Hospital morbidity of injured motorcyclists: factors associated with length of stay

Morbidade hospitalar de motociclistas acidentados: fatores associados ao tempo de internação

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Length of stay; External causes; Motorcycles; Trauma severity indices; Emergency nursing; Risk factors

Descritores
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Abstract

Objective: Identify factors of injured motorcyclists associated with hospital length of stay.
Methods: A retrospective cross-sectional study of motorcyclists with acute traumatic injury admitted to three reference trauma hospitals in São Paulo. Medical records of patients and necropsy reports were analyzed to extract variables that could be associated with length of stay, followed by an analysis by multiple linear regression to verify associated factors.
Results: One analysis of 91 motorcyclists showed that the following were associated with long length of stay ($p<0.05$): increased severity of trauma and infectious complications, pressure ulcers, rhabdomyolysis, and acute respiratory distress syndrome. Pressure ulcers and surgical site infections were predictors of long length of stay and death was a predictor of reduced length of stay.
Conclusion: The factors associated with length of stay resulted from both traumatic injury and the care provided to injured motorcyclists.

Resumo

Objetivo: Identificar fatores associados ao tempo de internação hospitalar de motociclistas acidentados.
Métodos: Estudo transversal, retrospectivo sobre motociclistas com lesões traumáticas agudas atendidos e internados em três hospitais referência para trauma de São Paulo. Prontuários de pacientes e laudo de necropsia foram consultados para obter variáveis que poderiam se associar ao tempo de internação, seguida da análise de regressão linear múltipla para verificar fatores associados.
Resultados: Análise de 91 motociclistas mostrou que o aumento da gravidade do trauma e as complicações infecciosas, úlcera por pressão, rabdomiólise e síndrome da angustia respiratória aguda associaram-se com maior tempo de internação ($p<0,05$). A úlcera por pressão e a infecção do sitio cirúrgico foram fatores preditores do aumento do tempo de internação e o óbito como preditor de redução da internação.
Conclusão: Os fatores que se associaram ao tempo de internação resultaram tanto das lesões traumáticas quanto do processo assistencial prestado aos motociclistas acidentados.

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Introduction

Traumatic injuries in motorcyclists caused by traffic accidents have shown alarming numbers due to their increasing incidence in the last few decades. According to a report from the World Health Organization (WHO), in 2010, 1.24 million people died due to traffic accidents, and half this number consisted of pedestrians, cyclists and motorcyclists. In addition, 92% of the deaths were in low- and middle-income countries.[1] The average annual proportion of deaths caused by traffic accidents is 18/100,000 inhabitants, and in Brazil, this proportion is 19.9/100,000 inhabitants, i.e., it is above the average.[1,2]

Some particularities regarding traffic accidents in Brazil should be noted. The study titled "Urban Mobility in Brazil" (*A Mobilidade Urbana no Brasil*), conducted by the Institute of Applied Economic Research (Ipea), highlighted the rapid growth of the motorcycle fleet in the country, which increased 619%, between 1998 and 2012. Such information draws attention to another number: the 2011 Map of Violence showed a 753% increase in the number of motorcyclists who died in traffic accidents in Brazil in the previous decade. Data published by the Mortality Data System of the Ministry of Health showed the increases: 1,047 deaths in motorcycle accidents were reported in 1998, 8,939 in 2008, and 11,433 in 2011, in Brazil.[2-5]

In São Paulo, the only category to report an increase in the number of fatalities was motorcyclists, with an 11.7% increase in 2010. The Traffic Engineering Company (*Companhia de Engenharia e Tráfego* - CET) reported 478 motorcyclist deaths in traffic, which was a 10.4% increase when compared to 2009.[2,5,6] There is evidently a relationship between motorcycle fleet growth and the number of deaths caused by motorcycle accidents, and this issue will clearly show increasing aggravation if efficient results-based public policies are not implemented soon.[6-8]

Aside from mortalities in motorcycle accidents, for survivors, traumatic injury may lead to hospitalization, and temporary or permanent physical disability, which may affect motorcyclist's return to daily activities and recovery of quality of life.

