries can also affect more (high injuries) or less (low injuries) the trunk, and cervical injuries affect the upper extremities.[1]

Furthermore, the American Spinal Injury Association (ASIA) developed a system of classification named ASIA Impairment Scale (AIS), scored A to E, when A means a complete injury, B means a sensory incomplete injury, C and D means incomplete motor injury, and E means a normal functions in all segments.[1] As a result, there is a wide range of impairments among individuals with spinal cord injuries, ranging from complete inability to perform activities to minor complications that do not significantly impact daily functioning. This wide variation directly affects functional independence.[2]

The term "functionality" is used to describe the interaction between individual and their context. In the case of functional independence, this construct is multifactorial and depends on health conditions, body functions, body structures, daily activities, social participation, the environment, and personal factors.[3] For individuals with SCI/D, functional independence is determined by uncontrollable factors and factors that can be controlled and addressed through rehabilitation.

In SCI/D the functional independence can be assessed by Spinal Cord Independence Measure (SCIM), Functional Independence Measure (FIM), Modified Barthel Index (MBI) or Quadriplegia Index of Function (QIF). MBI and QIF have low evidence of validity, and between FIM and SCIM, the SCIM is more sensitive and comprehensive for evaluating people with SCI/D.[4,5] The SCIM is an instrument developed by Catz and colleagues[6] to assess the functional independence of individuals with SCI/D. The original instrument was developed in 1997 and has since been revised and updated into new versions.[6-9] SCIM III is the third version, created in 2007, and is the version with the largest number of studies on its measurement properties.[8] The instrument is formed by everyday activities.[6-10]

To date, we are aware of only one study that has examined the functional independence of individuals with SCI/D in Brazil with the SCIM.[11] However, this previous study only explored the relationship between functional independence and a few clinical and personal factors, such as individuals with paraplegia or tetraplegia categorization, time since injury and sex.

Our study aimed to describe the functional independence level of rehabilitated individuals with SCI/D in southern Brazil. Additionally, the study investigated personal, social, injury-related, and bladder and bowel-related factors that may be associated with functional independence. Studies of the description are important for analyzing individuals with SCI/D functional independence, comparing this outcome across different regions and countries, and helping institutions evaluate their rehabilitation processes and understand the factors associated with independence.

Methods

This is an exploratory cross-sectional study conducted at the Centro Catarinense de Reabilitação, a specialized rehabilitation center for individuals with physical and intellectual disabilities, founded in 1960 and affiliated with the Santa Catarina State Ministry of Health, Brazil. The study protocol was approved by the Human Research Ethics Committee of the Federal University of Santa Catarina (CAAE No. 24149616.0.0000.0121). All participants were fully informed about the study and provided written consent before participation.

Participants

The inclusion criteria for this study were being 18 years or older, living in Santa Catarina State, having a formal diagnosis of SCI/D, and being registered with the local outpatient neurological rehabilitation program after injury. Individuals were excluded if cognitive impairment or communication difficulties were identified in the medical record that made it impossible to carry out the interview, if they could not be reached after three telephone calls on different days and times, or if they chose not to participate.

Procedures

Data collection occurred from October 2019 to January 2020. The study was divided into two stages: recruitment and interview. In the first stage, the head of the nursing service screened the clinical records available in the center's database (physical and electronic files) from 1996 to January 2020 and selected potential participants. Those selected were contacted by telephone, informed about the objectives, confidentiality, and voluntary nature of participation, and asked for consent to proceed to the next stage.

Clinical injury data, including aetiology, AIS, injury time and level, were collected from medical records at the rehabilitation center. Eligible individuals underwent a structured interview by trained researchers to collect sociodemographic and bowel and bladder pattern data and administer the SCIM III. Ideally, the interview was conducted in person, but for those unable to attend in person, it was conducted by telephone on previously agreed-upon days and times.

