Traumatic brain injury (2008 - 2018). Estimation of costs of brazilian public health system

Traumatismo cráneo encefálico (2008-2018). Estimación de los costos para el sistema público brasileño de salud

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Resumen

Objetivo: Describir los aspectos epidemiológicos de los pacientes ingresados en el Sistema Único de Salud (SUS) de Brasil, de 2008 a 2018, utilizando el código de Traumatismo craneoencefálico (TCE). **Método:** Estudio epidemiológico descriptivo. Los datos se obtuvieron consultando la base de datos DATASUS, referidos al número de hospitalizaciones por mes, tiempo promedio de hospitalización, costos de honorarios médicos, costos de gastos hospitalarios y número de muertes de pacientes hospitalizados por tratamiento de TCE. **Resultados:** Durante el período de estudio se realizaron 903.341 hospitalizaciones por tratamiento de TCE, con un aumento del 1,63% de 2008 a 2018, acompañado de un incremento en el pago a los profesionales. Durante el período 2008-2018, Brasil tuvo un promedio de 82.121,90 hospitalizaciones por año, con una estancia hospitalaria promedio de 11,01 días. Durante el período, se gastó en tratamiento quirúrgico por TCE, que oscilaron entre R$ 46.495.047,80 y R$ 83.025.626,78, con un aumento del 78,56% en los costos directos de asistencia terapéutica. **Conclusión:** El TCE representa un problema de salud con un impacto económico sustancial en el sistema de salud pública. Además de la alta tasa de mortalidad, es responsable de los altos costos de los servicios de salud.

Palabras clave: Epidemiología, traumatismo craneoencefálico, gastos en salud, Salud pública.

Abstract

Objective: Describe epidemiological aspects regarding patients admitted to Brazil's Unified Health System (UHS), from 2008 to 2018, using the traumatic brain injury (TBI) code. **Method:** Descriptive epidemiological study. Data was obtained by consulting the DATASUS database, referring to the number of hospitalizations per month, average hospitalization time, costs of medical fees, costs of hospital expenses and number of deaths of patients hospitalized for TBI treatment. **Results:** During the study period, 903,341 hospitalizations for TBI treatment were performed, with a 1.63% increase from 2008 to 2018, accompanied by an increase in the payment to professionals. During the period between 2008-2018, Brazil had an average of 82,121.90 hospitalizations per year, with an average length of hospital stay of 11.01 days. During the period, surgical treatment for TBI was spent, ranging from R$ 46,495,047.80 to R$ 83,025,626.78, with an increase of 78.56% in direct costs for therapeutic assistance. **Conclusion:** TBI represents a health problem with a substantial financial impact on the public health system. In addition to the high mortality rate, it is responsible for high costs of health services.

Key words: Epidemiology, traumatic brain injury, health expenditures, Public health.

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Introduction

According to the National Head Injury Foundation, traumatic brain injury (TBI) is an injury to the brain caused by external physical force that can cause reduction or alteration of consciousness, causing impairment of cognitive skills, physical functioning, behavioral and perceptual. TBI can be classified according to the Glasgow Coma Scale (GCS) in mild (14-15), moderate (9-13) and severe (3-8)[1,2]. The main causes of TBI are traffic accidents, but it can also be caused by falls, especially in the elderly and children, aggression, injuries by weapons, use of drugs and alcohol or even sports[1,3].

The patient's prognosis depends on the clinical evolution of the trauma, highlighting the extent of the injury, the initial GCS score, the response to treatment, associated injuries, age, comorbidities and the length of clinical and surgical interventions. The sequelae of patients affected by TBI can be temporary or permanent. The most common consequence is brain damage due to edema or hemorrhage due to trauma, resulting in an increase in intracranial pressure, which can generate several sequels whose severity and clinical characteristics are related to the affected area[1].

TBI is a leading cause of death and disability in young adults, making it a public health problem due to its major economic impact on the health and pension sectors[4,5,6]. Despite the advancement of technology in automotive vehicles and improvements in road safety, it is believed that in the year of 2020 it will be considered one of the main causes of death in the population. The current annual mortality rate from TBI worldwide is approximately 15-24/100,000 inhabitants[4]. However, the real incidence of injuries is underestimated due to the lack of medical assistance for mild cases and the unfavorable evolution of severe injuries even before medical assistance[5].

The goal of the present study is to describe the epidemiological data regarding the number of TBI hospitalizations per month, average hospital stay, costs of medical fees, costs of hospital expenses and number of deaths of patients admitted by the Brazilian's Unified Health System (UHS), in the period from 2008 to 2018, using the traumatic brain injury code.

