

The profile of spinal injuries in Porto Alegre

Estudo do perfil do trauma raquimedular em Porto Alegre

Estudio del perfil de trauma raquimedular en Puerto Alegre

Verônica Baptista Frison¹, Glaciéle de Oliveira Teixeira², Thais Fonseca de Oliveira²,
Thais de Lima Resende³, Carlos Alexandre Netto⁴

ABSTRACT | This transversal study aimed at determining the profile of the population who suffered spinal injury (SI) and was admitted to emergency hospitals in Porto Alegre/RS. The profile of the population who had SI between January 2005 and January 2010 was retrospectively investigated through data collected from medical records. A total of 1320 records were analyzed, of which 63.3% were male, with a mean age of 47.02±19.6 years. The most prevalent spinal cord injury (SCI) mechanisms were falls from a height (27.2%), traffic accidents (25.8%) and falls from own height (13.2%) and the spinal levels that are usually affected were lumbar (35,6%), thoracic (21.9%) and cervical (20.5%). Only 142 (10.7%) individuals who had a SI SCI, with a higher prevalence of incomplete lesion (63.3%). In Porto Alegre SI affects mainly middle aged men, who fell from a height and had the lumbar level as the most affected. The SCI affects younger individuals at the cervical level. These findings are important to guide the efficient allocation of resources for the management of these injuries and their repercussions and to prevent this kind of event in the risk population.

Keywords | spinal injuries; spinal cord compression; spinal cord injuries; epidemiology.

RESUMO | Este estudo de coorte retrospectivo foi desenvolvido com o objetivo de traçar o perfil da população que sofreu trauma raquimedular (TRM) e foi internada em hospitais de pronto atendimento de Porto Alegre/RS. O perfil da população que sofreu TRM de

janeiro de 2005 a janeiro de 2010 foi investigado retrospectivamente a partir da coleta de dados em registros médicos. Foram analisados 1320 prontuários, dos quais 63,3% eram do sexo masculino, com média de idade de 47,02±19,60 anos. Os mecanismos de TRM que prevaleceram foram queda de altura (27,2%), acidente de trânsito (25,8%) e queda da própria altura (13,2%), e os níveis da coluna vertebral mais acometidos foram lombar (35,6%), torácico (21,9%) e cervical (20,5%). Da amostra total, 10,7% dos indivíduos que sofreram TRM apresentaram lesão medular (LM), com maior prevalência da lesão incompleta (63,3%). O TRM em Porto Alegre acomete principalmente homens na meia-idade, que tiveram na queda de altura a etiologia mais frequente e no nível lombar o mais acometido. A LM ocorreu mais em indivíduos jovens, sendo o nível cervical o mais lesado. Esses achados são importantes para orientar a alocação eficiente de recursos para o manejo desses agravos e suas repercussões e para prevenir a sua ocorrência nas populações em risco.

Descritores | traumatismos da coluna vertebral; compressão da medula espinal; traumatismos da medula espinal; epidemiologia.

RESUMEN | Este estudio transversal fue desarrollado con el objetivo de trazar el perfil de la población que sufrió trauma raquimedular (TRM) y fue internado en hospitales de emergencia de Puerto Alegre/RS. El perfil de la población que sufrió TRM de enero de 2005 a enero de 2010

Study conducted at the Physical Therapy course of the Nursing, Nutrition and Physical Therapy Faculty at Pontificia Universidade Católica do Rio Grande do Sul (PUCRS) – Porto Alegre (RS), Brasil.

¹Mestre pelo Programa de pós-graduação em Neurociências da Universidade Federal do Rio Grande do Sul (UFRGS); Professora Assistente da Faculdade de Enfermagem, Nutrição e Fisioterapia da PUCRS – Porto Alegre (RS), Brasil.

²Physical Therapist – Porto Alegre (RS), Brasil.

³PhD in Health Sciences by the Postgraduate program of the Medical School at PUCRS; Professor at the Nursing, Nutrition and Physical Therapy Faculty of PUCRS – Porto Alegre (RS), Brasil.