Spinal cord independence measure

The SCIM III consists of three subscales: self-care (six items, scored from 0 to 20; SCIM SC), respiration and sphincter management (four items, scored from 0 to 40; SCIM RSM), and mobility (nine items, divided into "room and toilet" and "indoors and outdoors, on even surface", scored from 0 to 40; SCIM M). In this study, each subscale was treated as a single subscale. It has already been validated for assessment by observation or interview, and it has already been translated and validated for the Brazilian population.[12,13]

Data analysis

The IBM SPSS® Statistics 20.0 software was used for data analysis. The variables were analyzed for their distribution using the Kolmogorov-Smirnov normality test. Spearman's correlation coefficient (p) was used to assess the correlation between the SCIM scores and the variables, where 0.00 - 0.10 is negligible, 0.10 - 0.39 is weak, 0.40 - 0.69 is moderate, 0.70 - 0.89 is strong and 0.90-1.00 is a very strong correlation.[13] The significance level was set at $p < 0.01$. Mann-Whitney U test was performed for variables that correlated with functional independence and had two categories. The Kruskal-Wallis test was performed for variables that correlated with functional independence and had more than two categories, followed by the Mann-Whitney U test to test the difference between pairs. The significance level was set at $p < 0.05$.

For the post hoc test, the T7-T12 and L1-L5 categories of the region of neurological level were combined due to the small sample size of the last category. For bowel pattern, the categories "continence", "incontinence" and "constipations" were analyzed. Descriptive data was presented as absolute and relative frequency, median, first quartile, and third quartile.

Results

In the first stage, 254 potential individuals were selected. Of these, one chose not to participate, four did not meet the inclusion criteria, eight had died, and 120 could not be reached by the telephone number available in the medical record. A total of 121 medical records were analyzed (Table 1).

Table 1 - Characteristics of participants (n = 121)

Characteristics	n (%)
Sex	
Male	87 (71.9)
Female	34 (28.1)
Region of residence	
Metropolitan region	64 (52.9)
Non-metropolitan region	57 (47.1)
Age (years)	
Under 30	23 (19.0)
31-40	33 (27.3)
41-50	32 (26.4)
51-60	19 (15.7)
More than 60	14 (11.6)
Aetiology	
Traumatic	94 (77.7)
Non-traumatic	27 (22.3)
AIS	
A	69 (57.0)
B	12 (9.9)
C	5 (4.1)
D	8 (8.5)
Not available	27 (22.3)
Injury region	
C1 – T1	26 (21.5)
T2 – T6	30 (24.8)
T7 – T12	35 (28.9)
L1 – L5	3 (2.5)
Not available	27 (22.3)
Injury time (years)	
Under 5	50 (41.3)
6-10	39 (32.3)
More than 10	32 (26.4)
Bowel pattern	
Continence	81 (66.9)
Incontinence	8 (6.6)
Constipation	30 (24.8)
Diarrheic	1 (0.8)
Not applicable	1 (0.8)
Bladder pattern	
Continence	79 (65.3)
Incontinence	42 (34.7)
Characteristics	**Median (Q1 – Q3)**
Age (years)	42 (20 - 87)
Education (years)	9 (1 - 18)
Injury time (years)	6 (4 - 11)

Note: AIS = American Spinal Injury Association Impairment Scale; Q1 = first quartile; Q3 = third quartile.

Most of the individuals were men (71.9%), residents of the metropolitan region (52.9%), aged between 30 and 50 years (53.7%), and had a median education time of 9 years. The majority of injuries were traumatic, predominantly at the thoracic level and classified as AIS A, with a duration of more than five years (58.6%) (Table 1). Fifty-five interviews were conducted in person.

The SCIM total and subscales scores for the participant's characteristics are listed in Table 2. The SCIM scores by injury level are shown in Figure 1A-D, and the associations and strength of correlations between SCIM scores and participant's characteristics are presented in Table 3.

