

Estimate of physical sequelae in victims of road traffic accidents hospitalized in the Public Health System

Estimativa de sequelas físicas em vítimas de acidentes de transporte terrestre internadas em hospitais do Sistema Único de Saúde

Silvânia Suely Caribé de Araújo Andrade^{III}, Maria Helena Prado de Mello Jorge^I

ABSTRACT: *Objectives:* To describe the profile of the victims of road accidents presenting physical sequelae, according to the criteria established by researchers and analyze the trends in hospitalization for this cause in Brazil, from 2000 to 2013. *Methods:* An ecological time-series study was performed using the data from the Hospital Information System of the National Health System (SUS). Trends in hospitalization were estimated using Prais–Winstein regression. *Results:* During this period, a total of 1,747,191 hospitalizations for traffic accidents were registered; 410,448 were victims with physical sequelae. About 77.7% of them were male subjects, 26.5% belonged to the age group of 20 – 29 years, 46.4% lived in Southeast Brazil, 44.0% were pedestrians, and 31.1% were motorcyclists. In total, 51,189 cases were “confirmed” sequelae (12.5%), and pedestrians accounted for 43.8% of cases. There were 359,259 hospitalizations for the diagnosis of “possible” sequelae, and motorcyclists accounted for 43.3% of these cases. There was a trend of stability for all the patients with confirmed and possible sequelae, but there was a significant rise in hospitalization rates owing to confirmed sequelae among the men in North and Central-West regions. *Conclusion:* The hospitalizations associated with physical sequelae were responsible for about one-fourth of the hospitalizations in the Hospital Information System in the studied period. Most events involved men, young adults, residents in Southeast Brazil, and pedestrians. Hospitalization rates for traffic accidents associated with physical sequelae were stable in Brazil and regions, but a significant increase was observed for confirmed sequelae among men in the North and Central-West regions.

Keywords: Accidents, Traffic Complications. Temporal distribution. External causes. Information systems. Brazil.

^ISchool of Public Health, *Universidade de São Paulo* – São Paulo (SP), Brazil.

^{III}Department of Surveillance for Non-Transmissible Diseases and Illnesses and for Health Promotion, Health Surveillance, Health Ministry – Brasília (DF), Brazil.

Corresponding author: Silvânia Suely Caribé de Araújo Andrade. Departamento de Vigilância de Doenças e Agravos Não Transmissíveis e Promoção da Saúde, Secretaria de Vigilância em Saúde, Ministério da Saúde. SAF Sul, Trecho 02, Lotes 05 e 06, bloco F, torre I, Edifício Premium, térreo, sala 16, CEP: 70070-600, Brasília, DF, Brazil. E-mail: silvania.andrade@saude.gov.br

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RESUMO: *Objetivos:* Descrever o perfil das vítimas que foram internadas por lesões decorrentes de acidentes de transporte terrestre (ATT) e com diagnóstico sugestivo de sequelas físicas, no Brasil, de 2000 a 2013, e analisar sua tendência temporal neste período. *Métodos:* Estudo ecológico com dados do Sistema de Informações Hospitalares do Sistema Único de Saúde (SIH/SUS). Foi utilizada regressão de *Prais-Winstein* para estudo das tendências. *Resultados:* No período estudado, ocorreram 1.747.191 internações por ATT. O estudo destas identificou 410.448 pessoas (23,5%) com diagnóstico sugestivo de sequelas físicas. Destas, 77,7% eram do sexo masculino, 26,5% na faixa etária de 20 a 29 anos, 46,4% residentes na Região Sudeste, 32,5% pedestres e 31,1% motociclistas. Para sequela “certeza” foram observadas 51.189 casos (12,5%), 43,8% eram pedestres. Houve 359.259 internações cujo diagnóstico sugeria sequela física “provável”, destes 43,3% eram motociclistas. A tendência foi de estabilidade para as internações por ATT relacionadas ao total de pacientes com sequelas físicas e com sequela “provável”. Todavia, foi observado aumento nas internações por ATT com diagnóstico sugestivo de sequela “certeza” no sexo masculino e nas regiões Norte e Centro-Oeste. *Conclusão:* As internações com diagnóstico sugestivo de sequelas físicas representaram cerca de 1/4 das internações por ATT registradas. As maiores proporções foram no sexo masculino, entre os adultos jovens, residentes na região Sudeste e entre os pedestres. Houve estabilidade na tendência das taxas de internação por ATT com diagnóstico sugestivo de sequelas físicas para o Brasil e regiões, mas tendência ascendente para sequela “certeza” para a região Centro-Oeste e Norte e para o sexo masculino.