Material and Methods

The present manuscript is an epidemiological study, whose data were obtained by consulting the database provided by DATASUS (http://www.datasus.gov.br), accessed in the months of January and February 2019. The study population consisted of all cases of patients admitted for mild, moderate or severe traumatic brain injury (codes 03.03.04.008-4, 03.03.04.009-2 and 03.03.04.010-6), in the period between January 2008 and December 2018. From the data obtained in DATASUS, new tables were built. As it is a public domain bank, it was not necessary to submit the project to the Research Ethics Committee.

Results

In the period from January 2008 to December 2018, 903,341 hospitalizations were performed for the treatment

Table 1. Number of admissions for traumatic brain injury treatment separated by grade, in UHS, by región, 2008-2018

Year	Number of hospitalizations by region														
	North			Midwest			Northeast			Southeast			South		
	Mild	Moderate	Severe	Mild	Moderate	Severe	Mild	Moderate	Severe	Mild	Moderate	Severe	Mild	Moderate	Severe
2008	1,795	1,555	767	2,640	1,412	498	4,731	4,956	5,213	17,864	7,382	4,372	6,951	3,463	2,336
2009	2,642	2,006	551	3,193	2,080	612	7,966	5,821	4,050	20,504	9,582	3,511	8,666	4,563	2,171
2010	3,208	1,926	640	3,178	2,381	472	9,527	6,463	5,312	20,870	10,349	3,744	8,441	4,601	1,575
2011	3,470	2,272	684	3,113	2,494	409	9,121	7,595	5,496	20,844	10,744	4,137	8,381	4,758	1,556
2012	3,386	2,532	650	2,669	2,374	284	8,803	8,939	4,868	19,301	10,663	3,873	8,467	4,539	1,545
2013	3,967	2,534	651	2,437	2,333	320	9,925	9,513	4,900	18,624	10,860	3,878	9,167	4,157	1,523
2014	3,561	2,916	670	2,318	2,304	302	10,557	9,300	4,982	19,496	11,525	4,251	9,604	4,133	1,613
2015	3,352	2,625	898	2,360	2,233	266	9,832	9,468	4,687	20,371	11,740	4,137	8,960	4,281	1,462
2016	3,309	2,922	930	2,624	2,305	439	9,678	9,777	4,561	18,778	11,546	4,311	8,507	4,151	1,423
2017	3,349	2,829	845	2,813	2,074	531	10,017	8,597	4,381	17,653	11,529	3,959	9,688	4,177	1,447
2018*	3,018	2,561	818	2,747	2,117	575	10,159	7,860	4,167	17,295	11,236	3,974	8,824	3,747	1,593
Average	3,187	2,425.2	736.7	2,735.6	2,191.5	428	9,119.6	8,026.2	4,783.3	19,236.3	10,650.5	4,013.3	8,696	4,233.6	1,658.5
Total	35,057	26,678	8,104	30,092	24,107	4,708	100,316	88,289	52,617	211,600	117,156	44,147	95,656	46,570	18,244

Source: DATASUS, 2019. *Records corresponding to the first three months of 2018.

Table 2. Total number of admissions for treatment of traumatic brain injury of all grades, in UHS, by region, 2008-2018						
Year	**Number of hospitalizations**	**North**	**Northeast**	**Southeast**	**South**	**Midwest**
2018*	80,691	6,397	22,186	32,505	14,164	5,439
2017	83,889	7,023	22,995	33,141	15,312	5,418
2016	85,261	7,161	24,016	34,635	14,081	5,368
2015	86,672	6,875	23,987	36,248	14,703	4,859
2014	87,532	7,147	24,839	35,272	15,350	4,924
2013	84,789	7,152	24,338	33,362	14,847	5,090
2012	82,893	6,568	22,610	33,837	14,551	5,327
2011	85,074	6,426	22,212	35,725	14,695	6,016
2010	82,687	5,774	21,302	34,963	14,617	6,031
2009	77,918	5,199	17,837	33,597	15,400	5,885
2008	65,935	4,117	14,900	29,618	12,750	4,550
Total	903,341	69,839	241,222	372,903	160,470	58,907
Source: DATASUS, 2019. * Records corresponding to the first three months of 2018.						