The region of neurological level showed a moderate positive correlation with SCIM total, SCIM SC and SCIM RSM scores and a weak positive correlation with SCIM M scores. The cervical levels had lower scores than thoracolumbar levels for SCIM total, SCIM SC, SCIM RSM and SCIM M. Moreover, the high thoracic level had lower scores than the low thoracic and lumbar levels for SCIM total, SCIM SC and SCIM RSM (Figure 1B-D).

Sex showed a weak positive correlation with SCIM RSM. Women had lower scores than men for SCIM RSM (Figure 2A). AIS classification showed a weak positive correlation with SCIM M. Classifications A and B had lower scores than C and D for SCIM M (Figure 2B). The bladder pattern showed a weak negative correlation with SCIM total and SCIM RSM, and the incontinence group scored lower than continence group for SCIM total and SCIM RSM (Figure 2 C and D). The bowel pattern showed a weak negative correlation with SCIM RSM. The constipation group had lower scores than the continence group for SCIM RSM (Figure 2E).

Discussion

Our study is one of the first to analyze the functional independence of rehabilitated individuals with SCI/D in Brazil using the SCIM III scale and to examine the relationship between functional independence and personal, clinical, bowel and bladder factors. Our results indicate that cervical injuries result in 49-57% less general functional independence, as evaluated by SCIM total score, than thoracolumbar injuries. Additionally, cervical injuries also result in 73-75% less independence for self-care, 37-46% less independence for respiration and sphincter management, and 53-58% less independence for mobility subscores of the SCIM compared to thoracolumbar injury levels.

Table 2 - Median of SCIM scores for the participant's characteristics (n = 121)

Variables	SCIM Total	SCIM SC	SCIM RSM	SCIM M
	Median [Q1; Q3]	Median [Q1; Q3]	Median [Q1; Q3]	Median [Q1; Q3]
Total score	64.0 [56; 72]	18.0 [12; 20]	30.0 [23; 34]	17.0 [13; 19]
Age (years)				
Under 30	67.0 [57; 71]	19.0 [15; 20]	33.0 [23.5; 35]	17.0 [13; 19]