Palavras-chave: Acidentes de trânsito. Complicações. Distribuição temporal. Causas Externas. Sistemas de informação. Brasil.

INTRODUCTION

Traffic accidents are a major cause of death, injury and disability and they impact the health sector owing to overload of emergency and urgency services and demand for specialized care, social assistance, and rehabilitation¹⁻³. Many accidents do not have death as a consequence but sequelae with effects throughout the whole life of a person, including disabilities⁴.

Worldwide, 20 to 50 million people are estimated to be victims of nonfatal injuries in road accidents (RAs), which contributes to the increased prevalence of disabilities⁵. Overall, in 2000, RAs accounted for 69,138,531 disability-adjusted life years (DALY), representing a global burden of 2.4% of DALYs from all causes and ranking 10 among the 20 leading causes of mortality. In 2012, RAs reached the eighth position on the list of 20 leading causes of DALY with 78,723,890 years⁶.

Literature lacks information on the prevalence of people with disabilities owing to RAs, especially when it comes to permanent disability. However, there is evidence that the prevalence ranges from less than 1% in countries such as Croatia, Mexico, and Russia to 25% in Poland. On an average, 1 of 20 victims of road traffic accidents will be permanently disabled⁷.

The distribution of these occurrences is uneven across the countries. For those with high income, in 2004, 2.8 and 1.1 million cases of moderate or severe disability were reported

in the age group of 0 to 59 years and 60 or more years, respectively⁸. However, for countries with medium and low income, 35.4 million people aged 0 to 59 years and 5.7 million aged older than 60 years would present moderate or severe disabilities. In the Americas, over 5 million people are accounted for injuries subsequent to traffic accidents every year³.

In Brazil, mortality rates from RAs have declined partly owing to the implementation of the Traffic Code in 1998, but it has been increasing over the last decade. However, a large number of survivors exhibit significant physical and psychological sequelae, especially young adults⁹.

According to the data from the Violence and Injury Survey (VIVA) conducted in emergency and urgency rooms in 23 capitals and the Federal District in 2011, the leading causes of hospital admissions by external causes were falls, followed by RAs. Most cases (67%) progressed to hospital discharge in the first 24 hours after emergency care, while 23.1 and 6.6% were referred to hospital or other services, respectively¹⁰.

The National Households Survey, 2008 points out that 4.8 million people were involved in traffic accidents; of them, 30.7% stopped performing daily activities owing to the accident¹¹. Current data from the National Health Survey, conducted in a sample representative of the entire Brazilian territory, show that more than two million adults (aged ≥ 18 years) had been involved in traffic accidents with injury in the 12 months preceding the survey. Among them, 15.1% reported sequelae and/or disability resulting from this event, with the highest prevalence among women (18.6%) aged 40 to 59 years (21.3%) and individuals with low education (19.3%)¹².

In addition, external causes in general and, particularly, RAs result in high emotional and social costs, such as absence and leave from work, mental and emotional damage to the victims and their families, and the years of productivity or life lost^{2,3}. Psychological sequelae and posttraumatic stress disorder after RAs are potentially disabling in the long term, and although this is extremely relevant, it is little studied.

The aim of this study was to depict the profile of victims who were hospitalized owing to RA in Brazil between 2000 and 2013 and presenting physical sequelae and analyze the temporal trend in this period.

METHODS

An ecological time-series study was conducted with RA victims who showed diagnosis suggestive of physical sequelae in Brazil, from 2000 to 2013. Data on hospitalizations were obtained from the Hospital Information System of the National Health System (SIH/SUS), made available by the SUS Department of Informatics (DATASUS/Ministry of Health) through its website.

SIH/SUS includes the information about admissions in public and insured to SUS hospital^{13,14}. Annual rates of hospitalization owing to physical consequences of RA were calculated according to sex, age, and geographic region. For these rates, data were first

selected in the SIH database regarding hospitalizations with secondary diagnosis with codes V01–V89, 20th chapter of the 10th revision of International Statistical Classification of Diseases and Related Health Problems (ICD-10)¹⁵ corresponding to RA.