Table 3. Number of deaths from traumatic brain injury of all levels, in UHS, by región, 2008-2018						
Year	**Deaths**	**North**	**Northeast**	**Southeast**	**South**	**Midwest**
2008	5,086	306	1,304	2,291	729	456
2009	5,757	365	1,564	2,481	853	494
2010	6,441	429	1,933	2,779	876	424
2011	6,810	524	2,061	2,928	816	481
2012	6,686	510	2,174	2,765	842	395
2013	6,821	492	2,307	2,791	793	436
2014	7,201	525	2,380	3,074	819	403
2015	6,836	575	2,134	2,975	791	361
2016	7,393	603	2,437	3,097	781	475
2017	6,956	528	2,211	2,985	787	445
2018	6,822	484	2,078	3,002	808	450
Total	72,809	5,341	22,583	31,168	8,895	4,820
Source: DATASUS, 2019. * Records corresponding to the first three months of 2018.						

of TBI of all grades, in UHS. The annual average of hospital admissions for treatment of TBI was 88,130. The year with the lowest number of TBI was 2008 with 65,935 cases and the year with the highest number was 2014 with 87,532. From this total, 472,721 were due to mild TBI, which corresponds to 52.33% of the total; 302,800 were due to moderate TBI, which corresponds to 33.52% of the total; and 127,820 occurred due to severe TBI, corresponding to 14.14% of the total number of hospitalizations (Table 1). 2014 was also the year with the highest number of mild TBI, compared to moderate TBI, 2016 was the year with the highest number of hospitalizations and for severe TBI, 2008 was the year with the highest number of hospitalizations. In all years, the Southeast region had the highest rates, while the Midwest and North remained with the lowest (Table 2). The highest and lowest count of hospitalizations by region occurred in the Southeast, in 2015, and in the North, in 2008, with, respectively, 36,248 and 4,117 hospitalizations. All regions showed a pattern over the years, showing an initial increase, a subsequent decrease followed by a sudden peak and again a decrease. The year of 2008 had the lowest number of hospitalizations for all regions, accounting for a total of 65,935 hospitalizations in all.

The total number of deaths during the period from January 2008 to December 2018 was 72,809 and the mortality

Table 4. Number of deaths due to traumatic brain injury separated by severity, in UHS, by región, 2008-2018															
Year	Number of deaths														
	North			Midwest			Northeast			Southeast			South		
	Mild	Moderate	Severe	Mild	Moderate	Severe	Mild	Moderate	Severe	Mild	Moderate	Severe	Mild	Moderate	Severe
2008	66	101	139	55	199	202	200	353	751	441	687	1,163	114	283	332
2009	61	168	136	48	225	221	223	319	1,022	332	977	1,172	112	319	422
2010	74	168	187	52	191	181	245	332	1,356	356	1,063	1,360	104	340	432
2011	80	259	185	38	255	188	256	440	1,365	348	1,028	1,552	119	295	402
2012	51	283	176	41	262	92	208	674	1,292	327	967	1,471	107	290	445
2013	48	283	161	42	282	112	155	729	1,423	305	1,004	1,482	116	271	406
2014	61	275	189	50	235	118	147	727	1,506	316	1,155	1,603	89	319	411
2015	60	255	260	39	220	102	146	621	1,367	294	1,131	1,550	107	308	376
2016	88	246	269	53	225	197	133	683	1,621	281	1,146	1,670	94	326	361
2017	72	226	230	35	209	201	143	558	1,510	289	1,141	1,555	105	271	411
2018	58	187	239	42	195	213	134	512	1,432	293	1,101	1,608	93	304	411
Year average	65,3	222,8	197,3	45	227,09	166,09	180,9	540,7	1,331,3	325,6	1,036,3	1,471,4	105,4	302,3	400,8
Total	719	2,451	2,171	495	2,498	1,827	1,990	5,948	14,645	3,582	11,400	16,186	1,160	3,326	4,409
Source: DATASUS, 2019. * Records corresponding to the first three months of 2018.															