⁴PhD by Instituto de Ciências Básicas da Saúde, Biochemistry department at UFRGS – Porto Alegre (RS), Brasil.

fue investigado retrospectivamente a partir de la recopilación de datos en registros médicos. Fueron analizadas 1320 fichas clínicas, de las cuales 63,3% eran de sexo masculino, con promedio de edad de $47,02 \pm 19,6$ años. Los mecanismos de TRM que prevalecieron fueron caída de gran altura (27,2%), accidente de tránsito (25,8%) y caída desde la propia altura del sujeto (13,2%) y los niveles de la columna vertebral más lesionados fueron lumbar (35,6%), torácico (21,9%) y cervical (20,5%). De la muestra total, 142 (10,7%) de los individuos que sufrieron TRM presentaron lesión medular (LM), con mayor prevalencia de lesión incompleta

(63,3%). El TRM en Puerto Alegre ocurre principalmente en hombres en edad media, que tuvieron una caída de gran altura, la cual constituye la etiología más frecuente y el nivel lumbar es el más lesionado. Estos hallazgos son importantes para orientar la asignación eficiente de los recursos para el manejo de estas lesiones y sus consecuencias para prevenir su incidencia en la población en riesgo.

Palabras clave | traumatismos de la columna vertebral; compresión de médula espinal; traumatismos de la médula espinal; epidemiología.

INTRODUCTION

The spinal injury (SI) is described as a lesion of any component of the spine, be it bone, ligament, medullary, disc, vascular or radicular lesions¹. In contrast, the spinal cord injury (SCI) is defined as the decrease or loss of motor and/or sensory and/or anatomic function below the level of the lesion by the American Spinal Injury Association (ASIA), and such lesion can be complete or incomplete due to the impairment of neural elements inside the spinal channel².

SCI is characterized as one of the most severe disabling neurological syndromes, leading to changes in sensitivity, motricity and disorders of the autonomic system in the segments of the body that are located below the lesion^{3,4}. Even though its estimated worldwide incidence is not so high (15 to 40 cases per million), its social and economic cost is disproportionately high⁵, negatively impacting on the quality of life and self-esteem of those affected by it⁶.

As reported in literature, in Canada US\$ 61.6 million dollars were spent in a year only with hospital costs for SI⁷, whereas in the United States the cost of treatment is estimated as US\$ 9.7 billion a year⁸. Considering 2007 as the base year, in Spain it was estimated that the cost of SI for the society ranged from 131 to 302 million US\$, depending on the lesion mechanism⁹. From the data in these countries, where there are national registers which allow the better evaluation of the impact of SI on public health, it is clear that this condition, even if not so prevalent, is an important item in the public expenses with health. Even though there are not clearly defined numbers in Brazil, it is estimated that approximately R\$ 9 billion are destined to treatments for trauma every year, which correspond to almost one third of all the investment in public health in Brazil¹⁰.

In Brazil, studies showing the epidemiological profile of SI considering all kinds of trauma mechanisms in São Luís/MA¹¹ and in São Paulo/SP¹ were carried out. In both studies, mostly young men fell from high places or suffered falls, and this proportion was significantly higher than that of car accidents, with major thoracic or thoracolumbar impairment. A national study¹² confirms the prevalence among young men at reproductive age, but the distribution of trauma mechanisms follows a different order, in which traffic accidents appear with the highest number of cases, followed by falls and fire-arm injuries (FAI). In addition, regional differences are also clear, as observed in the comparison between the South region, which registered the highest number of cases resulting from diving in the country and the second highest level of traffic accidents, and the North region, which presented only one register of SI caused by traffic accident and one by diving¹². Additionally, it is important to consider that the differences also happen locally, as observed in a study conducted in Rio de Janeiro from 1996 to 2011, in which hospital admissions due to SI were analyzed in the municipal and state public emergency hospitals of the city¹³. The researchers compared several indicators and concluded that there were differences between the two health network, and the state hospitals presented higher values in terms of expenses with hospital admissions and their volume, besides a longer mean permanence, however, a significantly lower mortality rate than the one found in the municipal hospitals.