From the identification of hospitalizations owing to RAs, the case definition was used for people suffering sequelae according to the methodology developed by Mello Jorge and Koizumi¹⁶, who worked with visible sequelae according to primary diagnosis of “confirmed” sequel: bone crushing (ICD-10: S07, S17, S28, S38, S47, S57, S67, S77, S87, S97, T04, T14.7), amputation (ICD-10: S08, S18, S28, S38, S48, S58, S68, S78, S88, S98, T05, T09.6, T14.7, T11.6, T13.6), nerve injury (ICD-10: S04, S44, S54, S64, S74, S84, S94, T06.2, T14.4, T11.3), spinal cord injury (ICD-10: S14, S24, S34, T06.0, T06.1, T09.3, T09.4), and sequelae (ICD-10: S90 to S94); and “possible” sequel: traumatic brain injury (ICD-10: S06) and burn (ICD-10: The T20 T32). Psychological sequelae will not be considered in this work.

Population estimates provided by the Brazilian Institute of Geography and Statistics (IBGE), as projected for the period 2000–2060¹⁷, were used as denominators to calculate the hospitalization rates. Analysis of trend of admission owing to physical sequelae resulting from RAs in 2000–2013 was made with Prais–Winstein autoregression model. This method is recommended for time-series analysis, because it corrects the autocorrelation of residue¹⁸. Significant trend was when the estimated model obtained $p \leq 0.05$.

Variation in annual hospitalization rates (%) for physical sequelae resulting from RAs during the period was estimated using the log of hospitalization rate as the outcome (Y) in the Prais–Winstein regression model. The regression coefficient obtained was then applied to the formula of variation in annual rate (%): $(-1 + 10^b) \times 100$. The 95% confidence intervals (95%CI) of the variation in annual rate were determined by the following formula: $b \pm tEP$, where t is Student’s t -test value in the specific table and EP is the standard error of outcome of the coefficient provided by regression¹⁸. Analyses were performed using Microsoft Excel software (version 10) and Stata 11.

The data used in this study have public access, without identification of the patients. In addition, the ethical principles governing research involving human beings were complied with, according to the resolution of the National Health Council No. 466 of December 12, 2012. This study is part of the project approved by the Ethics Committee on Public Health School of Universidade de São Paulo, protocol 85973/2012.

RESULTS

In 2000–2013, there were 1,747,191 hospitalizations for RAs, with identification of 410,448 victims with diagnosis suggestive of physical sequelae across the country. Among the victims with sequelae, 77.7% were male subjects, 26.5% aged 20–29 years, 46.4% residents in the Southeast, and 32.5 and 31.1% pedestrians and motorcyclists, respectively. Considering the confirmed sequelae (bone crushing, amputation, nerve injury, spinal cord

injury, and proper sequel) 51,189 cases of hospitalization resulting from RA associated with this cause were identified, being 76.4% male subjects, 24.1% aged 20 to 29 years, 48.5% living in the Southeast, and 43.8% pedestrians (Table 1).

There were 359,259 admissions in the period of study, with diagnosis suggestive possible sequelae (traumatic brain injury and burns). Of them, 77.9% were male subjects, 26.9% aged 20 to 29 years, and 46.1% residents in the Southeast region. Motorcyclists accounted for the majority of RAs-related hospitalizations with diagnosis of possible sequelae (31.6%) (Table 1).

Crude hospitalization rates for RA-related physical sequelae, in the whole country, were 13.3 and 16.3 admissions per 100,000 inhabitants in 2000 and 2013, respectively. The rates in 2000 were 1.7 admissions per 100,000 inhabitants with confirmed sequelae, and 11.6 admissions per 100,000 inhabitants with possible sequelae. In 2013, these numbers reached 2.5 and 13.8 per 100,000 inhabitants with confirmed and possible sequelae, respectively (Table 2).

By comparing the age-standardised hospitalization rates for RA-related physical consequences by region in 2000, the highest rates for both the confirmed and possible sequelae were seen in the Southeast. However, in 2013, the highest rates were found in the Northeast region for the total of physical sequelae and possible sequelae and in the Central-west region for confirmed sequelae (Table 2).

In Brazil and regions, stability was seen in age-standardised hospitalization rates for RA-related hospitalizations, with diagnosis of physical sequelae in 2000–2013; the crude rate was 1.2% (95%CI -19.1 – 26.5) for the country (Table 2). For the diagnosis of confirmed sequelae owing to RA, there was an increase in the trend of hospitalization rates in the North (range: 9.8%; 95%CI 1.3 – 38.1) and Central-west regions (range: 17.6%; 95%CI 2.5 – 85.1) (Table 2).