Table 5. Mortality rate due to traumatic brain injury separated by severity, in UHS, by región, 2008-2018															
Year	Mortality rate														
	North			Midwest			Northeast			Southeast			South		
	Mild	Moderate	Severe	Mild	Moderate	Severe	Mild	Moderate	Severe	Mild	Moderate	Severe	Mild	Moderate	Severe
2008	3.67%	6.49%	18.12%	2.08%	14.09%	40.56%	4.22%	7.12%	14.4%	2.46%	9.3%	26.60%	1.64%	8.17%	14.21%
2009	2.3%	8.37%	24.68%	1.5%	10.81%	36.11%	2.79%	5.48%	25.23%	1.61%	10.19%	33.38%	1.29%	6.99%	19.43%
2010	2.3%	8.72%	29.21%	1.63%	8.02%	38.34%	2.57%	5.13%	25.52%	1.7%	10.27%	36.32%	1.23%	7.38%	27.42%
2011	2.3%	11.39%	27.04%	1.22%	10.22%	45.96%	2.8%	5.79%	24.83%	1.66%	9.56%	37.51%	1.41%	6.2%	25.83%
2012	1.5%	11.1%	27.07%	1.53%	11.03%	32.39%	2.36%	7.53%	26.54%	1.69%	9.06%	37.98%	1.26%	6.38%	28.8%
2013	1.2%	11.16%	24.73%	1.72%	12.08%	35%	1.56%	7.66%	29.04%	1.63%	9.24%	38.21%	1.26%	6.51%	26.65%
2014	1.71%	9.43%	28.20%	2.15%	10.19%	39.07%	1.39%	7.81%	30.22%	1.62%	10.02%	37.7%	0.92%	7.71%	25.48%
2015	1.78%	9.71%	28.95%	1.65%	9.85%	38.34%	1.48%	6.55%	29.16%	1.44%	9.63%	37.46%	1.19%	7.19%	25.71%
2016	2.65%	8.41%	28.92%	2.01%	9.76%	44.87%	1.37%	6.98%	35.54%	1.49%	9.92%	38.73%	1.1%	7.85%	25.36%
2017	2.14%	7.98%	27.21%	1.24%	10.07%	37.85%	1.42%	6.49%	34.46%	1.63%	9.89%	39.27%	1.08%	6.48%	28.40%
2018	1.92%	7.3%	29.21%	1.52%	9.21%	37.04%	1.31%	6.51%	34.36%	1.69%	9.79%	40.46%	1.05%	8.11%	25.80%
Average	2.05%	9.18%	26.78%	1.64%	10.36%	38.8%	1.98%	6.73%	27.83%	1.69%	9.73%	36.66%	1.21%	7.14%	24.16%
Source: DATASUS, 2019. * Records corresponding to the first three months of 2018.															

Table 6. Average length of stay in days for patients with traumatic brain injury of all levels, in UHS, by región, 2008-2018

Year	Average Length of stay	North	Northeast	Southeast	South	Midwest
2008	13.8	14.8	16.1	13.3	11.8	12.9
2009	12.2	12.8	14.2	12	10.2	10.9
2010	11.3	12.6	11.9	11.1	10.8	10.2
2011	10.8	11.3	11.2	10.6	10.8	10
2012	10.8	11	10.9	10.8	11	9.8
2013	10.6	10.5	10	11	11	10.3
2014	10.2	10	9.8	10.2	10.5	11.4
2015	10.2	9.9	9.8	10.2	10.6	11.8
2016	10	9.7	9.3	10.1	11.2	10.9
2017	10.4	9.7	10.2	10.5	11.1	10.6
2018*	10.9	10.2	10.3	11.2	11.6	11.2
Average for period	11.1	11.13	11.24	11	10.96	10.9

Source: DATASUS, 2019. * Records corresponding to the first three months of 2018.

rate during the study period was 8.05%. The highest number of deaths occurred in the Southeast, in 2016, with 3,097 deaths. In contrast, the lowest number of deaths occurred in the North in 2008, with 306 deaths from TBI of all levels. All regions increased the absolute number of deaths in the 10 years analyzed by the survey, except for the South and Center-West regions, which maintained the same average over time. The year with the highest number of deaths, considering all regions, was in 2016, with 7,393 deaths recorded (Table 3). The mild TBI presented 7,946 deaths during this period with mortality rate 1,71%; moderate TBI presented 25,623 deaths in that period with mortality rate 8,62% and severe TBI presented 39,238 deaths with mortality rate 30,84% (Table 4). The mild TBI had the highest mortality rate in the Northeast, in 2008 with 4.22%; the moderate TBI had the highest mortality rate, 14.09%, in the midwest in 2008; and severe TBI had the highest mortality rate recorded in 2011, in the Midwest with 45.96% of deaths (Table 5).

The average annual hospital stay in daily rates, during the study period, for mild TBI was 2.8 days, for moderate TBI was 7.1 days and servere TBI was 10.7 days (Table 8). The average hospital stay was longer in the Northeast, in 2008, with 16.1 days. The lowest average hospitalization time also occurred in the Northeast, in 2016, with 9.3 days (Table 6). The highest average annual hospital stay in daily rates, during the study period, for mild TBI occurred in the northern region, with 3.5; moderate TBI also occurred in the northern region, with an average of 7.9 days; while in severe TBI, the highest annual average was in the southeast, with 12.6 days (Table 7).