In view of increased incidence of motorcycle accidents leading to injuries at various levels of severity, the objective of the present study was to analyze hospital morbidity in order to report post-traumatic consequences in the acute phase. The goal was to identify factors associated with length of stay for injured motorcyclists.

Methods

This is a quantitative retrospective cross-sectional study conducted in three reference trauma hospitals in the municipality of São Paulo; two were university hospitals and one was a hospital school.

The study population consisted of motorcyclists treated in the Emergency Room (ER) from June 1 to November 30, 2005. The subjects were categorized under V20 to V29 in Chapter XX of "External Causes of Morbidity and Mortality" in the 10th International Statistical Classification of Diseases and Health-Related Problems. They had acute traumatic injuries and were admitted into one of the three hospital facilities. Data were collected from the medical records of patients and necropsy reports for the victims who died from the Institute of Forensic Medicine.

Patient length of stay was defined as a dependent variable, and it consisted of the period between admission to the ER to hospital discharge. The following were considered as independent variables: gender, age, outcome (death or hospital discharge), trauma severity and complications.

Complications were defined as those related to the primary diagnosed injury and recorded by the medical and nursing team during hospitalization. Injury severity was measured according to the Abbreviated Injury Scale (AIS 2005 - updated 2008), and trauma severity was calculated using the New

Injury Severity Score (NISS), considering a score ≥ 16 as important trauma.[9]

Data were stored and analyzed on an electronic spreadsheet using SPSS (Statistical Package for the Social Sciences) version 13.0. For the analysis of variables associated with length of stay, continuous variables were initially evaluated in terms of adhesion to a normal curve using the Kolmogorov-Smirnov test. Univariate analyses were conducted using association tests (Mann-Whitney and Kruskal-Wallis tests) and correlation tests (Spearman's correlation coefficient), followed by multiple linear regression analysis. Due to their multicollinearity, the independent variables were changed into z-scores to conduct the regression analysis, using the stepwise method. Multiple modeling was processed, considering the variables presenting p≤0.20, and the results were considered statistically significant when p<0.05.

The study was registered in the Research Ethics Committee of the Federal University of São Paulo under no. 0177/09.

Results

The sample consisted of 91 injured motorcyclists, 90.1% were male, and the mean age was 26.2 years old (min.:16 and max.: 50 years old; SD:8.2; median: 24 years). The most affected body regions were the head (28.7%), followed by the lower limbs (24.7%) and face (22.2%). Considering trauma severity, most (53.8%) obtained NISS scores ≥16, which classified them as important trauma. Hospital mortality was 13.2%.

Considering the length of stay as a dependent variable, as shown in table 1, the median length of stay for women was twice that for men, but no statistically significant difference was observed (p=0.526). The median for days of hospitalization was the highest for motorcyclists between 36 and 40 years old (13.0 days), standing out from the others, who presented very similar values, but with no significant statistical difference in length of stay (p=0.271).

Table 1. Length of stay of injured motorcyclists, by gender, age, outcome and trauma severity

Variables	Median	Length of stay Mean	SD	(Min. - Max.)		p value
Gender						
Male (n= 82)	4.0	18.3	50.4	0.02	365	0.526*
Female (n=9)	8.0	12.6	18.9	0.22	61	
Age group (years)						
16 to 20 (n=27)	3.0	27.12	76.4	0.02	365	0.271**
21 to 25 (n=25)	3.0	10.5	30.6	0.03	156	
26 to 30 (n=17)	4.0	18.6	32.0	1	115	
31 to 35 (n=10)	5.0	18.2	38.2	0.30	126	
36 to 40 (n=5)	13.0	11.6	5.3	3	17	
> 41 (n=7)	5.0	9.1	9.9	3	31	
Outcome						
Discharge (n=79)	5.0	15.2	45.2	0.38	365	0.062*
Death (n=12)	3.5	34.7	64.4	0.02	183	
NISS						
< 16 (n=42)	3	4.9	5.8	0.38	36	0.049*
> 16 (n=49)	6.0	29.2	64.3	0.02	365	

*Mann-Whitney test; **Kruskall-Wallis test

Regarding outcomes, the motorcyclists who survived presented a median length of stay of 5 days, which was higher than the median for deaths (3.5 days), but no statistically significant difference was found (p=0.062).

