Journal of Nursing
Revista de Enfermagem
UFPE On Line
ISSN: 1981-8963

ORIGINAL ARTICLE

FACTORS ASSOCIATED WITH THE MORTALITY FROM TRAUMATIC BRAIN INJURY

FATORES ASSOCIADOS À MORTALIDADE POR TRAUMATISMO CRANIOENCEFÁLICO

FACTORES ASOCIADOS CON LA MORTALIDAD EN EL TRAUMATISMO CRANEOENCEFÁLICO

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ABSTRACT

Objective*:** to analyze the factors associated with mortality from traumatic brain injury (TBI). ***Method: cross-sectional study, conducted with the data of 399 medical records of TBI victims at a general hospital in the city of Jequié/BA, from 2009 to 2011. The prevalence ratio (PR) was used as measure of association. The data were analyzed with the software SPSS, version 21.0 (SPSS Inc., Chicago, IL.). The descriptive analysis was performed with the data, presented in absolute and relative frequencies, organized in tables and, later, the discussion was made based on the literature. ***Results*:** the factors associated with mortality from this type of trauma were: age, with a progressive increase of the PR along with the age's increase; aggression as a mechanism responsible for originating the trauma (PR=2.00; $CI_{95\%}$ 1.19-3.46); and the first seven days after the event (PR=2.09; $CI_{95\%}$ 1.19-3.66). ***Conclusion*:** the death prevalence in individuals hospitalized for TBI increases along with the age, in victims of aggression and in the first seven days after the event. ***Descriptors*:** Traumatic Brain Injuries; Hospital Mortality; Public Health Surveillance.

RESUMO

Objetivo*:** analisar os fatores associados à mortalidade por traumatismo cranioencefálico (TCE). ***Método: estudo transversal realizado com dados de 399 prontuários de vítimas de TCE em um hospital geral do município de Jequié/BA, de 2009 a 2011. Utilizou-se a razão de prevalência (RP) como medida de associação. Os dados foram analisados com o auxílio do SPSS versão 21.0 (SPSS Inc., Chicago, IL.). Realizou-se análise descritiva com os dados apresentados em frequências absoluta e relativa em tabelas, em seguida, apoiando-se na literatura para a discussão. ***Resultados*:** os fatores associados à mortalidade por esse tipo de trauma foram: idade, com aumento progressivo da RP conforme maior é a faixa etária; agressão como mecanismo gerador do trauma (RP=2,00; $IC_{95\%}$ 1,16-3,46); e os 7 primeiros dias depois de ocorrido o evento (RP=2,09; $IC_{95\%}$ 1,19-3,66). ***Conclusão*:** a prevalência de óbito em indivíduos internados por TCE aumenta com o avançar da idade, em vítimas de agressão e nos sete primeiros dias depois de ocorrido o evento. ***Descritores*:** Traumatismos Cranioencefálicos; Mortalidade Hospitalar; Vigilância em Saúde Pública.

RESUMEN

Objetivo: analizar los factores asociados con la mortalidad en el traumatismo craneoencefálico (TCE). ***Método:*** estudio transversal con datos de 399 registros médicos de víctimas de TCE en un hospital general de la ciudad de Jequié/BA, de 2009 a 2011. Se utilizó la razón de prevalencia (RP) como una medida de asociación. Los datos fueron analizados con el programa SPSS, versión 21.0 (SPSS Inc., Chicago, IL.). Se realizó un análisis descriptivo de los datos presentados en frecuencias absolutas y relativas en las tablas; a continuación, fue hecha la discusión basándose en la literatura. ***Resultados:*** los factores asociados con la mortalidad por este tipo de trauma fueron: la edad, con el aumento progresivo de la RP como la edad; agresión como mecanismo generador de trauma (RP=2,00; $IC_{95\%}$ 1,16-3,46); y los primeros 7 días después del evento ocurrieron (RP=2,09; $IC_{95\%}$ 1,19-3,66). ***Conclusión:*** la prevalencia de muerte en pacientes hospitalizados por TCE aumenta con la edad, en las víctimas de agresión y los primeros siete días después de ocurrido el evento. ***Descriptores*:** Traumatismos Craneocerebrales; Mortalidad Hospitalaria; Vigilancia En Salud Pública.