Thus, considering that differences in the profile of SI can be even local, the use of epidemiological data to plan health actions is very important to guide health promotion strategies, which can result in the prevention of the main etiological causes and in improved quality of life for the population^{14,15}. The results of the epidemiological study also enables the development of a more

effective and proper treatment for the analyzed population. Therefore, epidemiological data concerning SI have been used by health professionals, and those of other fields, to improve the quality of life of people with injuries and to help prevent the lesion in populations at risk¹⁶. Nonetheless, it is necessary to base the management and the planning of health actions on more accurate information; thus, it is important to reassess the epidemiology of the SI in regular intervals, and also, data should concern specific populations, given the specific features of each people^{15,17}, region¹² or location¹³.

Up until this moment, no study has been found in literature that describes the epidemiological profile of individuals who suffered SI in the city of Porto Alegre/RS. Therefore, the objective of this study was to determine the profile of individuals who suffered SI in the city of Porto Alegre and surroundings between 2005 and 2010, bearing in mind the need to intervene with preventive programs and public health policies that seek to effectively reduce spinal cord injury in this community, as well as planning the care of those who are injured.

METHODOLOGY

This is a cross-sectional and retrospective study performed at the medical records' archives from *Hospital Cristo Redentor* (HCR) and *Hospital de Pronto Socorro* (HPS), both in the city of Porto Alegre/RS. The choice of these hospitals is due to the fact that patients suffering from spinal cord injury in Porto Alegre and Greater Porto Alegre are always taken to one of these two institutions, which are referral centers for this type of injury.

Data collection occurred from May to August 2010. In this study, data from medical records of patients who suffered SI from January 2005 to January 2010 were included, in which there was the corresponding international classification of diseases (ICD). All medical records were analyzed from the admission due to SI until hospital discharge. Therefore, medical records of patients who were not diagnosed with SI from hospital admission to hospital discharge, also through the ICD register, were excluded.

The following variables were collected: gender, age, trauma mechanism, level of trauma, level of SI (when present) and type of SI, being the latter divided into complete and incomplete.

This study was approved by the Research Ethics Committee of *Pontifícia Universidade Católica do Rio Grande do Sul*, number 10/04968, by the Research Ethics Committee of *Grupo Hospitalar Conceição*, project number 10-010, and by the Research Ethics Committee of the Municipal Health Authority of Porto Alegre, number 001.004651.10.3, registration number 458. According to the resolution 196/96 IX.2 "e" (CONEP – Ministry of Health), data will be stored for 5 years and then destroyed.

Initially data were analyzed through descriptive statistics, with the distribution of simple and relative frequencies, as well as position (mean and median) and dispersion (standard deviation and amplitude). The normality of data was investigated by the Kolmogorov-Smirnov test.

Student's *t*-test was used to compare quantitative variables. The χ^2 test was used to compare the proportions of the same variable, considering the theoretical distribution of homogeneity between the compared categories. Data were statistically treated with the software SPSS 17.0 (Statistical Package to Social Sciences for Windows), and the adopted significance level (α) was 5% for decision criteria.

RESULTS

In this study, 1,320 medical records were analyzed; data concerning the absolute and relative distributions for gender, age, and age group are presented in Table 1, also divided by hospital. From the total number of analyzed records, 394 (29.8%) did not present the description of trauma mechanism, and 281 did not present the description of the level of trauma (Table 2). Therefore, all the analyses concerning the trauma mechanism and the level of trauma were conducted with the total sample of 926 and 1,039 medical records, respectively.

Of the analyzed medical records (Table 1), 63.3% of individuals were male, with mean age of 47.02 ± 19.60 years. In terms of distribution of the sample by age group, no statistically significant differences were found between the two studied institutions. Children and adolescents were the least prevalent group (6.8%), followed by the elderly (aged ≥ 60 years; 28.1%), and the adults were the most prevalent group (65.1%).