Based on the NISS, the median length of stay of injured motorcyclists with NISS scores ≥16 was twice the number of days when compared to those presenting NISS <16, which was a statistically significant difference (p=0.049).

In general, the patients who presented complications during hospitalization presented longer length of stay. The patients who presented the following complications: pressure ulcer (PU), aspiration and non-aspiration bronchopneumonia (BCP), urinary tract infection (UTI), surgical site infection (SSI), rhabdomyolysis, sepsis, abscess and acute respiratory distress syndrome (ARDS) presented significantly longer length of stay than patients without those complications, as shown in table 2. For the patients who presented cardiac arrest (CA), compartment syndrome (CS), diabetes insipidus (DI), fat embolism, pneumothorax, meningitis, acute kidney injury (AKI) and pulmonary embolism (PE), the difference in length of stay was not statistically significant when compared to those who did not present those complications.

Table 2. Association of complications with length of stay (days)

Complication	n	Length of stay					p value
		Median	Mean	SD	(Min. - Max.)		
PU							
Present	11	75	105.2	104.1	13	365	<0.001†
Absent	80	3.0	5.7	8.0	0.02	61	
Non-aspiration BCP							
Present	8	44.5	66.2	69.1	3	183	0.003†
Absent	83	4.0	13.0	43.5	0.02	365	
Aspiration BCP							
Present	5	36	120.4	147.9	14	365	0.001†
Absent	86	4.0	11.8	27.9	0.2	183	
UTI							
Present	6	135.5	149.7	122.9	4	365	0.001†
Absent	85	4.0	8.4	16.2	0.02	126	
SSI							
Present	5	17	109.4	156.6	4	365	0.034†
Absent	86	4.0	12.4	28.0	0.02	183	
Rhabdomyolysis							
Present	5	115.0	94.6	81.4	5	183	0.005†
Absent	86	4.0	13.3	42.2	0.02	365	
Sepsis							
Present	4	93.5	141.0	162.4	12	365	0.003†
Absent	87	4.0	12.0	27.8	0.02	183	
CA							
Present	4	91.5	137.1	114.7	0.02	365	0.954†
Absent	87	4.0	12.3	26.0	0.02	156	
Abscess							
Present	2	240.0	240.0	176.8	115	365	0.020†
Absent	89	4.0	12.7	29.6	0.02	183	
ARDS							
Present	2	73.0	73.0	59.4	31	115	0.037†
Absent	89	4.0	16.5	47.6	0.02	365	
Compartment syndrome							
Present	2	3.0	3.0	2.8	1	5	0.463†
Absent	89	4.0	18.0	48.7	0.02	365	
Diabetes insipidus							
Present	1	17.0	17.0	-	17	17	0.222†
Absent	90	4.0	17.7	48.5	0.02	365	
Fat embolism							
Present	2	79.5	79.5	108.2	3	156	0.377†
Absent	89	4.0	16.4	46.4	0.02	365	
Pneumothorax							
Present	1	36	36	-	36	36	0.158†
Absent	90	4.0	17.5	48.5	0.02	365	
Meningitis							
Present	1	17.0	17.0	-	17	17	0.222†
Absent	90	4.0	17.7	48.5	0.02	365	
AKI							
Present	1	31.0	31.0	-	31	31	0169†
Absent	90	4.0	17.6	18.5	0.02	365	
PE							
Present	1	3.0	3.0	-	3	3	0.769†
Absent	90	4.5	17.9	48.7	0.02	365	

†Mann-Whitney test

Table 3 shows the factors associated with length of stay, according to the multiple linear regression model.