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INTRODUCTION

The traumatic brain injury (TBI) is one of the events responsible for the high number of deaths and permanent sequelae among the population, which causes socio-economic losses for the entire society. In the United States, the estimative is that, yearly, 1.7 million TBI cases occur, from which roughly 80% are discharged after receiving urgency and emergency hospital services, 275 thousand are hospitalized, and 52 thousand die.[1] In Europe, the estimative is 235 TBI for every 100 thousand inhabitants, by year[2], and a total of 6.2 million of people with at least one sequel resulting from this type of trauma.[3]

In Brazil, in 2012, there were more than 102 thousand hospitalizations resulting from TBI in the Unified Health System (SUS), which resulted in nearly 10,000 deaths and an expenditure of about R$148 million with these hospitalizations.[4]

In a study about mortality from external causes at a general hospital of Jequié, Bahia, in 2009, Nery *et al*[5] evidenced that TBI was the main diagnosis (61.8%) among deaths, reinforcing the importance of knowing the epidemiological profile of this type of trauma in the city, in addition to investigating which factors influence on the mortality from this grievance.

The objective of this study is to analyze the factors associated with the mortality from traumatic brain injury.

METHOD

Cross-sectional study, developed from the research project << Morbidity and mortality from external causes at a public hospital in inner Bahia >>, approved by the Research Ethics Committee of the State University of Southwest Bahia (UESB), with Certificate of Presentation for Ethics Consideration number 26666614.9.0000.0055, and conducted with the data from the medical records of victims of external causes hospitalized in the city of Jequié, Bahia, from 2009 to 2011, at the General Hospital Prado Valadares (HGPV), a reference to the health microregion compound by 25 cities.

The criterion for defining TBI was to have the head as the affected body segment, complemented by the main medical diagnosis, accessed from the International Classification of Diseases (ICD-10). Therefore, the cases were defined as TBI when in accordance with any ICD-10 that referred to traumatic brain injury (S00-S09). It is noteworthy that the cases attended in the emergency room of the institution, victims of accidents and less serious violence, which did not require hospitalization, were not considered in the study.

The case outcome (death or survival) was considered as the dependent variable. The independent variables were: demographic characteristics (gender and age group); regarding the grievance (city and place of the event, trauma mechanism and specificities of each of the mechanisms involved, as the height of the fall, condition at the time of the traffic accident and means used for aggression); and regarding the provided care (time of stay in hospital).

The collected data were analyzed with the software SPSS, version 21.0 (SPSS Inc., Chicago, IL.). A descriptive analysis was performed, and the data were presented in absolute and relative frequencies. Then, the variables were grouped into categories, taking into account the literature and data distribution. The prevalence ratio (PR) was used as a measure of association, with their respective confidence intervals (CI) at 95%. The chi-square tests of Pearson and the Fisher's exact test were used to assess the association between the dependent variable and the other variables, considering as statistically significant the p-value < 0.05.

RESULTS

At the HGPV, from 2009 to 2011, a total of 2,565 cases involving external causes was attended. Among these cases, 399 (15.5%) represented TBI cases, and 157 (39.3%) of these (399) occurred in 2009, 106 (26.6%), in 2010, and 136 (34.1%), in 2011.

It was observed that, among the analyzed cases, there was prevalence of males (83.7%), age group between 20 and 29 years (27.2%), victims of traffic accidents (58.3%), the event occurring in cities surrounding Jequié (50.7%), the event occurring in the street (51.4%), and the outcome being the hospital discharge (78.8%). The average time of hospital stay was 8.8 (± 10.7) days. Deaths from TBI represented 15.6% of the total. Table 1 shows in detail the profile of the study population.

Table 1. Profile of traumatic brain injury victims hospitalized at a general hospital of Jequié - BA, 2009-2011.

Variables/categories	n	%
Gender (n=399)*		
Male	334	83.7
Female	65	16.3
Age group (n = 398)*		
0 - 9 years	39	9.8
10 - 19 years	54	13.6
20 - 29 years	108	27.2
30 - 39 years	69	17.3
40 - 49 years	45	11.3
50 - 59 years	30	7.5
60 - 69 years	21	5.3
70 - 79 years	18	4.5
≥ 80 years	53	3.5
Trauma mechanism (n = 389)*		
Traffic accident	227	58.3
Fall	96	24.7
Aggression	66	17.0
City of the event (n = 343)*		
Jequié	169	49.3
Other city	174	50.7
Place of the event (n = 140)*		
Residence	34	24.3
Public highway (street)	72	51.4
Public highway (highway)	26	18.6
Farm	4	2.9
Working place	1	0.7
Other places	3	2.1
Outcome (n = 391)*		
Discharge	308	78.8
Evasion	2	0.5
Transference	20	5.1
Death	61	15.6

*The number of TBI cases is different for each item due to the ignored information.

The factors statistically associated with the mortality from TBI were: age, with a progressive increase of the PR along with the age's increase; aggression as a mechanism responsible for originating the trauma (PR=2.00; $CI_{95\%}$ 1.19-3.46); and the first seven days after the event (PR=2.09; $CI_{95\%}$ 1.19-3.66). In turn, gender and the event's city and place were not statistically associated with the outcome of the TBI case (Table 2).