Data regarding the absolute and relative distributions of trauma mechanism and level of injury, according to the presence or absence of lesion for the total of patients, as well as both hospitals, are presented in Table 2.

Falling from a high place (27.2%), traffic accident (25.8%) and falling from one's own height (13.2%) were the main trauma mechanisms. The most affected spinal levels were: lumbar (35.6%), thoracic (21.9%), cervical (20.5%), and sacral (0.75%).

Only 142 (10.7%) individuals who suffered SI presented spinal cord injury (SCI), with prevalence of the incomplete lesion (63.3%; χ^2 calc=27.586; $p < 0.001$). The male gender was mostly affected (81.9%), and the mean age was 39.6 ± 17.9 years.

The cervical level was the most affected one (42.2%), followed by the thoracic (37.3%), lumbar (20.4%), and the FAI was the main lesion mechanism.

DISCUSSION

This study shows that the SI affects mostly men (63.3%). This data is in accordance with several studies conducted in the past few years, which show that among the different investigated populations, the male gender is always more prevalent^{1,11,18-22}. The mean age of this study was 47.02 years, similar to the findings by Gonçalves et al.¹⁸, who analyzed medical records of patients admitted to a hospital in São Paulo from 2003 to 2006, and also to those by Jiménez-Ávila, Calderón-Granados and Bitar-Alatorre²³, whose study was conducted in Mexico and observed that the population with SI is mainly composed of male individuals, with mean age of 48.9 ± 16.8 years. However, in the study by Brito et al.¹¹ (33.96 ± 13.56 years), as well as in that by Vasconcelos and Riberto²⁴ (38 ± 17 years), both performed in Brazil, the mean age was much lower than that of our sample and the one by Gonçalves et al.¹⁸. Both studies diverge not only from the results in this study, but also from recent reviews, which point to the increase in the age when the SI occurs, partially explained by the aging of the population in developed countries^{15,17,25} and by the etiology of the trauma, which ranges from violence in developing regions, such as Africa, Middle East, and Latin America, to falls in Japan and Western Europe, which are developed regions²⁵.

By observing the age and the etiology of SI, it seems clear that the reduction of the prevalence and the incidence of SI will require attention to socioeconomic, anthropological, and cultural issues^{13,15,16,26,27}. The main trauma mechanisms of this research were falling from high places (27.2%), followed by traffic accidents (25.8%), and falling from one's own height (13.2%). Koch, Graells and Zanielli¹⁹ found

Table 1. Absolute and relative distribution for gender and age in the two analyzed hospitals

Variables	Total	Hospital		P
		HPS	HCR	
Gender*				
Female	354 (37.8)	354 (37.8)	130 (33.9)	0.206 [§]
Male	582 (62.2)	582 (62.2)	253 (66.1)	
Age (years)				
Mean \pm SD	47.8 \pm 20.0	47.8 \pm 20.0	44.8 \pm 18.6	0.009 [¶]
Minimum-maximum	1.8-92.0	1.8-92.0	6.0-91.0	
Age group (years)*				
≤19	90 (6.8)	56 (6.0)	34 (8.9)	>0.05 [§]
20-29	204 (15.5)	134 (14.3)	50 (13.1)	
30-39	203 (15.4)	126 (13.4)	57 (14.9)	
40-49	230 (17.4)	184 (19.6)	63 (16.4)	
50-59	223 (16.8)	138 (14.7)	90 (23.5)	
60-69	171 (13.0)	120 (12.8)	41 (10.7)	
70-79	128 (9.7)	94 (10.0)	31 (8.1)	
80-89	63 (4.8)	78 (8.3)	16 (4.2)	
≥90	8 (0.6)	7 (0.7)	1 (0.3)	

HPS: Hospital do Pronto Socorro; HCR: Hospital Cristo Redentor; *Values presented as n (%).
[§]Pearson's χ^2 test with continuity correction; [¶]Student's *t*-test for independent groups assuming variance heterogeneity

Table 2. Absolute and relative distribution of the trauma mechanism and level of spinal lesion according to the presence or absence of lesion for the total of patients in both hospitals