The rates of admission for RA with diagnosis of possible sequelae were stable for both Brazil (range: 0.7%, 95%CI -8.6 – 12.5) and the regions (Table 2). Among the female subjects, hospitalization rates owing to RA with diagnosis suggestive of physical consequences ranged from 6.1 admissions per 100,000 women in 2000 to 6.9 admissions per 100,000 women in 2013. The rates were stable for RA with sequelae (range: -0.5%; 95%CI -19.1 – 22.4), confirmed sequelae (range: 2.3%; 95%CI -10.4 – 19.5) and possible sequelae (range: -0.9%; 95%CI -9.8 – 9.0) among women from 2000 to 2013 (Table 3).

Hospitalization rates after RA with sequelae for male subjects were 20.52 and 25.79 hospitalizations per 100,000 men in 2000 and 2013, respectively. Stable behavior was observed in the hospitalization rates for RA with diagnosis suggestive of sequelae (range: 1.9%; 95%CI -15.7 – 23.3) and possible sequelae among the male subjects in the period studied (range: 1.4%, 95%CI -8.2 – 9.4). However, an increase in the trend was seen in the hospitalization rates for RA with confirmed sequelae among men (range: 6.5%; 95%CI 1.2 – 29.0) (Table 3).

Table 1. Hospitalizations from traffic accidents related to diagnosis of physical sequelae according to victims' characteristics, Brazil, 2000 – 2013 (n = 410,448).

Characteristics	Total		Sequelae			
			Confirmed (n = 51,189)		Possible (n = 359,258)	
	n	%	n	%	n	%
Gender						
Male	318,913	77.7	39,102	76.4	279,811	77.9
female	91,534	22.3	12,087	23.6	79,447	22.1
Age group (years)						
0 – 9	40,972	9.9	2,780	5.4	38,192	10.6
10 – 19	70,078	17.1	5,670	11.1	64,408	17.9
20 – 29	108,810	26.5	12,337	24.1	96,473	26.9
30 – 39	70,461	17.2	9,613	18.8	60,848	16.9
40 – 49	49,348	12.0	7,845	15.3	41,503	11.6
50 – 59	31,924	7.8	5,498	10.7	26,426	7.4
60 – 99	38,855	9.5	7,446	14.6	31,409	8.7
Region						
North	20,494	4.9	2,032	4.0	18,462	5.1
Central-west	30,986	7.6	3,434	6.7	27,552	7.7
Northeast	114,540	27.9	14,352	28.0	100,188	27.9
Southeast	190,404	46.4	24,814	48.5	165,590	46.1
South	54,024	13.2	6,557	12.8	47,467	13.2
Victim						
Motorcyclist	127,780	31.1	14,266	27.9	113,514	31.6
Pedestrian	133,389	32.5	22,425	43.8	110,964	30.9
Occupant of motor vehicle	45,791	11.2	4,569	8.9	41,222	11.5
Cyclist	39,746	9.7	2,451	4.8	37,295	10.4
Occupant of truck	1,636	0.4	296	0.6	1,340	0.4
Bus	814	0.2	129	0.3	685	0.2
Others and unspecific	61,292	14.9	7,053	13.7	54,239	15.1

Table 2. Hospitalization rates (crude and age-standardized) for victims of traffic accidents with sequelae, annual variation rates (%) and trends, Brazil and regions, 2000 and 2013 (n = 410,448).

