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EPIDEMIOLOGICAL FEATURES OF TRAUMATIC BRAIN INJURIES FROM A FIRST LEVEL TRAUMA CARE NATIONAL MEDICAL CENTER IN GEORGIA

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Keywords: *traumatic brain injury, hospitalization, Georgia.*

Introduction. *Traumatic brain injuries are a significant public health issue in both developed and developing countries. In Georgia, traumatic brain injuries remain one of the leading causes of mortality and disability. Traumatic brain injuries affect families, communities and societies in Georgia and have far-reaching human, social and economic costs, manifested in increased emergency department visits, hospitalizations, disability and deaths. The aim of this study is to retrospectively analyze the epidemiological features of Traumatic Brain Injuries on the example of Medical Centre in Georgia which provides a first level trauma care for patients in the country.* ***Material and methods****. Retrospective observational study was conducted from August 1 to October 31, 2018. The study included patients who were admitted with a Traumatic Brain Injuries diagnosis and S00-S09.0 codes (ICD 10). SPSS 20 was used for statistical analysis.* ***Results.*** *A total of 96 TBI-related hospitalizations were studied. 56.3% (n=54) of hospitalized patients were males. The average age of patients was 40.7 years. Furthermore, patients aged 25-44 years were more represented in the number of TBI-related hospitalizations (39.6%). 95.8% of all Traumatic brain injuries hospitalizations were as a result of unintentional injuries. Unintentional falls were shown to be the predominant mechanism of injury accounting for over half of TBI-related hospitalizations (56.2%). The second most common mechanism of injury is the road traffic injury, mostly occurring among males (63.9%).* ***Conclusions.*** *This study offers an insight into understanding the epidemiological features of Traumatic Brain Injuries on the example of the National Medical Center from Georgia.*

Cuvinte cheie: *leziuni cerebrale traumatice, spitalizare, Georgia.*

CARACTERISTICI EPIDEMIOLOGICE ALE LEZIUNILOR TRAUMATICE CEREBRALE DINTR-UN CENTRUL MEDICAL NAȚIONAL DE INGRIJIRE A TRAUMATISMELOR DE PRIM NIVEL DIN GEORGIA

Introducere*. Leziunile cerebrale traumatice (LCT) reprezintă o problemă semnificativă de sănătate publică atât în țările dezvoltate, cât și în cele în curs de dezvoltare. În Georgia, leziunile cerebrale traumatice rămân una dintre principalele cauze de mortalitate și dizabilitate. Leziunile cerebrale traumatice afectează familiile, comunitățile și societățile din Georgia și au costuri umane, sociale și economice de anvergură, manifestate prin creșterea vizitelor la secțiile de urgență, spitalizări, dizabilități și decese. Scopul acestui studiu este de a analiza, retrospectiv, trăsăturile epidemiologice ale leziunilor cerebrale traumatice, în baza exemplului Centrului Medical din Georgia, care oferă un prim nivel de îngrijire a traumei, pacienților din țară.* ***Material și metode.*** *A fost realizat un studiul observațional retrospectiv în perioada 1 august – 31 octombrie 2018. Studiul a inclus pacienți care au fost internați cu diagnostic de leziuni cerebrale traumatice - codurile S00-S09.0 (ICD 10). Analiza statistică a datelor a fost realizată în SPSS 20.* ***Rezultate.*** *Au fost studiate 96 de spitalizări legate de LCT; 56,3% (n=54) dintre pacienții internați fiind bărbați. Vârsta medie a pacienților a fost de 40,7 ani. În plus, pacienții cu vârsta cuprinsă între 25-44 de ani au fost mai frecvenți în numărul de spitalizări legate de LCT (39,6%). 95,8% dintre toate spitalizările cu leziuni cerebrale traumatice au fost ca urmare a unor leziuni neintenționate. Căderile neintenționate s-au dovedit a fi mecanismul predominant de rănire, reprezentând peste jumătate din spitalizările legate de LCT (56,2%). Al doilea cel mai frecvent mecanism de rănire este vătămarea rutieră, care se înregistrează, mai ales, în rândul bărbaților (63,9%).* ***Concluzii.*** *Acest studiu oferă o perspectivă asupra înțelegerii caracteristicilor epidemiologice ale leziunilor cerebrale traumatice, în baza Centrului Medical Național din Georgia.*