Variables	Total (n=1,320)	Spinal Lesion	
		Yes (n=142)	No (n=1,178)
Trauma mechanism			
Fall from high places	359 (27.2%)	29 (8.1%)	330 (91.9%)
Traffic accidents	340 (25.8%)	35 (10.3%)	305 (89.7%)
Fall from own height	174 (13.2%)	6 (3.4%)	168 (96.6%)
Firearm	53 (4.0%)	40 (75.5%)	13 (24.5%)
No description*	394 (29.8%)	-	-
Level of trauma			
Cervical	271 (20.5%)	60 (42.2%)	211 (57.8%)
Thoracic	288 (21.8%)	53 (37.3%)	235 (62.7%)
Lumbar	470 (35.6%)	29 (20.4%)	441 (79.6%)
Sacral	10 (0.8%)	-	10 (100%)
No description*	281 (21.3%)	-	-

*No description: no description was found in the medical records in relation to mechanism or level of trauma; values presented as n (%)

that among the 502 studied patients, accidents caused by falls (50.4%) were the main mechanism, followed by traffic accidents (25.5%). The similarity between this study and the one by Koch, Graells and Zanielli¹⁹, both conducted in states in the South of Brazil, points to the need for

improvements in the workplace and traffic safety. The need to improve traffic safety is corroborated by the findings of Vasconcelos and Riberto²⁴, who showed that half of the interviewed individuals with SI, about the seriousness of SIs. The preventive aspects of SI most mentioned by the interviewees were the need for more attention, precaution and caution, the proper use of individual protection devices and respect for traffic rules²⁴.

Therefore, while the etiology of trauma mechanisms was similar in two Brazilian states — the one in this study and the one in the study by Koch, Graells and Zanielli¹⁹ —, Pirouzmand²⁰ shows that, for 10 years, 66% of the 12,192 patients from an adult trauma center in Canada suffered SI from a traffic accident. The researcher also points out that falls and violence, second and third causes of SI, respectively, increased during this same period. These findings are similar to the ones in the study by Jackson et al.¹⁶, also conducted in North America, stating that traffic accidents responded for 45.6% of SI cases in the United States from 1973 to 2003, followed by falls (19.6%) and violence (17.8%). In Nigeria, Africa, men (70.1%) suffered SI due to traffic accidents (77.4%)²⁷.

Although in this study FAI corresponded to only 4.0% of the causes of SI, they correspond to the main mechanism that leads to spinal cord injury (75.5%), and this is in accordance with the study by Koch et al.¹⁹ (2007), which presents FAI as being responsible for 65.91% of spinal lesions. The social and cultural characteristics of the country and/or region probably explain this agreement between the findings of the aforementioned studies, which are in accordance with other cultures: in the United States, from 2000 to 2003, violence was the third most frequent cause of SCI (17.8%), and in a prior period (1990 to 1999) it was the second most common cause¹⁶, which shows that this tendency also comes from other decades and cultures.

The results in this study indicated the lumbar spine (35.6%) as being the most affected by SI, which is in accordance with the study by Pirouzmand²⁰, who found this same level as being the most affected one (50%) in a study that documented the epidemiology of SI and spinal lesion in the largest adult trauma center in Canada in two decades. A possible explanation for the lumbar region to be the most affected one in our study may be the great percentage of falls from a high place and from one's own height, since these trauma mechanisms usually lead to lesions in this region²⁸. Changes that come with aging may be seen as trauma facilitators, such as the worsened proprioception, the presence of tremors which make walking difficult, the slower defense reflexes, and

the tissue changes characteristic of the aging process, thus leading to an increased risk of falls in this age group²⁹. This is in accordance with the fact that 27.5% (n=363) of the present sample consisted of elderly individuals (71.67±8,33 years old), who also accounted for most of those who fell from their own height (124/175; 71%).