The total value of hospital services during period 2008-2018 was R$713,165,269.36. The value of hospital services has fluctuated over the years with an increase in all Brazilian regions, with a maximum cost in 2016 of R$75,441,299.60 (Table 9). The value of hospital services spent in 2008, the year with the lowest UHS spending on TBI, corresponded to 4.66% of the total invested. On the other hand, there was a progressive increase in the amount invested until 2016, the year of highest expenditure, representing 8.99% of the total expenses for TBI from 2008-2018. From 2016 to 2018 there was a relative drop in spending. The highest annual expenditure on TBI, regardless of degree, occurred in the southeast region: the mild TBI generated expenses of R$6,471,406.93, the moderate TBI spent R$10,017,355.70; and the severe TBI accounted for R$11,467,875.09 (Table 10).

Table 8. Average length of stay of the patient according to the traumatic brain injury (TBI) classification, in UHS, in all regions of Brazil, 2008-

Mild TBI	Moderate TBI	Severe TBI
2.8 days	7.1 days	10.7 days

Source: DATASUS, 2019.

The highest amount paid for professional services was also maximum in 2016 (R$12,383,496.51) - which corresponds to 10.04% of total spending on professional services for 2008-2018.The amount varied in 2017 and 2018 with a progressive drop in the amount invested in professionals, 9.87% in 2017 and 9.6% in 2018 (Table 11). From the total expenses with professional services in the period evaluated for treatment of TBI, regardless of degree, the highest were in the Southeast: the mild TBI presented R$18,644,376.11 in expenses, the moderate TBI corresponded to R$15,483,581.06 and the severe TBI burdened the SUS system by R$18,227,219.27 (Table 12).

Table 7. Average length of stay in days for patients with traumatic brain injury of all levels, in UHS, by región, 2008-2018.

Year	Average hospital stay time (in days)														
	North			Midwest			Northeast			Southeast			South		
	Mild	Moderate	Severe	Mild	Moderate	Severe	Mild	Moderate	Severe	Mild	Moderate	Severe	Mild	Moderate	Severe
2008	4,1	9,1	9,9	3,2	7,5	8,6	4,2	5,3	7,4	2,8	7,9	10,3	2,6	6,1	8,7
2009	3,6	8,9	11,4	2,9	6,3	8,5	4,0	5,9	7,3	2,6	7,8	11,6	2,4	6,4	8,9
2010	3,8	7,9	10,4	3,1	6,5	8,6	3,9	5,8	7,5	2,6	7,9	12,4	2,5	6,4	9,4
2011	3,5	8,1	11,0	3,1	6,8	9,1	3,7	5,7	7,9	2,6	7,7	13,0	2,5	6,1	10,0
2012	3,2	8,2	11,7	3,1	7,6	15,2	3,4	5,9	8,6	2,7	7,9	13,1	2,5	6,2	10,2
2013	3,3	8,1	10,7	2,8	7,6	14,8	3,0	6,7	8,9	2,7	7,8	12,4	2,3	6,5	10,7
2014	3,3	7,8	12,1	3	6,6	14,2	3,0	6,5	9,4	2,7	7,9	13,2	2,2	6,6	11,6
2015	3,5	7,6	13,0	3	6,6	13,3	3,2	6,3	10,0	2,6	7,8	13,3	2,3	7,0	10,9
2016	3,5	7,1	13,1	3,1	6,5	10,1	3,3	6,7	10,6	2,7	8,0	13,6	2,3	6,7	11,1
2017	3,3	7,4	14,5	2,9	7,1	10,4	3,3	6,4	10,5	2,7	7,8	13,8	2,1	6,6	10,6
2018*	3,4	7,7	14,4	2,8	6,3	10,2	3,2	6,8	11,0	2,7	7,5	12,7	2,2	6,0	11,7
Annual average	3,5	7,9	12,0	3	6,8	11,1	3,4	6,1	9,0	2,6	7,8	12,6	2,3	6,4	10,3

Source: DATASUS, 2019. * Records corresponding to the first three months of 2018.