31-40	62.0 [52; 71]	18.0 [12; 20]	30.0 [23; 33]	16.0 [11; 18]
41-50	68.5 [62; 73.5]	18.5 [12; 20]	30.0 [25; 34.5]	18.0 [16; 19.5]
51-60	63.0 [57; 72]	20.0 [13; 20]	27.0 [22; 34]	19.0 [15; 23]
Over 60	52.5 [21; 66]	12.0 [3; 20]	23.5 [18; 26]	13.0 [1; 18]
Sex				
Male (n = 87)	66.0 [58; 73]	18.0 [13; 20]	31.0 [24; 35]	18.0 [13; 19]
Female (n = 34)	60.5 [46; 68]	18.0 [10; 20]	25.0 [18; 31]	16.0 [11; 21]
Education (years)				
Under 5	63.0 [56; 68]	18.0 [12; 20]	31.0 [23; 33]	17.0 [13; 19]
6-10	69.0 [60; 74]	18.5 [14; 20]	33.0 [25; 34]	18.0 [14; 20]
Over 10	61.0 [38; 69]	18.0 [8; 20]	25.5 [18; 31]	17.0 [11; 19]
AIS				
A (n = 69)	63.0 [56; 70]	19.0 [14; 20]	27.0 [23; 33]	17.0 [12; 18]
B (n = 12)	62.0 [20; 70]	15.5 [3; 20]	31.5 [16; 35]	13. 5 [4; 18]
C (n = 5)	73.0 [68; 81]	13.0 [5; 20]	37.0 [27; 40]	21.0 [21; 23]
D (n = 8)	72.5 [58; 74]	19.0[14; 20]	28.5 [22; 31.5]	24.0 [20; 26]
N/A (n = 27)	66.0 [56; 74]	17.0 [12; 20]	30.0 [23; 34]	18.0 [13; 26]
Injury region				
C1 – T1 (n = 26)	32.5 [18; 68]	5.0 [2; 16]	18.0 [14; 27]	8.0 [3; 19]
T2 – T6 (n = 30)	63.0 [57; 69]	18.5 [17; 20]	28.5 [24; 33]	17.0 [13; 19]
T7 – T12 (n = 35)	69.0 [60; 73]	20.0 [18; 20]	33.0 [26; 35]	18.0 [15; 19]
L1 – L5 (n = 3)	75.0 [68; 78]	20.0 [19; 20]	33.0 [29; 34]	19.0 [18; 23]
N/A (n = 27)	66.0 [56; 74]	17.0 [12; 20]	30.0 [23; 34]	18.0 [13; 26]
Time since injury (years)				
Under 5	66.0 [59; 73]	18.0 [14; 20]	31.0 [26; 35]	17.5 [14; 21]
6-10	63.0 [49; 70.5]	19.0 [10; 20]	26.0 [22; 33]	17.0 [11; 19]
Over 10	63.0 [29; 70]	18.0 [7; 20]	25.0 [18; 33]	17.5 [5; 19]
Bowel pattern				
Continence (n = 81)	68.0 [56; 73]	18.0 [12; 20]	32.0 [24; 35]	17.0 [12; 19]
Incontinence (n = 8)	59.5 [54; 68]	18.5 [12; 20]	23.0 [21; 32]	19.0 [16; 20]
Constipation (n = 30)	60.5 [58; 64]	18.0 [12; 20]	25.0 [23; 28]	17.0 [14; 19]
Diarrheic (n = 1)	26	13	13	0
N/AP (n = 1)	74	20	35	19
Bladder pattern				
Continence (n = 79)	67.0 [58; 73]	18.0 [13; 20]	31 [25; 35]	18.0 [14; 20]
Incontinence (n = 42)	60.0 [41; 67]	18.0 [9; 20]	24.5 [19; 31]	17.0 [7; 19]