Table 2. Prevalences, prevalence ratio and confidence intervals of the deaths from traumatic brain injury at the general hospital, according to demographic variables regarding the grievance and care. Jequié - BA, 2009-2011.

Variables/categories	Death prevalence (%)	PR	$CI_{95\%}$	P-value
Gender				
Female	11.1	1.00		
Male	16.5	1.48	0.71-3.10	0.284
Age group				
0 - 19 years	2.2	1.00		
20 - 39 years	14.9	6.80	1.65-28.01	0.001
40 - 59 years	23.0	10.45	2.49-43.80	< 0.001
60 - 79 years	27.0	12.30	2.83-53.45	< 0.001
≥ 80 years	42.9	19.50	4.36-87.23	< 0.001
Trauma mechanism				
Traffic accident	12.5	1.00		
Fall	15.8	1.26	0.71-2.25	0.431
Aggression	25.0	2.00	1.16-3.46	0.014
City of the event				
Jequié	17.2	1.00		
Other city	15.6	0.91	0.56-1.47	0.697
Place of the event				
Public highway (street or highway)	18.8	1.00		
Other places	24.4	1.30	0.66-2.57	0.453
Time of stay				
≥ 8 days	9.3	1.00		
≤ 7 days	19.5	2.09	1.19-3.66	0.007

Regarding the mechanisms responsible for the trauma, among the traffic accidents, those involving motorcycle were the most numerous (57.2%), especially among men (91.0%), age group from 20 to 29 years (44.6%). Regarding the height of the fall, the ones that occurred at the same level were the most frequent (55.2%). Furthermore, most of them occurred at the individual's residence (27.1%), especially among the elderly (29.2%) and children under 10 years (21.9%). Regarding the aggressions that caused the TBI, physical aggression/beating prevailed (69.6%), highlighting the male as the most affected (83.3%). Young adults, aged from 30 to 39 years (30.3%) and from 20 to 29 years (27.3%), were the main victims of this type of injury (Table 3).

Table 3. Profile of the victims of traumatic brain injury hospitalized at a general hospital of Jequié - BA, 2009-2011.

Variável/categorias	n	%
Condition when the traffic accident occurred (n=215)*		
Car occupant	46	21.4
Motorcyclist	123	57.2
Cyclist	15	7.0
Pedestrian	31	14.4
Height of the fall (n=87)*		
Same level	48	55.2
Furniture	13	14.9
Building, trees, animals	19	21.8
Stairs	7	8.1
Type of aggression (n=66)*		
Physical aggression/beating	46	69.6
Light weapon	10	15.2
Firearm	10	15.2

***** The number of TBI cases is different for each item due to the ignored information.

Among the traffic accidents, falls and aggressions, the highest death rates were, respectively, accidents with pedestrians, fall from stairs and aggressions by light weapon. These variables, however, were not statistically associated with the death from TBI (Table 4).

Table 4. Prevalences, prevalence ratio and confidence intervals of the deaths from traumatic brain injury at a general hospital, according to the trauma mechanisms. Jequié - BA, 2009-2011.

Variables/categories	Death prevalence (%)	PR	$CI_{95\%}$	P-value
Condition when the traffic accident occurred				
Car occupant	9.1	1.00		
Motorcyclist	12.3	1.35	0.47-3.86	0.783
Cyclist	0.0	---	---	0.564
Pedestrian	22.6	2.48	0.79-7.76	0.183
Height of the fall				
Same level	17.0	1.00		
Furniture	7.7	0.45	0.06-3.29	0.668
Building, trees, animals	10.5	0.62	0.14-2.65	0.711
Ladder	28.6	1.68	0.44-6.35	0.601
Type of aggression				
Physical aggression/beating	22.7	1.00		
Light weapon	40.0	1.76	0.69-4.48	0.424
Firearm	20.0	0.88	0.23-3.41	1.000

DISCUSSION

The TBI mortality rate, at the place and in the time of the present study, was 15.6%, intermediate value when compared to other studies about this type of trauma, which found 10.2%[6], 10.5%[7], 22.0%[8] and 33.3%.[9] It is noteworthy that, during the use of these indicators, it is necessary to take into account differences in the nursing screening and the practice of hospitalization between the various hospital units.

Advanced age is a recognized predictor of mortality and worse prognosis during hospitalization for TBI.[10] As well as the results found by this study, Hukkelhoven *et al*[11] and Mushkudiani *et al*[12] corroborate that, often, the higher the age, the worse the prognosis resulting from this trauma. Other studies[9,13-4] also found the association between mortality from TBI and age, with the highest rates of deaths among the elderly.