Discussion and Conclusion

This study was carried out using a DATASUS database. The number of patients who suffered TBI (codes 03.03.04.008-4, 03.03.04.009-2 and 03.03.04.010-6), based on the number of hospitalizations, in the period from 2008 to 2018, was 903,341, with an average of 82,121.9 hospitalizations per year. In comparison, the United States estimates around 500,000 new patients with TBI per year, with an incidence of 103/100,000 inhabitants. The European Union has an incidence of 235/100,000 inhabitants, Germany of 340/100,000 inhabitants, Finland 101/100,000 inhabitants, Italy of 212-372/100,000 inhabitants and Portugal 137/100,000 inhabitants. It must be considered that this value is underestimated, influenced by the bias of being underdiagnosed and due to the lack of many accurate data regarding data from the private and public sectors, in several countries[4,7].

A percentage of 40% of the trauma victims evolve with TBI, among them 20% die on the spot or on the first day of hospitalization and 80% within the first seven days after the event. Restricting to children and adolescents, TBI is responsible for more than 75% of childhood deaths, with trauma being its main cause[5,6]. In the period of the present study, there were a total of 72,809 deaths, with higher numbers in 2014 and 2016.

In the quantitative analysis by regions, the following was observed: in the Center-West region, it had the lowest number of hospitalizations (58,907), while the highest number was observed in the Southeast region (372,903), accounting for 41.28% of the total. These data could infer that some factors could justify this difference, such as: population density, higher number of traffic accidents and access to health by the patient.

Regarding the average number of days spent, there was an oscillation between 10 days in 2016 and 13.8 days in 2008, with a general average of 11.01 days of hospitalization for TBI therapy. A comparison of the average per region shows that the Northeast region had the longest average length of stay (11.24 days), with the Midwest region having the shortest time (10.90). Analyzing according to the severity of the TBI, it is noticed that the severe has a longer hospital stay, with 10.7 days, the moderate with 7.1 days and the mild with 2.8 days, which is explained by the greater need for assistance and complexity of each case.

According to DATASUS, R$46,495,047.8 was spent on TBI treatment in 2008, of which R$39,101,896.08 on hospital services and R$7,393,151.80 on professional services. In 2018, total expenses were R$83,025,626.78, of which R$71,182,892.96 was equivalent to hospital services, showing an increase of 82.04%, and R$11,842,733.82 to services. professionals, with an increase of 60.18%. It is noticed that by region to the Southeast it is that it presents a greater total expenditure, corroborating with the greater number of hospitalizations and events.

Regarding the number of deaths, there were a total of 72,809 deaths between 2008-2018, with an average of 6,619 deaths. Between that period there was an increasing increase from 2008-2014, with a decrease in 2015, and an increase in 2016, where it had the highest number of deaths (7,393),

Table 9. Costs (in Brazilian Reais) for hospital Services related to traumatic brain injury treatment, in UHS, by region, 2008-2018

Year	Total (R$)	North	Northeast	Southeast	South	Midwest
2008	39,101,896.08	2,225,410.03	8,238,376.24	17,798,287.96	8,479,679.80	2,360,142.05
2009	52,528,488.61	3,081,475.87	10,414,633.36	23,841,318.10	11,689,944.72	3,501,116.56
2010	58,733,649.00	3,772,639.91	13,183,440.60	26,379,530.03	11,562,728.18	3,835,307.28
2011	63,621,334.81	4,596,394.19	14,622,336.30	28,531,918.88	11,862,307.75	4,008,377.69
2012	66,018,662.81	4,781,904.79	15,548,699.45	28,684,316.83	12,039,310.95	4,964,430.79
2013	66,346,099.26	5,265,336.55	17,632,010.07	26,498,357.07	12,138,016.80	4,812,378.77
2014	71,945,730.55	5,555,922.43	18,854,327.37	30,138,016.81	13,179,704.77	4,217,759.17
2015	73,564,342.77	5,862,869.01	19,372,511.11	31,296,764.16	12,806,227.88	4,225,970.61
2016	75,441,299.60	6,284,327.69	20,039,851.25	31,890,449.42	12,282,514.47	4,944,156.77
2017	74,680,872.91	6,234,746.36	18,196,421.95	31,570,057.08	13,305,498.78	5,374,148.74
2018*	71,182,892.96	3,931,252.81	17,686,938.91	30,893,998.73	13,138,811.58	5,531,890.93
Total	713,165,269.36	51,592,279.64	173,789,546.61	307,523,015.07	132,484,745.68	47,775,679.36

Source: DATASUS, 2019. * Records corresponding to the first three months of 2018.