Note: SCIM = Spinal Cord Independence Measure; SC = self-care; RSM = respiration and sphincter management; M = mobility; Q1 = first quartile; Q3 = third quartile; n = number; AIS = American Spinal Injury Association Impairment Scale; N/A = not available; N/AP = not applicable.

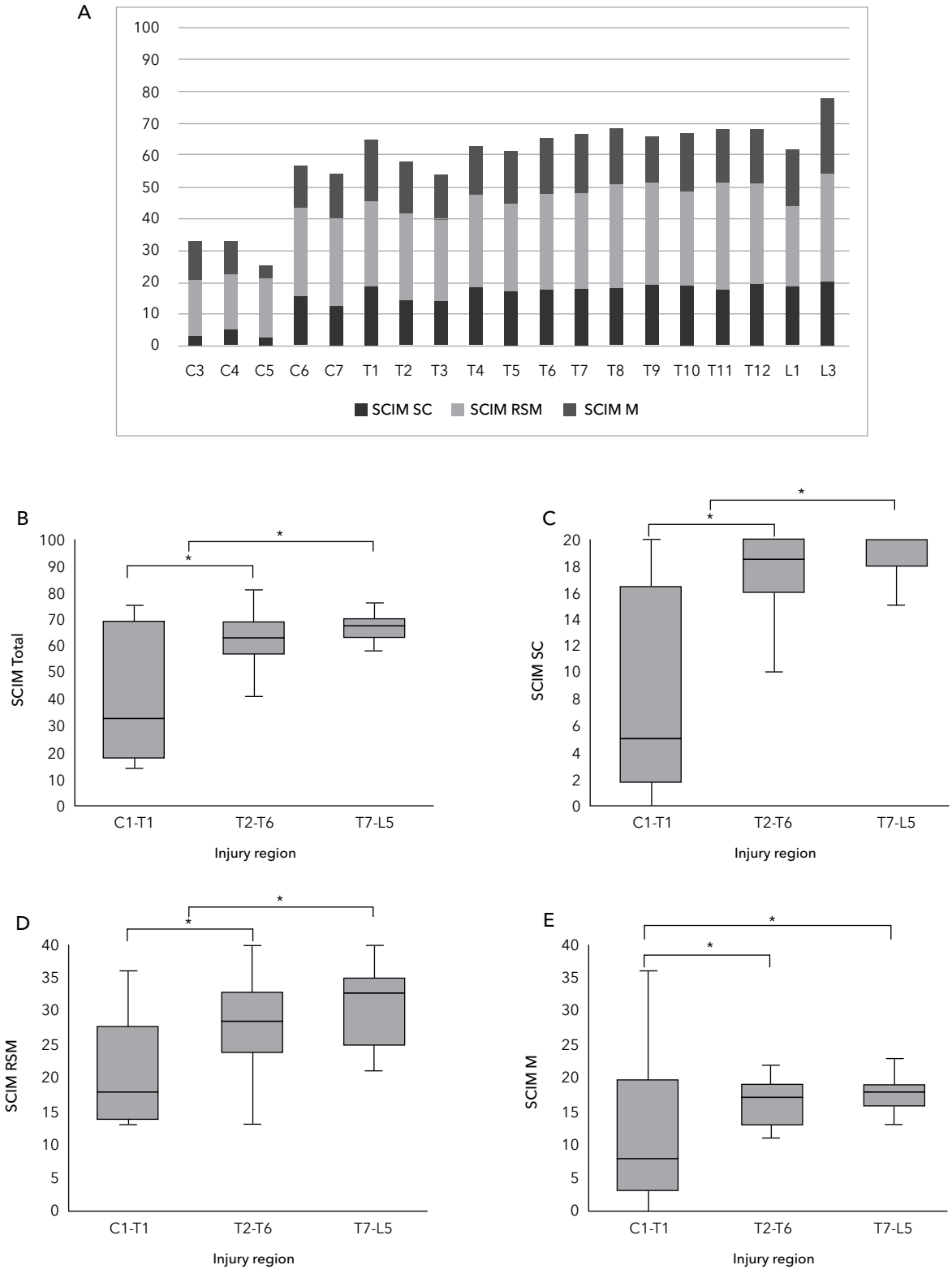

Figure 1 - Spinal Cord Independence Measure (SCIM) scores per level of injury.

Note: SC = self-care; RSM = respiration and sphincter management; M = mobility.