Table 3. Multiple linear regression model for length of stay

Model		$ß_0$	ß	p Wald test	(CI=95%) Lower	Upper	p-value (model)
1	(constant)	0.636		0.000	0.518	0.753	<0.001
	PU	0.441	0.618	0.000	0.323	0.559	
2	(constant)	0.636		0.000	0.522	0.749	
	PU	0.466	0.653	0.000	0.351	0.581	<0.001
	Outcome	-0.161	-0.225	0.007	-0.276	-0.045	
3	(constant)	0.636		0.000	0.526	0.746	
	PU	0.440	0.617	0.000	0.326	0.554	
	Outcome	-0.184	-0.258	0.002	-0.298	-0.071	<0.001
	SSI	0.144	0.201	0.015	0.015	0.029	

In model 1, PU accounted for 37.6% of length of stay of injured motorcyclists. The length of stay was positively affected by the presence of PU, that is, the length of stay increased in comparison to those who did not present PU.

In model 2, when associating outcome plus PU, the model accounted for the length of stay of 41.9% motorcyclists, and the length of stay was negatively affected by the outcome. In this sample, 41.7% of deaths occurred within 2 days after admission.

The inclusion of SSI in model 3 accounted for 45.2% of length of stay, observing that the presence of surgical site infection increased the length of stay.

Therefore, the model resulting from linear regression analysis indicated PU and SSI were predictors of longer length of stay, that is, the motorcyclists who presented PU and SSI remained in the hospital longer than those who did not present these complications. Also in this model, death was identified as a predictor of reduced length of stay, as deaths of injured motorcyclists occurred early, thus reducing their length of stay.

Discussion

The prevalence of young people in motorcycle accidents has been reported in several studies, and it was no different in the studied sample. Mortality data from Brazilian capitals from 1996 to 2004 showed a prevalence of deaths from motorcycle accidents among people 20 to 49 years old.[1,10] In

other countries, studies on motorcycle accidents have also reported the prevalence of young male motorcyclists among fatal and non-fatal victims, including Thailand, New Zealand, the United States, France, Italy, the United Kingdom and Greece.[11-14]

Motorcycle accidents have an impact on society due to lost years of productive life, functional disabilities, costs related to social services and health, and suffering. Several studies on injured motorcyclists were conducted in the late 2000s that focused on trauma severity, helmet use or non-use, intake of alcohol and hospital cost, aiming to diagnose and obtain data to support prevention programs.[10-14]

Vulnerability of motorcyclists at the time of the accident may lead to traumatic injury due to absorption of generated energy, frequently resulting in fractures of the extremities and cranioencephalic traumas, which may extend the length of stay and cause complications. In the studied sample, the main body regions with traumatic injury were similar to those of other studies, that is, head, lower limbs and face.[2-6,8,12-14]

One analysis of hospital morbidity due to external causes conducted in Brazil showed that fractures accounted for 37.5% of admissions, with fractures of the extremities corresponding to almost the totality (84.5%) of this group.[12-15] A study conducted in 2007 also showed fractures, especially in the upper and lower limbs, corresponding to almost half of admissions (42.6%).[16] In 2004, aiming to identify the profile of traffic victims, a study observed that the most frequent injury was fractures, present in more than 90% of the cases, with lower limbs (LL) as the most frequently affected regions.[16]

In the studied sample, 24.7% of injuries were due to LL fractures. A high frequency of injuries to limbs was also detected by a study conducted in the United States with hospitalized motorcyclists, which observed LL injuries in 29.4% of the victims, followed by upper limb (UL) fractures in 13.1%.[17,18] The same author compared his data to data from other studies that used the same methodology with victims of firearm injuries, showing that these victims presented high risk of hospital mortality, and motorcycle accident victims had a longer length of stay for limb injury recovery due to complications that occurred during hospitalization.[18]

Although fractures of the extremities and pelvis are frequently present in motorcycle accidents, the results of studies have not yet dealt with measures or resources that could prevent or reduce these types of injuries.