The connection between trauma mechanism, age, and level of trauma is also clear when the results of two Brazilian studies are observed; one was conducted in Curitiba/PR³⁰, and another in Ribeirão Preto/SP²⁴. In both cases, the sample was mostly composed of young men (mean age: Curitiba=27 years; Ribeirão Preto=38 years). While the former assessed only SI caused by fire-arm injury, the latter analyzed all the trauma mechanisms, except those caused by firearms. Regardless of the etiology differences, the thoracic region was the most affected one, or one of the most affected ones. In Ribeirão Preto, traffic accidents were responsible for half of the SI cases, out of which half occurred with motorcycles; therefore, the cervical spine was the most affected one (45%), followed by the thoracic and the lumbar spine (27 and 25%).

The president of the Brazilian Society of Neurosurgery stated that “the experience of other countries shows that the awareness of the population, allied to concrete measures as law proposals, may positively interfere in the trauma rates in Brazil”¹⁰. Therefore, through the data presented in this research, as well as the results presented by Vasconcelos and Riberto²⁴, it is possible to infer that campaigns to prevent workplace accidents and to promote traffic education, increasing the population's awareness, could temporarily help to reduce the rates of falling from high places and traffic accidents, which represent the major causes of SI in this region of the country. It is worth remembering that some campaigns have been done, such as: *Conte para a gente Conte com a gente* (Tell us, Count on Us), launched by the Ministry of Labor in 2006, and *Tolerância Zero* (Zero Tolerance), also idealized by the government, to decrease the rate of traffic accidents caused by drink (drink driving) ou por driving under the influence of alcohol driving. However, as widely shown by the media, both campaigns lost power with time. Therefore, besides the current intensified control, there is the need to establish a permanent education program related to workplace and traffic safety in schools, companies, and driving schools, aiming at reducing and permanently controlling the rates related to falling from high places and traffic accidents.

When affecting economically active people, the SI ends up interrupting the professional activity of these subjects, thus changing their routine and their families',

besides generating high costs for the society³¹. In the United States, the economic impact of SI surpasses US\$ 4 billion/year⁸, whereas in the world the estimated cost is US\$ 518 billion. Hence, it is necessary to evaluate the responses after a spinal lesion, not only in terms of neurological damage and functional reestablishment, but also regarding psychosocial aspects and monetary costs for the subject and the society. This is even more relevant when observing the fact that the severity of the damage is directly correlated to the costs, which are, in the first year after the lesion, estimated in US\$ 682,957 for tetraplegic patients and US\$ 249,549 for paraplegic patients³¹.

It is important to mention that, besides the sequels of the neurological lesion, the duration of hospital stay for individuals who suffer the trauma and SI can be significantly impacted by other impairments. That is, adverse events with significant resulting morbidities are common during the acute phase of hospitalization for these individuals. In a study performed by Cheung et al.³² with 110 people who suffered spinal lesions between 2008 and 2009, in Canada, adverse events occurred in 83.6% of the cases, being mostly with men with mean age of 45.8±19.6 years. These events occurred in the intraoperative period (20.0%), as well as in the pre and postoperative periods (79.1%), the urinary tract infection (36.5%) being the most common adverse event, followed by pneumonia (34.6%), neuropathic pain (22.1%), pressure ulcers (19.2%), and delirium (18.3%). Therefore, the costs in the initial phase can be higher due to these morbidities, besides delaying the return of these individuals to the society³².

While developing this study, some limitations and difficulties were encountered: (1) it was difficult to locate the SI cases in the system, which made the study longer and harder, as it was necessary to conduct manual searches in the medical records of both hospitals; (2) medical records had insufficient data and/or incomplete data; and (3) inadequate storage of the medical records, in humid and little ventilated places, making them sensitive to manipulation.

Besides the aforementioned difficulties, there is also the lack of regularization of the registers of these individuals, which could be classified according to internationally accepted scales, such as the one proposed by the ASIA, which considers the levels of deficiency in stages of decreasing severity³³.

The standardization of the assessment procedures by the public hospitals would improve the prognosis and make treatment plans more efficient, thus minimiz-

ing possible unnecessary interventions, and also justifying, in time for better rehabilitation, the indicated treatments for each type of lesion³⁰.