Sequelae	Hospitalization rates*				Variation in Annual rate (%)	95%CI	Trend
	Crude		Standardized				
	2000	2013	2000	2013			
Brazil	13.3	16.3	14.6	18.6	1.2	-19.1 – 26.5	Stability
Regions							
North	9.9	14.9	10.7	15.4	6.5	-18.4 – 38.9	Stability
Northeast	11.1	20.0	12.1	23.4	5.5	-20.5 – 39.8	Stability
Southeast	15.2	15.4	17.7	17.5	2.2	-16.7 – 25.3	Stability
Central-west	10.1	16.2	10.9	17.3	7.6	-19.5 – 43.7	Stability
South	12.7	12.6	13.5	13.9	-0.9	-18.5 – 20.3	Stability
Confirmed sequelae							
Brazil	1.7	2.5	1.8	2.4	4.0	-14.8 – 27.0	Stability
Regions							
North	0.9	1.5	1.1	1.6	9.8	1.3 – 38.1	Increase
Northeast	1.4	2.4	1.5	2.4	1.3	-24.6 – 36.1	Stability
Southeast	2.3	2.8	2.4	2.7	2.2	-16.7 – 25.3	Stability
Central-west	1.1	2.8	1.1	2.8	17.6	2.5 – 85.1	Increase
South	0.9	2.1	1.0	2.0	12.2	-27.7 – 66.5	Stability
Possible sequelae							
Brazil	11.6	13.8	14.6	18.6	0.7	-8.6 – 9.3	Stability
Regions							
North	17.7	26.5	9.9	14.0	6.2	-8.3 – 13.5	Stability
Northeast	19.5	35.9	9.9	17.8	5.7	-8.2 – 13.1	Stability
Southeast	27.6	25.4	13.6	12.7	-2.8	-10.5 – 8.1	Stability
Central-west	17.9	26.9	9.1	12.4	4.9	-9.9 – 14.1	Stability
South	23.7	21.4	11.9	10.7	12.2	-12.1 – 8.9	Stability

*per 100,000 inhabitants; 95%CI: 95% Confidence Interval.

Source: Information System of the National Health System/Health Ministry (SIH-SUS/MS).

DISCUSSION

Hospitalizations for RAs with diagnosis of physical sequelae accounted for more than one-fourth of all traffic-related cases recorded in the Hospital Information System (SIH) from 2000 to 2013. The highest proportions were observed among male young adults living in the Southeast region and among pedestrians. This profile was similar for both the types of sequelae (confirmed and possible), the latter differing as to the victims mostly affected: motorcyclists.

The regions with the highest hospitalization rates were Southeast and Northeast, in 2000 and 2013, respectively. The trend of hospitalization rates owing to RA associated with diagnosis suggestive of physical sequelae for Brazil and regions was stable. However, an increasing trend in the hospitalization rates for traffic-related diagnosis of confirmed sequelae was seen, especially in the North and Central-west regions among male subjects.

Traffic accident mortality rates in Brazil are currently lower than in the early 1990s, partly owing to the application of the New Traffic Law in 1998. However, a high number of survivors show significant physical and psychological sequelae, especially among young adults^{9,19}.

Across the country, there are no data showing the burden of physical sequelae in any type of RA. The first general estimates of the situation were made by Mello Jorge and

Table 3. Hospitalization rate (crude and standardized) for the victims of traffic accidents with physical sequelae according to type and sex, 2000 and 2013 ($n = 410,448$).

Sequelae	Crude hospitalization rate*		Variation in Annual rate (%)	95%CI	Trend
	2000	2013			
Gender					
Female	6.1	6.9	-0.5	-19.1 – 22.4	Stability
Male	20.5	25.8	1.9	-15.7 – 23.3	Stability
Confirmed sequelae					
Gender					
Female	0.8	1.1	2.3	-10.4 – 19.5	Stability
Male	2.6	3.8	6.5	1.2 – 29.0	Increase
Possible sequelae					
Gender					
Female	5.3	5.8	-0.9	-9.8 – 9.0	Stability
Male	17.9	21.9	1.4	-8.2 – 9.4	Stability

*per 100,000 inhabitants; 95%CI: 95% Confidence Interval.

Source: Information System of the National Health System/Health Ministry (SIH-SUS/MS).

Koizumi¹⁶, starting from some selected diagnoses (including the spine injuries with spinal cord impairment and amputations) of victims of traffic accidents, and they estimated that about 20% of cases that evolve to hospital discharge showed some type of sequel.

In the United States, data from the National Health Interview Survey Disability 1995, estimated 1,275,172 people with disabilities related to traffic accidents, with the highest proportions among women and adults aged 55 to 64 years²⁰. A study conducted in Yorkshire, England, with a cohort of 1,239 adults (aged ≥ 18 years) and data collected from 1993 to 1999, showed a prevalence of 18.3% of sequelae from foot injuries and demanding change in occupation²¹.

The prevalence of accident-related disability (falls, occupational events, traffic accidents, among others) in a population-based study in Ghana was 0.83% (95%CI 0.67 – 1.01%), with no difference between the men and women, and collisions between vehicles being the most frequent type of accident. Pedestrian injuries were the second most common cause of disabling injuries²².