Among the complications found in the present study, the most frequent was PU. The maintenance of integrity of the skin and underlying tissues for prevention of PU has traditionally been the responsibility of the nursing team, although other health team members have to be involved, due to the multifactorial nature of this lesion. In international studies, PU has been considered an indicator of quality of care.[16,17]

For the American College of Surgeons (ACS), quality indicators allow analysis of the trauma patient care process, consisting of goals or standards that can increase the probability of favorable results for patients.[19-21] In this study, PU was a factor associated with longer length of stay. It should be noted that frequently affected regions - sacral, trochanteric, occipital and calcaneal regions - may be related to mobilization difficulties for patients due to traumatic injuries, external fixation, monitoring, sedation and pain. The prevention of PU is essential and patient evaluation should be rigorous, from pre-admission to admission to the ER and during hospitalization.

Another trauma care quality indicator, according to the ACS, is the audit filter "Specific Complications".[21-23] This filter covers eight infection-related items.[14] In the studied sample, six of these items were observed: SSI, UTI, aspiration and non-aspiration BCP, sepsis and meningitis. Of these, only meningitis was not associated with longer length of stay.

The risk of infection in trauma patients may be due to factors related to patients, surgical procedures, use of invasive devices and immobility. The factors related to patients may include: old age, obesity, malnutrition, immunodepression, comorbidities, smoking and alcohol consumption. The factors related to surgical procedures include

long-duration surgery, early administration of antibiotics and presence of foreign bodies.[18-21]

Infection in patients with multi-systemic trauma is associated with a high number of surgical interventions and administration of drugs, especially antibiotics, which may result in longer length of stay.

Motorcyclists presenting SSI showed extended length of stay, with two cases of patients who were hospitalized for more than 6 months. The infection sites were the lower limbs and the head. When reported in the lower limbs, SSI involved traumatic injuries that required external fixation of the limb and/or artery ligation and/or fasciotomy and/or amputation and the occurrence of rhabdomyolysis, characterizing them as complex injuries requiring extended treatment. The two motorcyclists with SSI in the head were submitted to craniotomy and placement of an external ventricular drain, and their complications were meningitis and ventriculitis.

It should be noted that the more severe the trauma, the greater the systemic repercussions and the greater the probability of progression of systemic inflammatory response syndrome, multiple organ failure and death. For this reason, the early recognition and treatment of the priorities mentioned above are essential, as prognoses are primarily determined by the success of initial treatment.[21]

The present study provided information about hospital morbidity of injured motorcyclists admitted to reference trauma hospitals in São Paulo. However, a method-related limitation was observed. Since it was a retrospective study based on medical records, any absence of data could not be confirmed.

Data about motorcycle accidents reinforces the need to conduct prospective studies to produce detailed analyses in terms of effects from the impact on the occurrence of complications, functional ability of victims, sequelae and quality of life. These results could be used for the implementation of preventive measures in prompt service to motorcycle accident victims.

The use of motorcycles as a means of transportation may continue to increase considerably and concomitantly; thus, it is important to improve preventive measures, whether educational or coercive, including user and vehicle safety, adequacy of public roads and intensification of public education. Such efforts should include participation the scientific community, public policymakers and, above all, users of all motor vehicles.

Conclusion

The results of the present study support the conclusion that increased injury severity and infectious complications, PU, rhabdomyolysis and ARDS were associated with longer length of stay. The predictors of longer length of stay were PU and SSI, and death was a predictor of reduced hospitalization.

Collaborations

Araujo GL and Whitaker IY participated in the phases of study design, analysis, data interpretation, wording, relevant critical review of the intellectual content and final approval of the version to be published.

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