Table 10. Cost (in Brazilian Reais) for hospital Services related to traumatic brain injury treatment, in UHS, by region, 2008-2018.(PART II)

Year	Hospital expenses in hospitalization					
	Southeast			South		
	Mild	Moderate	Severe	Mild	Moderate	Severe
2008	5,049,361.54	5,369,576.21	7,379,350.21	2,055,664.84	2,966,975.15	3,457,039.81
2009	6,431,220.30	8,265,029.20	9,145,068.60	2,775,423.73	4,627,930.56	4,286,590.43
2010	6,658,233.42	9,366,855.88	10,354,440.73	2,860,870.41	4,877,824.02	3,824,033.75
2011	6,721,682.99	9,856,172.40	11,954,063.49	3,025,851.73	4,926,440.52	3,910,015.50
2012	6,495,204.38	10,146,250.38	12,042,862.07	3,079,460.63	4,766,121.10	4,193,729.22
2013	6,158,872.96	9,716,945.09	10,622,539.02	3,274,162.75	4,584,099.89	4,279,754.16
2014	6,608,104.92	10,614,120.77	12,915,791.12	3,528,503.84	4,732,971.45	4,918,229.48
2015	7,063,817.75	11,369,042.80	12,863,903.61	3,291,185.09	5,338,254.44	4,176,788.35
2016	6,815,784.13	11,413,407.93	13,661,257.36	3,135,084.05	4,828,412.82	4,319,017.60
2017	6,518,410.65	12,289,842.68	12,761,803.75	3,873,131.67	5,056,804.20	4,375,562.91
2018*	6,664,783.26	11,783,669.41	12,445,546.06	3,572,905.77	4,358,220.66	5,207,685.15
Annual average value	6,471,406.93	10,017,355.70	11,467,875.09	3,133,840.41	4,642,186.80	4,268,040.57
Total amount	71,185,476.30	110,190,912.75	126,146,626.02	34,472,244.51	51,064,054.81	46,948,446.36

Source: DATASUS, 2019. * Records corresponding to the first three months of 2018.

Table 11. Amount paid (in Brazilian Reais) for professional Services for the treatment of traumatic brain injury, UHS, by region, 2008-2018

Year	Total (R$)	North	Northeast	Southeast	South	Midwest
2008	7,393,151.80	436,974.32	1,555,525.76	3,373,713.83	1,544,032.37	482,905.52
2009	9,853,880.91	612,199.39	2,019,708.86	4,423,046.35	2,101,658.92	697,267.39
2010	10,798,311.53	738,608.40	2,505,238.62	4,755,493.34	2,043,714.78	755,256.39
2011	11,505,463.65	873,146.52	2,712,650.18	5,034,245.37	2,061,884.28	823,537.30
2012	11,584,331.17	906,620.19	2,786,867.88	4,953,205.72	2,056,803.67	880,833.71
2013	11,453,618.05	983,258.35	3,046,142.52	4,521,816.82	2,062,369.66	840,030.70
2014	12,091,535.53	995,647.38	3,169,761.42	5,024,776.41	2,190,356.56	710,993.76
2015	12,177,256.78	1,020,682.64	3,209,682.42	5,144,188.68	2,097,567.49	705,135.55
2016	12,383,469.51	1,088,022.07	3,290,763.45	5,176,036.79	1,982,931.18	845,716.02
2017	12,170,254.30	1,075,134.05	2,974,359.96	5,057,136.28	2,155,487.51	908,136.50
2018*	11,842,733.82	1,021,202.73	2,888,967.32	4,891,516.85	2,127,108.08	913,938.84
Total	123,254,007.05	9,751,496.04	30,159,668.39	52,355,176.44	22,423,914.50	8,563,751.68

Source: DATASUS, 2019. * Records corresponding to the first three months of 2018.

followed by a decrease in the following years. Associated with the highest number of deaths, the years 2014 and 2016, also represent the highest number of hospitalizations. Among the period studied, evaluating both ends, there was an increase of 34.13% in this variable.

Based on the data collected by the study, it is clear that even with the improvement in road safety in automotive vehicles, leading to greater prevention of the main cause of TBI, direct and indirect costs are growing. Indirect costs refer to the loss of productivity caused by the health problem, and direct costs, those produced by hospital expenses. It is estimated that trauma is responsible for the loss of more productive years than cardiovascular disease and cancer combined. This constitutes a major public health problem with an economic impact on the health and social security sector[5,7].