A study conducted in the city of Maringá (PR), with 3,468 victims of traffic accidents in 2000, established these risk factors associated with hospitalization: being a pedestrian, cyclist or motorcyclist, being aged > 50 years, facing heavy transport or bus collision, dawn or afternoon accidents, with the driver living in the city²³. Although this research does not mention physical sequelae, it agrees to this study as to the type of victim hospitalized in two studies: mostly pedestrians. However, there is a difference in age group. The authors stated that most seniors involved in RA were pedestrians, which increases vulnerability to RA.

A possible explanation to more frequent hospitalizations related to RA with diagnosis of physical sequelae among young adults is the increased exposure of this risk group to situations such as alcohol abuse, driving after taking alcohol, risky exposures when conducting vehicles, exceeding speed limits, inexperience, and fatigue^{10,24-29}.

The predominance of hospitalizations associated with sequelae and its upward trend in male subjects is consistent with other studies showing that men and young adults are the group mostly affected by RA^{10,25,27-29}. In 2006, the leading cause of hospitalizations among men aged 15 to 59 years was external³⁰. In 2010, 929,893 hospital admissions were reported owing to external causes, traffic accidents accounting for 15.7% of all cases and increased risk for men aged 20 to 59 years³¹. Sociocultural factors (misogyny, power relations, competitiveness, aggressiveness, and others) that establish male behavior in society may be related to their increased exposure to health-damaging situations^{29,32,33}.

A systematic review of RA injuries reported that 35 to 40% of them show serious injuries, the main victims being male pedestrians aged between 19 and 29 years. The head injury is the most common type of injury in severe and fatal cases with a greater potential to generate sequels³⁴.

Our data on geographic distribution of hospitalizations for RA with sequelae shows that the Southeast and Northeast regions are the most affected, corroborating a study

showing that, in 2003, the Southeast was proportionally the geographic portion with the highest concentration of deaths resulting in RA (41%), followed by the Northeast (22%)¹⁹. The Northeast region also showed an increased risk of death from ATT between 2000 and 2010³⁵.

Motorcyclists were the most common victim in traffic-related hospital admissions with diagnosis of possible sequelae. The motorcycle was involved in 56.8% of all RA ($n = 7,451$) referred to urgency and emergency services in 24 state capitals and the Federal District, as investigated by the Violence and Injury Survey (VIVA) in 2011¹⁰. The use of safety devices such as helmet minimizes the severity of accidents and, consequently, the occurrence of sequelae³³. However, data from a time series of 1980 through 2003 indicate an increased mortality by RAs among the motorcyclists; the most probable hypothesis is related to the growth of motorcycle fleet in the country¹⁹.

The reasons for the increase in motorcycle fleet can be attributed to the precariousness of public transportation, tele-delivery services, the possibility of job for young people, and the easiness of buying a motorcycle³⁴. Motorcyclists pointed that the risk of traffic accidents are related to personal and social interests to meet the demands involving money, speed, and time³⁵.

The trend of increase in traffic-related hospitalization rates, with confirmed sequelae, mainly in the Central-west region, match data regarding RA mortality, which states that the region showed the highest mortality rates in 2003²². The main risk factors involved in traffic-related sequelae are: availability of urgency services, injury severity, time to pre-hospital care, and spinal cord damage^{34,39-42}.

A limitation of this study was the use of database related only to admissions in services linked to SUS. However, these admissions account for about 70% of hospitalizations in the country^{13,14}. Another limitation was the exclusion of psychological sequelae.

CONCLUSION

Prevention of RA and sequelae in Brazil is directly related to prehospital and hospital care of the victims, the monitoring of violence accidents, and the adoption of educational and legislative measures of road safety to contribute to the reduction the morbidity and mortality from these cases, according to the guidelines of National Policy for Morbidity and Mortality Reduction on Violence and Health^{40,43}. Rehabilitation has shown a rapidly increasing importance with the rise of confirmed sequelae in the country. However, rehabilitation services are still insufficient, inadequate, and show low coverage⁴⁴. It is, therefore, recommended an increased investment in the prevention of RA and rehabilitation of victims with sequelae, reducing social impact in such cases. Brazil lacks and needs public health policies and strategies, which allow access to both the preventive and rehabilitation actions.

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