INTRODUCTION

Traumatic brain injuries (TBI) are a significant public health issue in both developed and developing countries (1-9) accounting for about 41% of overall Years of Life Lost (YLL) (10), with an estimated annual incidence of TBI globally about 27 to 69 million (11, 12). A surveillance study of TBI-related deaths in the US indicated that TBI remains the chief cause of death and disability in young people (13). Another study (14) found an increasing incidence rate of TBIs among people aged 65 years and older in high-income countries as a result of an unintentional fall. A meta-analysis of hospital-based studies from 16 European countries found the incidence of hospital-admitted TBIs to be approximately 262 cases per 100,000 individuals (15). Low-income and middle-income countries report higher incidence rates of TBI compared to developed countries. Estimates from Maas et al. indicate that from 50-60 million new TBI cases which occur annually, only about 2.5 million are reported to occur in high-income countries with almost 90% of TBI-related deaths occurring in low-income and middle-income countries (16). TBI incidence rates in Latin America is 150 and mortality from Severe TBI is very high, as well (17).

Georgia, by virtue of its GNI per capita of US $ 4046,8, is categorized as a middle-income country that is still in the 'Centre of Development' (18). In Georgia, just like other developing countries, TBI remains one of the leading causes of mortality and disability, especially among young Georgians (19). TBI affects families, communities and societies in Georgia and have far-reaching human, social and economic costs manifested in increased emergency department visits, hospitalizations, disability and deaths. According to a 2016 report by the 'Brain and Spinal Cord Injury Trust Fund Commission' (20), Georgia reported 27,840 TBI injuries which involve 20,488 emergency department visits and 7,352 hospital admissions.

The aim of this study is to retrospectively analyze the epidemiological features of TBI on the example of National Medical Centre in Georgia which provides a first level trauma care for patients across the country.

MATERIAL AND METHODS

This present study was designed within the project "INITIatE: International Collaboration to Increase Traumatic Brain Injury Surveillance in Europe", funded by the United States National Institutes of Health and led by the University of Iowa and the Cluj School of Public Health. Retrospective observational study was conducted from August, 1st to October, 31st 2018, within the first level trauma center, located in Tbilisi, the capital of Georgia, which provides both 320 beds and f trauma care to the population of Georgia (3,716,900). The study included patients admitted in the Medical Center during the study period with a TBI diagnosis and S00-S09.0 codes (ICD 10). The collected data were uploaded into a REDCap (research electronic software) database. SPSS 20 (from IBM Corp, NY, USA) was used for the descriptive statistical analyses of TBI-related variables.

RESULTS

A total of 96 TBI-related hospitalizations were studied. 56.3% (n=54) of hospitalized patients were males and 43.8% (n=42) were females, indicating a male to female ratio of 1.3:1. The age of the patients ranged between 2 years to 85 years. The average age of the participants in this study was 40.7 years. Furthermore, the modal age group was 25-44 years old, reflective of the fact that patients who were aged between 25-44 years old were more represented in the number of TBI-related hospitalizations in the health facility at 39.6% (n=38), followed by 45-64 years accounting for 25 (26.0%) patients and 15-24 years who accounted for 19 (19.8%) patients. The males were also over-represented among the two most frequent age groups of TBI patients making up 68.4% (n=26) and 64% (n=16), respectively. The employment and social status of the patients were in consonance with the age distribution viz. 34 (35.4%) hospitalized patients were still unemployed, followed by 20 (20.8%) employed patients. Retirees accounted for 12.5% (n=12) of all hospitalized patients, while 16 (16.7%) patients had no employment and social statuses.

Most TBIs were recorded to occur in urban areas (n=90; 93.8%) with transport systems, which include public highways, streets or roads viz. the most common place of TBI occurrence (38; 39.6%), followed by home accidents, accounting for 27.1% (n=26) of all TBI occurrences. The result showed that 95.8% (n=92) of all TBI hospitalizations were as a result of unintentional injuries

with only 2.1% (n=2) of patients shown to have sustained work-related injuries. In accordance with the intent of injuries, unintentional falls were shown to be the predominant mechanism of injury, accounting for over half of TBI-related hospitalizations (56.2%; n=54) and evenly distributed among both males and females (50%; n=27). The second most common mechanism of injury was determined to be the road traffic injury (RTI), mostly occurring among males (63.9%; n=23), accounting for 37.5% (n=36) of TBI-related hospitalizations, followed by being struck by an object and assault offences at 3.1% (n=3) and 2.1% (n=2), respectively. Cumulatively, falls were found more likely to occur in females rather than men (64.3% in females vs. 50% in males) in most TBI-related hospitalizations.