With the aging, there is a decline in the general health condition, which may also be associated with the presence of comorbidities. In a multicenter study, conducted in the United States,[15] it was found that 73% of elderly victims of TBI have suffered from some

morbidity before the trauma (especially hypertension and heart diseases), whereas, among young adults, this percentage was 28%. It is also noteworthy the increased use of anticoagulants drugs among the elderly, which is associated with the increased risk of death among patients with head trauma.[16]

Regarding the mechanisms responsible for the TBI, the aggressions prevailed, twice more prevalent among patients who died when compared to deaths from traffic accidents. This result indicates the severity of the violence problem away from big cities, prevailing the influence of social determinants such as unemployment, poverty, impunity and the decontrol of arms and illicit drugs trafficking, bringing negative effects to the population and the health system as a whole.

Another factor related to the increased violence is the consumption of alcohol. Studies describing the profile of victims of accidents and violence attended at urgency/emergency services, selected in Brazilian capitals in 2009[17] and 2011[18], found that alcohol consumption was recorded in 35% and 16.3% of the victims of violent events, respectively, mostly compound by aggression or ill-treatment.

In the present study, among the types of aggressions that led to the TBI, the light weapon showed the highest mortality rate, an unusual result, given the low kinetic energy involved when compared to the trauma caused by firearm, which generally causes more extensive injuries.[19] Meanwhile, Santana *et al*[20] report that the prevalence of episodes of violence with light weapons is explained by the fact that many objects can be used as light weapons, denoting an easy attack tool for the individual practicing the violent act.

Despite not having statistically significant association with death for TBI, traffic accidents deserve a closer look as they accounted for 58.3% of cases. The accidents involving motorcyclists prevail, representing 57.2% of the total.

This finding is explained by the current constitution of Jequié vehicle fleet. The number of motorcycles, for some years, has been higher than the number of cars, reaching, in 2013, a total of 20,271 and 16,457, respectively.[21] In addition to the large quantity of motorcycles, the high number of victims with TBI is also explained by the recklessness of the motorcyclists, who circulate at high speed and without protective equipment and signaling,[22] as well as the poor planning of public roads. Other studies[8,23-4] reaffirm this growing incidence of head trauma due to motorcycle accidents.

The prevalence of deaths in patients with TBI is higher in the first seven days of hospitalization. This may reflect an inadequate health care provided immediately, a few hours after the injury or during the course of hospitalization. It may also reflect the severity of the case, as the most serious cases led, more often, the individual to death in this period.

In this sense, Koizumi *et al*,[6] using the data from hospitalizations and deaths of residents in the city of São Paulo, observed that, of all deaths from TBI, 81.1% occurred in the first seven days of hospitalization. Walder *et al*,[14] in a prospective cohort study with patients with TBI, in Switzerland, also found that most of the deaths occurred during the first week of hospitalization.

The results of this study corroborate with the literature, describing the first days after the trauma as crucial to the outcome. Especially the first 72 hours, once, in serious brain injuries, where the brain blood flow reduces roughly 50% during the first six to 12 hours post-trauma,[25] followed by vasogenic and cytotoxic edema, concurrent and proportional to the severity of TBI. This edema reaches its peak around the third day.[26] For this reason, it is important that a multidisciplinary team assesses the victim of TBI, with the objective of stabilizing the injuries already installed and preventing further injury, extending the interventions to the pre-, intra- and post-hospital domains.[13,27]

CONCLUSION

From 2009 to 2011, at the analyzed hospital unit, the factors associated with mortality from TBI were the age advancing, aggression as cause of the trauma mechanism and the first seven days after the event. It is noteworthy, however, that this study had some limitations. Among them, there is the failure to investigate other variables due to underreporting of information in the medical records. Furthermore, it is believed that the prevalence of deaths from TBI may be underestimated due to differences in the cases' coding and lack of multitrauma situations' inclusion. It should also be considered that the low number of cases and the restriction to a single locoregional context limit the external validity of the results, which should, then, be interpreted with caution. In this sense, other studies with analytical approach and larger samples/populations and different contexts are necessary for establishing adjustments of the variables of interest, while verifying this

and other features associated with death from TBI.

Considering the reached results, some procedure may be observed, in order to positively interfere in the factors associated with the highest mortality from TBI, namely:

a) Prioritizing the efforts for implementing health preventive and promotion actions, especially in primary care, in order to reduce the frequency of comorbidities developed over the years among individuals with advanced age.

b) Promoting ongoing formation and information about preventing accidents and violence, and the procedures when they occur, in order to promote the citizen's co-responsibility.

c) Focusing on health prevention and traffic education, through inter-sectorial actions, as a way to ease the increasing occurrence of this grievance, even if the pre- and intra-hospital integrated care to TBI victims keep getting improved.

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Submission: 2015/07/26
Accepted: 2016/05/27
Publishing: 2016/07/01

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