CONCLUSION

According to the studied population and period, it is possible to conclude that the profile of the SI trauma in Porto Alegre can be described as: male individuals, with mean age of 47 years, being the falls from high places the most prevalent etiology and the lumbar level the most affected one. In contrast, spinal lesion affected younger men, who suffered cervical lesions due to firearm injuries.

The findings from this study can help managers, researchers and professionals involved in the health care of people with SCI to plan future programs of health promotion and disease prevention, as well as for the care and the provision of rehabilitation services.

REFERENCES

1. Campos MF, Ribeiro AT, Listik S, Pereira CAB, Andrade Sobrinho J, Rapoport A. Epidemiologia do traumatismo da coluna vertebral. *Ver. Col Bras Cir.* 2008;35(2):88-93.
2. Medola FO, Castello GLM, Freitas LNF, Busto RM. Avaliação do alcance funcional de indivíduos com lesão medular espinhal usuários de cadeira de rodas. *Revista movimenta.* 2009;2(1):12-6.
3. Saraiva RA, Piva Júnior L, Campos da Paz Jr A, Pacheco MAR. As Bases Fisiopatológicas para Anestesia no Paciente com Lesão Medular. *Rev Bras Anesthesiol.* 1995;45(6):387-98.
4. Leal-Filho MB, Borges G, Almeida BR, Aguiar AAX, Vieira MACS, Dantas KS, et al. Spinal Cord Injury: Epidemiological study of 386 cases with emphasis on those patients admitted more than four hours after the trauma. *Arq Neuropsiquiatr.* 2008;66(2-B):365-8.
5. Sekhon LH, Fehlings MG. Epidemiology, demographics, and pathophysiology of acute spinal cord injury. *Spine* 2001;26(Suppl 24):S2-12.
6. Blanes L, Carmagnani MIS, Ferreira LM. Quality of life and self-esteem of persons with paraplegia living in São Paulo, Brazil. *Qual Life Res.* 2009;18:15-21.
7. CIHI. The Burden of Neurological Diseases, Disorders and Injuries in Canada. Ottawa: Canadian Institute for Health Information; 2007. Disponível em: http://secure.cihi.ca/cihiweb/products/BND_e.pdf.
8. CDC. Spinal Cord Injury (SCI): Fact Sheet. Atlanta, GA: National Center for Injury Prevention and Control; 2006. Disponível em: <http://www.cdc.gov/TraumaticBrainInjury/scifacts.html>.
9. García-Altés A, Pérez K, Novoa A, Suelves JM, Bernabeu M, Vidal J, Arrufat V, Santamariña-Rubio E, Ferrando J, Cogollos M, Cantera CM, Luque JC. Spinal cord injury and traumatic brain injury: a cost-of-illness study. *Neuroepidemiology.* 2012;39(2):103-8.