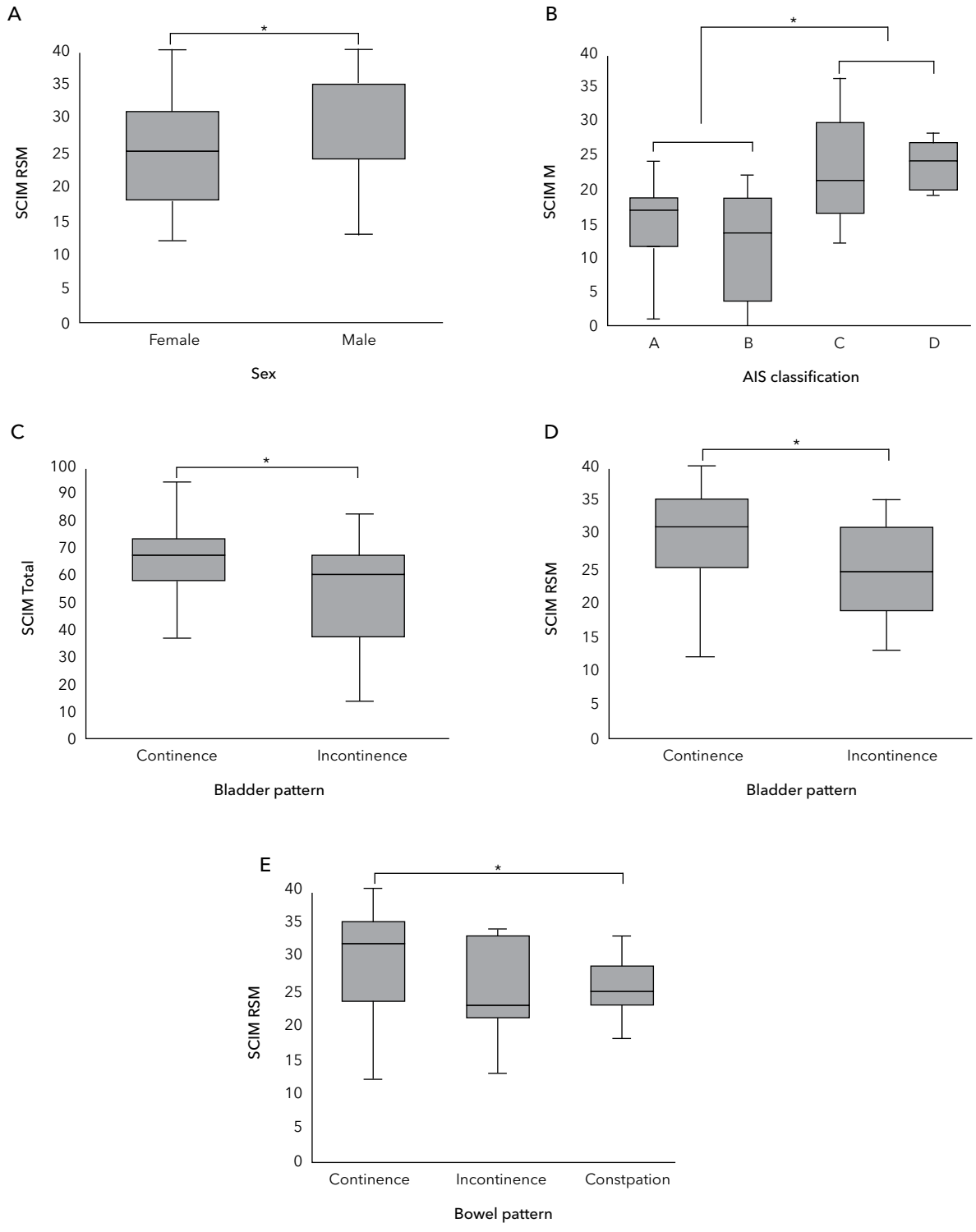

Figure 2 - Association between Spinal Cord Independence Measure (SCIM) scores with injury region.

Note: AIS = American Spinal Injury Association Impairment Scale; RSM = respiration and sphincter management; M = mobility.

Table 3 - Association of SCIM scores with participant's characteristics (n = 121)

Variables	SCIM TOTAL		SCIM SC		SCIM RSM		SCIM M	
	Rho	p	Rho	p	Rho	p	Rho	p
Age (year)	-0.099	0.281	-0.083	0.366	-0.220	0.015	0.062	0.498
Education (years)	-0.158	0.083	-0.101	0.268	-0.179	0.049	-0.173	0.058
Time since injury (years)	-0.219	0.016	-0.111	0.225	-0.227	0.012	-0.179	0.050
Gender	0.166	0.069	0.051	0.581	**0.270**	**0.003***	0.050	0.585
AIS (n = 94)	0.155	0.136	-0.076	0.468	0.064	0.542	**0.345**	**0.001***
Injury region (n = 94)	**0.490**	**0.000***	**0.570**	**0.000***	**0.508**	**0.000***	**0.329**	**0.001***
Bowel pattern	-0.204	0.025	-0.063	0.495	**-0.295**	**0.001***	0.033	0.720
Bladder pattern	**-0.281**	**0.002***	-0.113	0.216	**-0.334**	**0.000***	-0.207	0.022

Note: SCIM = Spinal Cord Independence Measure; SC = self-care; RSM = respiration and sphincter management; M = mobility; Rho = correlation coefficient; AIS = American Spinal Injury Association Impairment Scale. Bold values = statistically significant; *p < 0.01.