This work is part of the first study that evaluates the estimate of expenditures of the Unified Health System in Brazil with TBI. During the period 2008-2018, Brazil had an average of 82,121.9 hospitalizations per year, with an overall average hospital stay of 11.01 days. During the same period, expenses for the treatment of TBI were spent, ranging from R$ 46,495,047.8 to R$ 83,025,626.78, with an increase of 78.56% in the direct costs for therapeutic assistance. With the number of deaths averaging 6,619 per year, with a relative increase of 34.13%.

Therefore, it is necessary to consider the importance of primary and secondary prevention resources, mainly related to automobile accidents, in order to reduce spending in both the health and social security sectors. In addition, new epidemiological studies should involve the portion of the population from the private health sector, in search of more accurate values of this estimate, since the presence of various biases leads to underestimated epidemiological valu**References**

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Table 12. Amount paid (in reais) for professional Services for the treatment of TBI separated by degrees, in SUS, by región, 2008-2018

Gastos con honorarios médicos

Year	North			Midwest			Northeast			Southeast			South		
	Mild	Moderate	Severe	Mild	Moderate	Severe	Mild	Moderate	Severe	Mild	Moderate	Severe	Mild	Moderate	Severe
2008	151,963.38	158,406.53	126,604.41	210,865.23	158,344.90	113,695.39	403,734.61	330,555.72	821,235.43	1,446,287.97	810,969.04	1,116,456.82	572,122.51	451,364.78	520,545.08
2009	231,732.61	214,851.78	165,615.00	268,162.58	274,735.70	154,369.11	726,738.65	492,309.82	800,660.39	1,809,116.50	1,229,685.97	1,384,243.88	764,474.85	691,990.53	645,193.54
2010	300,136.87	257,450.99	180,840.54	288,651.44	306,882.07	159,722.88	894,177.17	583,400.28	1,027,661.17	1,832,196.24	1,372,314.84	1,550,982.26	760,274.64	717,845.42	565,594.72
2011	337,068.75	358,333.72	177,744.05	285,639.65	405,676.05	132,221.60	851,792.60	717,164.51	1,143,693.07	1,831,332.02	1,431,847.38	1,771,065.97	772,130.80	721,060.35	568,693.13
2012	292,617.15	424,640.56	189,362.48	252,247.49	492,448.11	136,138.11	801,085.23	882,461.09	1,103,321.56	1,707,464.94	1,460,276.86	1,785,463.92	767,599.99	684,872.09	604,331.59
2013	344,804.54	449,411.24	189,042.57	211,553.06	490,805.29	137,672.35	834,314.87	1,058,161.57	1,153,666.08	1,616,305.59	1,371,777.19	1,533,734.04	811,993.71	644,603.20	605,772.75
2014	306,882.75	495,026.00	193,738.63	203,161.82	374,365.97	133,465.97	892,641.94	1,050,103.28	1,227,016.20	1,706,499.22	1,466,968.77	1,851,308.42	859,911.75	652,029.61	678,415.20
2015	294,331.05	415,769.65	310,581.94	204,251.90	377,758.15	123,125.50	868,107.02	993,818.35	1,347,757.05	1,787,286.11	1,534,403.37	1,822,499.20	795,468.40	733,050.52	569,048.57
2016	316,138.04	415,357.81	356,526.22	261,209.66	386,685.64	197,820.72	841,004.06	994,150.41	1,455,608.98	1,711,562.91	1,552,996.10	1,911,477.78	751,817.17	640,989.54	590,124.47
2017	311,120.03	438,341.62	325,672.40	284,214.24	380,650.89	243,271.37	834,264.31	851,929.89	1,288,165.76	1,610,372.60	1,668,824.85	1,777,938.83	888,674.44	666,385.82	600,427.25
2018*	288,623.28	382,182.02	350,397.43	288,047.78	336,144.71	289,746.35	866,983.42	798,919.04	1,223,064.86	1,585,952.01	1,583,516.69	1,722,048.15	830,016.70	587,539.57	709,551.81
Annual average value	288,674.40	364,524.72	233,284.15	250,727.14	362,227.04	165,568.12	801,349.44	795,724.90	1,144,713.68	1,694,943.28	1,407,598.27	1,657,019.93	779,498.63	653,793.76	605,245.28
Total amount	3,175,418.45	4,009,771.92	2,566,125.67	2,758,004.85	3,984,497.48	1,821,249.35	8,814,843.88	8,752,973.96	12,591,850.55	18,644,376.11	15,483,581.06	18,227,219.27	8,574,484.96	7,191,731.43	6,657,698.11

Source: DATASUS, 2019. * Records corresponding to the first tiree months of 2018.

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