Thus, over half of all TBI-related hospitalizations were due to falls, mainly occurring in the 25-44 and 45-64 age groups, viz. in 61.1% (n=33) of cases. It is noteworthy that the most causes of TBI hospitalizations were most prevalent among the 25-44 age group. TBI hospitalizations resulting from falls and road traffic injuries contribute 92,1% (n=35) of the TBI cases in this age group. All TBI cases resulting from assaults fall within this age group with half of assault-related injuries occurring among females. Road traffic injuries were the most common cause of TBI-related hospitalizations among those aged 15-24 years accounting for over half of TBI hospitalizations in this age category (52.6%; n=10). Most of injuries 46.3% (n=25) result from falls at home, followed by other unspecified locations – 22.2% (n=12), 13% (n=7) at residential institutions, where mostly were not work-related injuries (92.6%; n=50). All assaults occurred in urban areas (100%; n=3), mostly among females (66.7%; n=2), occurring at some unspecified locations. The majority (97.2%; n=35) of road traffic injuries occurred at public highways, streets or roads and 2.8% (n=1) at other specified locations. The highest male to female ratio (2:1) accounted for injuries resulting from being struck by or against an object while the lowest ratio was for falls (1:1). However, injuries caused by assault (violence) also showed a highest female to male ratio (1:1).

The most common hospital arrivals were carried out by ambulances, which accounted for 62.5% of hospital arrivals (n=60) with 14.6% (n=14) of injury cases arriving through 'other' means. Among the patients who arrived by other means, 71.4% (n=10) were referrals from another hospital and 14.3% (n=2) were brought by helicopters. While 13.5% (n=13) arrived by private/public transport, injury-to-hospital arrival timeframe ranged from 3 minutes to 73 hours. However, the average time interval between the injury onset and time of attendance was 3.36 hours. Nearly half (47.9%; n=46) of the TBI patients came to the hospital in less than 1 hour, while 8.3% (n=8) of patients arrived 1-2 hours post-injury. In addition, 15.6% (n=15) of TBI patients experienced an injury-to-hospital attendance timeframe of 2-4 hours while it took more than four hours for 9.4% (n=9) of injured patients to arrive to the health facility (tab. 1, tab. 2). The amount of days spent in the health facility varied from 0 to 72 days and was determined by the injury severity. Most patients (38.1%; n=37) spent 1 day in hospital (a modal length of 1 day) and 1 day was also the mean duration of hospital stay. In-patient treatment was completed in all TBI cases (100%). However, the discharge status was also related to TBI severity as 2.1% (n=2) of hospitalized TBI patients died, 1% (n=1) transferred to a rehabilitation Center and 96.9% (n=93) were sent home. Over two-thirds of TBI patients who spent more than 7 days in hospital were males (68.75%; n=11); 43.6% (n=17) of 25-44 years old spent up to 1 week in hospital and were overrepresented among those who spent over 15 days in hospital (77.8%; n=7). 44% (n=11) and 22.2% (n=2) of 45-64 years old spent close to 7 days and over two weeks in hospital respectively. The longest hospital stay length was related to TBIs resulting from falls and road traffic accidents, whereas the latter accounted for 88.9% of all hospital stays that lasted 15 days or more. Patients with severe TBI had a longer hospital stay; 77.8% (n=7) of patients who spent more than 15 days in hospital arrived by ambulance, and most patients who arrived within an hour (less than 1 hour) post-injury had the shortest hospital stays.

DISCUSSIONS

This hospital-based study relied on comprehensive demographic, epidemiological, management and outcome characteristics of traumatic brain injury from the INITIatE TBI database, Georgia. The present hospital-based trauma database offered the perfect springboard to study trends, patterns, and outcomes of traumatic brain injuries so as to inform effective preventive, control and treatment measures. Hence, the knowledge of

Table 1. Hospital stay length based on demographic and epidemiologic factors.