High thoracic injuries (T2-T6) result in 9% less general functional independence than low thoracic (T7-T12) injuries and 16% less independence than lumbar levels. For the self-care score, high thoracic injuries result in 7.5% less independence than low thoracic and lumbar injuries. For respiration and sphincter management, high thoracic injuries result in 14% less independence than low thoracic and lumbar levels.

Furthermore, women had 20% less independence for respiration and sphincter management than men, and individuals classified A or B on the AIS scale had 20-44% less independence for mobility than those classifies C or D. Assuming both women and men data together, being continent correlated with 28-40% more independence for respiration and sphincter management than constipation or incontinence, continent individuals had 10% more functional independence and 20% more independence for respiration and sphincter management than incontinent individuals.

Comparing our results with studies warrants caution due to variations in methods and data representation. Nonetheless, our findings indicate that region of neurological level is the most significant factor correlated with functional independence and are consistent with the literature.[14] Conversely, Benedicto et al.[11] and Osterthun et al.[15] categorized participants as either individuals with paraplegia or tetraplegia, observing distinct differences in SCIM total, self-care and respiration, and sphincter management scores between these groups. Similary, Majamäki et al.[16] segmented participants into several groups based on the AIS classification and injury level (C1-C4 AIS A, B and C; C5-C8 AIS A, B and C; T1-S5 AIS A, B and C; and all levels AIS D), and identified variances among these groups.

Our research also highlighted differences among all groups, barring the thoracic categories, particularly in the SCIM M score, and it was noted that AIS A classification did not significantly differ from AIS B, nor did C from D. However, distinct variations were observed between the combined A+B and C+D groups. Unlike other studies, which did not perform comparative analysis based on characteristics as ours did, their findings generally indicate a trend where lower-level injuries corresponded with higher SCIM total score.[14,17-20]

The median SCIM total values in our study were 64, which is slightly higher than other studies conducted in North America and Asia.[18,19] However, for individuals with C1 to T1 injury levels, we found a median value (MV) of 32; from T2 to T6, MV of 63; from T7 to T12, MV of 69; and from L1 to L5, MV of 75, which are comparable to the findings in other studies in Europe, North America, and Asia.[14,18,20] Differences in sociodemographic and economic situations, healthcare systems, or the population included may explain minor value differences. For instance, Ackerman et al.[20] found that for cervical-level injuries, the median value ranged from 19 to 50; for high thoracic-level injuries, the median value was 63; and for low thoracic and lumbar-level injuries, the median value was 66 in a population of six countries in North America, Europe, and Asia, with AIS classification

A or B. Moreover, Aidinoff et al.[14] found that for cervical-level injuries the median values ranged from 8 to 43; for high thoracic-level injuries, the median values ranged from 58 to 63; for low thoracic-level injuries, the median values ranged from 63 to 69; and for lumbar level injuries, the median values ranged from 72 to 76 in a United States population with complete injuries. Khatri et al.[18] reported a median value of 21 for cervical-level injuries, 61 for thoracic-level injuries, and 79 for lumbar-level injuries in a Nepalese population of children and adults with complete injuries. Loni et al.[19] found that values increased as the level of the injury decreased, with a maximum variation of 8 to 64 points between the cervical and thoracolumbar levels. There were also higher values as the classification went from AIS A to B and C, ranging from 8 to 42 for A, 15 to 55 for B, and 21 to 64 for C in an Iranian population over 15 years old.[19] Osterthun et al.[15] found that for individuals with long-standing motor complete SCI/D, the median value was 37 for tetraplegic individuals and 65 for paraplegic individuals.[15] In addition, Jörgensen et al.[17] reported a mean of 65.2 (± 24.2), a value similar to the median found in our study.