10. Sociedade Brasileira de Neurocirurgia. Projeto Pense bem: use a cabeça para proteger seu corpo. 2007. Disponível em: http://www.sbn-neurocirurgia.com.br/site/pense_bem.asp.
11. Brito LMO, Chein MBC, Marinho SC, Duarte TB. Avaliação epidemiológica dos pacientes vítimas de traumatismo raquimedular. *Rev Col Bras Cir*. 2011; 38(5):304-9.
12. Masini M. Estimativa da incidência e prevalência de lesão medular no Brasil. *J Bras Neurocirurg*. 2001;12(2):97-100.
13. Santos TSC, Guimarães RM, Boeira SF. Epidemiologia do trauma raquimedular em emergências públicas no município do Rio de Janeiro. *Esc Anna Nery*. 2012; 16(4):747-53.
14. Castiel LD, Rivera FJU. Planejamento em saúde e epidemiologia no Brasil: casamento ou divórcio? *Cad. Saúde Pública*. 1985;1(4):447-56.
15. Ning GZ, Wu Q, Li YL, Feng SQ. Epidemiology of traumatic spinal cord injury in Asia: a systematic review. *J Spinal Cord Med*. 2012;35(4):229-39.
16. Jackson AB, Dijkers M, Devivo MJ, Poczatek RB. A demographic profile of new traumatic spinal cord injuries: change and stability over 30 years. *Arch Phys Med Rehabil*. 2004;85(11):1740-8.
17. Hagen EM, Rekand T, Gilhus NE, Grønning M. Traumatic spinal cord injuries-incidence, mechanisms and course. *Tidsskr Nor Laegeforen*. 2012;17:132(7):831-7.
18. Gonçalves AMT, Rosa LN, D'Ángelo CT, Savordelli CL, Bonin GL, Squarcino IM, et al. Aspectos epidemiológicos da lesão medular traumática na área de referência do Hospital Estadual Mário Covas. *Arq Méd ABC*. 2007;32(2):64-6.
19. Koch A, Graells XSI, Zaninelli EM. Epidemiologia de fraturas da coluna de acordo com o mecanismo de trauma: análise de 502 casos. *COLUMNA/COLUMNNA*. 2007;6(1):18-23.
20. Pirouzmand F. Epidemiological trends of spine and spinal Cord injuries in the largest Canadian adult trauma center from 1986 to 2006. *J Neurosurg Spine*. 2010;12:131-40.
21. Janahú MTA, Neves LMT, Silva MC, Oliveira IS. Trauma raquimedular: perfil epidemiológico dos pacientes atendidos no Pronto Socorro Municipal Mário Pinotti nos anos de 2003 à 2005. *Fisioterapia Ser*. 2009;4(4):246-9.
22. Siscão MP, Pereira C, Arnal RLC, Foss MHDA, Marino LHC. Trauma raquimedular: caracterização em um Hospital Público. *Arq Ciênc Saúde*. 2007;14(3):145-7.
23. Jiménez-Ávila JM, Calderón-Granados A, Bitar-Alatorre WE. Direct cost of spinal cord injuries. *Cir Cir*. 2012;80(5):435-41.
24. Vasconcelos ECLM, Riberto M. Caracterização clínica e das situações de fratura da coluna vertebral no município de Ribeirão Preto, propostas para um programa de prevenção do trauma raquimedular. *Coluna/Columna*. 2011;10(1):40-3.
25. Burns AS, O'Connell C. The challenge of spinal cord injury care in the developing world. *J Spinal Cord Med*. 2012;35(1):3-8.
26. Devivo MJ. Epidemiology of traumatic spinal cord injury: trends and future implications. *Spinal Cord*. 2012;50(5):365-72.
27. Obalum DC, Giwa SO, Adekoya-Cole TO, Enweluzo GO. Profile of spinal injuries in Lagos, Nigeria. *Spinal Cord*. 2009;47(2):134-7.
28. Parreira JG, Vianna AMF, Cardoso GS, KaraKhanlan WZ, Caill D, Periingueiro JAG, Soldá SC, Assef JC. Lesões graves em vítimas de queda da própria altura. *Rev Assoc Med Bras*. 2010;56(6):660-4.
29. Muniz CF, Arnaut AC, Yoshida M, Trelha CS. Caracterização dos idosos com fratura de fêmur proximal atendidos em hospital escola público. *Ver. Espaço para a saúde*. 2007;8(2):33-8.
30. Araújo Júnior FA, Heinrich CB, Cunha MLV, Veríssimo DCA, Rehder R, Pinto CAS, Bark SA, Borba LAB. Traumatismo raquimedular por ferimento de projétil de arma de fogo: avaliação epidemiológica. *Coluna/Columna [online]*. 2011;10(4):290-2.
31. Talu U, Swamy G, Berven S. Spinal cord injury: an update. *Semin Spine Surg*. 2005;17:73-83.
32. Cheung A, Street J, Noonan V, Cartar L, Dvorak M. Incidence and Impact of Acute Adverse Events in Patients with Traumatic Spinal Cord Injury. *Spine J*. 2011;11(10, Supplement):S2.
33. ASIA. Normas para a classificação neurológica e funcional das lesões da medula espinhal. *Rev Bras Ortop*. 1994;29(3):99-106.