		0 to 1 day	2-7 days	8-15 days	>15 days	Total
		N (%)	N (%)	N (%)	N (%)	
Gender	**Male**	21 (53.8)	22 (53.7)	3 (42.9)	8 (88.9)	**54 (56.2)**
	Female	18 (46.2)	19 (46.3)	4 (57.1)	1 (11.1)	**42 (43.8)**
Age, p value 0,2	**0-14**	2 (5.1)	0 (0)	0 (0)	0 (0)	**2 (2.1)**
	15-24	8 (20.5)	9 (22.0)	2 (28.6)	0 (0)	**19 (19.8)**
	25-44	14 (35.9)	16 (39.0)	1 (14.3)	7 (77.8)	**38 (39.6)**
	45-64	9 (23.1)	11 (26.8)	3 (42.9)	2 (22.2)	**25 (26.0)**
	65 and above	6 (15.4)	5 (12.2)	1 (14.3)	0 (0)	**12 (12.5)**
Mechanism of injury, p value 0,05	**Fall**	25 (64.1)	24 (58.5)	4 (57.1)	1 (11.1)	**54 (56.2)**
	Road Traffic Injury (RTI)	11 (28.2)	14 (34.1)	3 (42.9)	8 (88.9)	**36 (37.5)**
	Assault	0 (0)	2 (4.9)	0 (0)	0 (0)	**2 (2.1)**
	Struck by/or against	2 (5.1)	1 (2.4)	0 (0)	0 (0)	**3 (3.1)**
	Other	1 (2.6)	0 (0)	0 (0)	0 (0)	**1 (1.0)**
Mode of arrival, p value 0,05	**Ambulance**	24 (61.5)	25 (61.0)	4 (57.1)	7 (77.8)	**60 (62.5)**
	Private/public vehicle	10 (25.6)	3 (7.3)	0 (0)	0 (0)	**13 (13.5)**
	Walk-in	3 (7.7)	4 (9.8)	0 (0)	0 (0)	**7 (7.3)**
	Police	1 (2.6)	0 (0)	0 (0)	0 (0)	**1 (1.0)**
	Other	1 (2.6)	9 (20.0)	3 (42.9)	1 (11.1)	**14 (14.6)**
Time interval between time of injury and time of attendance, p value 0,00	**Less than 1 hour**	24 (77.4)	15 (45.5)	1 (20.0)	6 (66.7)	**46 (59.0)**
	1-2 hours	4 (12.9)	2 (6.1)	1 (20)	1 (11.1)	**8 (10.3)**
	More than 2 hours	3 (9.7)	16 (48.5)	3 (60)	2 (22.2)	**15 (19.2)**
		31 (39.7)	**33 (42.3)**	**5 (6.4)**	**9 (11.5)**	**78 (100)**

Table 2. TBI description for different age groups.

		Age Groups					Total
		0-14	15-24	25-44	45-64	64 and above	
		N (%)	N (%)	N (%)	N (%)	N (%)	
Mechanisms of injury, p value 0,00	**Fall**	2 (100)	9 (47.4)	17 (44.7)	16 (64)	10 (83.3)	**54 (56.2)**
	Road Traffic Injury (RTI)	0 (0)	10 (52.6)	18 (47.4)	7 (28)	1 (8.3)	**36 (37.5)**
	Other	0 (0)	0 (0)	3 (8)	2 (8)	1 (8)	**6 (5,3)**
Injury occurrence area, p value 0,1	**Rural**	1 (50)	0 (0)	2 (5.3)	1 (4)	0 (0)	**4 (4.2)**
	Unknown	0 (0)	0 (0)	1 (2.6)	1 (4)	0 (0)	**2 (2.1)**
	Urban	1 (50)	19 (100)	35 (92.1)	23 (92)	12 (100)	**90 (93.8)**
		2 (2.1)	**19 (19.8)**	**38 (39.6)**	**25 (26)**	**12 (12.5)**	**96 (100)**

TBI incidence and distribution in Georgia is fundamental for the identification of high-risk groups, improved healthcare resource allocation and targeting of interventions as demonstrated

by the results of this thesis. Furthermore, such epidemiological estimates can serve as a basis for comparison and evaluation of future population based on interventions tailored for these high-risk population groups.