For the self-care subscale, we found the same value as Khatri et al.,[18] which is higher than Ackerman et al.[20] and similar to Aidinoff et al.[14] Our findings on the respiration and sphincter management subscale and the mobility subscale were comparable to the other studies. Benedicto et al.[11] and Osterthun et al.[15] found no difference between men and women. In contrast, Majamäki et al.[16] found that women had a higher SCIM total score than men (80.0 and 73.5, respectively); however, our results differ from this study, as we found that men had a higher score only in respiration and sphincter management (25.0 and 31.0, respectively). Majamäki et al.[16] divided participants into age groups (20-30, 31-45, 46-60, 61-75, >75 years old) and found differences between the groups for the SCIM total, self-care and SCIM M. Osterthun et al.[15] divided the sample into > 55 years and < 55 years old and found no difference between the age groups, which is consistent with our findings of no association between age and SCIM total score.

Regarding the time since injury, Benedicto et al.[11] divided participants into < 2 years and 2-5 years after the onset of the injury and found a difference between the groups for self-care. Majamäki et al.[16] divided participants into 1-5 years, 6-10 years, 11-15 years and >15 years after the onset of the injury and reported differences between all groups. Our findings differed, since we found no difference between the groups based on time since injury. Lastly, although Benedicto et al.[11] categorized educational levels as high and low, our study divided them into ranges or years. Interestingly, neither study observed significant differences or associations between SCIM total scores and education levels. Notably, no other study has associated or compared the SCIM total score with groups according to bowel or bladder pattern.

This study is among the first to provide data on functional independence in a Brazilian population with SCI/D using the SCIM. However, as the seventh largest country in the world in population and the fifth largest country in territory, Brazil exhibits significant cultural, social, and demographic variations, including disparities in the form and quality of health services provided to its population. This study was conducted with a sample from only one Brazilian state, even though it is the smallest state in the southern region of the country, both in terms of population and territorial level it is larger than countries in Europe, such as Denmark, Croatia and the Netherlands, and in terms of Human Development Index (2022 data) it is also similar to countries as Bulgaria, Albania, Grenada and China.[21-23] Therefore, the results may be universally applicable to other states in Brazil or countries with similar socioeconomic characteristics as well as similar characteristics in health service provision.

Conclusion

This study provides one of the first comprehensive analyses of functional independence in individuals with SCI/D in Brazil using the SCIM III. Among the factors examined, the neurological level of injury emerged as the most significant determinant of functional independence, confirming its importance as a core, non-modifiable clinical characteristic. Importantly, our findings also highlight the influen-ce of sex and AIS classification on specific functional domains. Women demonstrated lower scores in the respiration and sphincter management domain, suggesting that sex-specific strategies may be beneficial during rehabilitation.

Similarly, individuals with more severe AIS classifications (A and B) showed significantly lower mobility scores compared to those with incomplete motor injuries (C and D), underscoring the relevance of neurological severity in predicting functional outcomes. Furthermore, bladder and bowel patterns, while weakly correlated with functional independence, represent potentially modifiable factors. These domains should be addressed proactively during long-term rehabilitation to optimize independence in activities of daily living and quality of life.

Clinically, this study offers valuable benchmarks for comparing SCIM scores in Brazil to international data and provides insights for tailoring rehabilitation approaches based on injury characteristics and personal factors. These findings support a more individualized and context-sensitive rehabilitation model for people with SCI/D and emphasize the importance of continuity of care beyond the initial phase of rehabilitation.

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Authors' contributions

DAC, TCSL, FF, and ADT contributed to the study's conceptualization and design; AL, DAC, TCSL, SPBON, ADT and JI, to the development of the study; DAC, TCSL, SPBON, and ADT, to the data collection; and AL, ADT, and JI, to the data analysis, interpretation and writing of the report. DAC, TCSL, SPBON, and FF provided feedback on the original draft report. All authors approved the final version.

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