There were similarities in trends and patterns between TBI epidemiology in Georgia and that of other countries. The study results showed that TBIs were more over-represented in men than in women indicating an increased risk of TBI incidence for men. This might be reflective of the men's societal roles in the Georgian society where they are more likely to be in the labor force and engaged in high-risk behaviors and activities, rather than their female counterparts. Therefore, the analysis of TBI-related hospitalizations revealed that most patients suffered from mild TBIs, which is similar to the findings of studies from other countries, both in HICs and LMICs. There is an increased risk of dementia, epilepsy and death associated with TBI-related hospitalizations. As regarding the mild TBI, accounting for most TBI-related hospitalizations, these may be further associated with post-traumatic symptoms, serious impairment, long-term morbidity and disability.

The study revealed that falls are the chief mechanisms for TBI in Georgia, followed by road traffic accidents which remain the leading cause of fatal TBI. This is similar to the findings from high-income countries where majority of TBI hospitalizations were fall-related. Conversely, findings from LMICs, particularly the Asian and African countries, reveal that road traffic accidents are the leading cause of TBI. This might be as a result of on-going infrastructural developments evidenced by the construction of high-rise buildings, implementation of effective road safety strategies, improvements in road infrastructure, and other human development indicators in the upper middle-income country. Furthermore, the peak of TBI incidence occurs in much younger age groups in LMICs, aged between 28 and 33 years, as indicated by this study, unlike in HICs where the changing epidemiological pattern shows a higher TBI incidence among the elderly population which are fall-related. In light of increasing fall-related TBI incidence among young adults in Georgia, there is a need to adopt preventive strategies which focus on reducing young people's exposure to environmental hazards and other activities that expose them to risk. One of the most striking findings was the under-representation of assault or violence – related injuries in the study sample. Violence against women is prevalent in Georgia, being ranked 94th out of 144 countries in the global gender gap index. In Georgia's socio-cultural context, family honor supersedes individual agency as intimate partner violence is considered a family issue unsuited for outside interference or publicity. Hence, stigmatization must have accounted for the under-reporting and misclassification of violence-related TBIs among the study population. The findings showed TBI severity and time of attendance can be associated with hospital stay length and TBI outcomes. Most of cases, in whom TBI proved fatal, suffered either moderate or severe TBIs and were brought in to the hospital by ambulance more than one-hour post-injury. Delays in seeking adequate and timely care for TBIs, especially mild TBIs, persist in LMICs due to self-care treatments, limited out-of-hospital services, lack of awareness and misunderstanding of the disease process. Thus, it is crucial to raise awareness on the dangers of help-seeking delays for TBIs, as well as the provision of organized trauma protocols to facilitate quick access to trauma facilities for all trauma cases.

The clinical results showed a comprehensive CT scan conducted on all TBI patients, which is an important aspect of TBI management and care. However, 5 out of 14 TBI patients (35.7%) who had to undergo a pre-scheduled surgery, were mainly young adults with mild TBI prognosis, thus the operation was not performed This findings highlight the need for a better financial access to more fundamental aspects of TBI care and management such as surgery, in order to reduce financial barriers to adequate TBI treatment and management. Also, appropriate steps need to be taken to ensure that public health policy and clinical practice in TBI management reflects evidence-based care guidelines in research and development. Certain patients' clinical variables such as GCS score, CT scan result, intracranial pressure monitoring were associated with the hospital stay length and TBI-related outcomes. The results indicated that patients with longer hospital stay length had abnormal CT scan results, moderate or severe GCS scores, and required mechanical ventilation, anti-seizure medication and/or surgery. TBI outcomes were fatal for moderately and severely patients (GCS<10). However, mortality rate was found to be associated with increasing age. These findings are congruous

with earlier studies, where older age was found to be an independent predictor of poor hospitalization outcomes and highest case fatality rates from TBI-related hospitalizations. Therefore, highly developed systems of personalized care, from pre-hospital to post-acute care, is strongly recommended for the effective treatment and management of TBI cases in Georgia, as well as the different stages of the TBI disease process should be considered.

CONCLUSIONS

This study offers an insight into understanding the epidemiological features of TBI in Georgia on the example of one National Medical Center, as well as spotlights the significant trends and their implications within public health practice and recommendations for targeted preventive measures, control and treatment of TBI in Georgia.

CONFLICT OF INTERESTS

The authors report no conflicts of interest in this work.

ETHICAL APPROVAL

Study Protocol was approved by Medical Ethics Committee of National Center of Disease Control and Public Health (N2018-055; 24.12.2018).

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