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Original Article

Traumatic Head Injuries in Moldova: a Cross-Sectional Analysis of Medical Registry Data

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Abstract

Aim: The aims of this study were to evaluate the demographics and crash profiles of road traffic-related traumatic brain injury (TBI) patients treated at two emergency departments in the Republic of Moldova, and to identify areas for prevention.

Materials and methods: A prospective study was conducted using data from the medical records of a pilot TBI registry from the emergency departments of two large hospitals in Moldova. The study sample included patients with TBI related to road traffic mechanisms from March 1 to August 31, 2019.

Results: During the study period, 368 patients were included in the TBI registry, with 113 (30.7%) of them having TBIs caused by traffic. Children under the age of 18 (44.2%), people aged 30-49 (18.6%), and males (71.7%) were the largest proportions of the road traffic-related TBI patient population. Most (78.8%) of the TBI injuries occurred in a transportation area (street, road, highway, etc.), among children under age of 18, while walking (36.7%) or riding in a passenger vehicle (68.4%). Pedestrians (42.5%) accounted for the most cases, followed by passengers (33.6%) and drivers (23.9%). Over two-thirds of all cases were tested for alcohol. Most cases were in June (20.4%) and between 2 pm and 6 pm (29.2%) within the research period.

Conclusions: This is the first study to examine the road traffic-related traumatic brain injuries in the Republic of Moldova, which underlines the high burden of injuries among males, children, and the middle-aged population. Results from this study will help to support the development of a country's national TBI registry and can argue for the running of comprehensive measures in road injury prevention targeted to the most affected populations

Keywords

driver, motor vehicle occupant, traumatic brain injury, pedestrian, passenger

INTRODUCTION

Traumatic brain injuries (TBI) are a major cause of death and disability, with an overwhelming impact on the health of patients and their families worldwide. The World Health Organization estimates that almost 90% of the global deaths caused by injuries occur in low- and middle-income countries, and that around 10 million people are affected annually by traumatic brain injuries.[1,2] Simultaneously, because TBI require long-term care, the

WHO encourages the development and support of surveillance systems and research to measure the impact of TBI and develop effective preventive methods.[1,3] In Europe, traumatic brain injuries account for the majority of trauma.[1,4,5] Each year around 2.5 million people suffer a TBI, and 1 million are admitted to a hospital for medical care[6], the most common causes being road traffic crashes and falls[4,7]. Injury prevention for the Republic of Moldova is one of the priority areas for public health surveillance. However, there are few data regarding TBI currently reported in the country.[8]

AIM

This study aimed to assess the demographics and crash profiles of road traffic-related traumatic brain injury (TBI) patients treated at two emergency departments (ED) in Moldova, and to identify areas for prevention. To date, no national injury-related data registry is available in the country, and this study is the first to hone in on specific injury topics for prevention using data from a pilot TBI registry.

MATERIALS AND METHODS

Study setting

The study was carried out in the Republic of Moldova, which is divided administratively and geographically into 32 districts, 13 municipalities, and two recognized autonomous territorial units, each of which contains 60 cities and 1614 communes and villages. On January 1, 2019, the Republic of Moldova's stable population was 3.521 million people. As one of the countries with the lowest Gross Domestic Product (GDP) in Europe, Moldova has a relatively low investment in roadway infrastructure and safety.

Data and study design

A prospective study was performed using data from a pilot TBI registry which collected data from the two largest trauma hospitals in Moldova. The registry included the medical data of patients treated in the emergency departments from March 1 to August 31, 2019. Patients were identified using ICD10 codes within individual medical records. This pilot registry was the first in the country and was established as part of the international project INITIatE (International Collaboration to increase Traumatic Brain Injury Surveillance in Europe), coordinated nationally by the Nicolae Testemitanu State University of Medicine and Pharmacy from the Republic of Moldova, and internationally by the College of Public Health, the University of Iowa and the Department of Public Health, Babeş-Bolyai University, Cluj-Napoca.

Settings and population

The registry includes patients of all ages who were treated throughout the study period and whose ICD10 code indicated any kind of head injury. Road traffic injuries were identified through text in the medical record (as ICD external causes are not routinely recorded). According to the national clinical protocol, a traumatic brain injury represents all primary, secondary and late lesions of the scalp, skull and brain caused by a mechanically injured agent's direct or indirect action. The researchers did not interact with the patients directly; data were extracted from the pilot TBI registry.

Study variables

Distributions of transportation-related TBI cases were examined using the demographic, patient, and crash characteristics. Specific demographic and patient characteristics examined included segregated age groups (<18, 19-29, 30-49, 50-59, 60+), sex (male, female), employment status (unemployed, employed, student), alcohol screen (self-reported and driver's alcohol screen), seat belt use (yes, no, unknown). Crash characteristics examined included crash month, crash location (urban, rural), work-related (yes, no), place of injury occurrence (home and residential institution; school, sport, or recreation area; medical service area; transport area; industrial, farm, or construction area; commercial area).

Statistical analysis

The REDCap electronic data collection tool was used to upload the data and SPSS Statistics Base 20.0.0 was used for data analyses. Ethics committee approval was obtained from Nicolae Testemitanu State University of Medicine and Pharmacy, Republic of Moldova before the beginning of the study.

RESULTS

Sample characteristics

A total of 368 patients (201 adults and 167 children) were included in the TBI registry, of which 197 (53.5%) TBI cases related to falls, 113 (30.7%) cases reported with traffic-related mechanisms, 51 (13.9%) cases due to assault (violence), and 7 (1.9%) case related to struck by/or against **(Table 1)**. Cases of TBI with traffic-related mechanisms (113, 30.7%) vary with an age range of 0 to 79 years old, mean 31.9±24.9 years old (95% CI 29.4–34.5). Most cases were among children (44.2%), followed by the age group of 30-49 years old (18.6%). Most cases were among males (71.7%). Approximately half were among the unemployed (47, 8%), a quarter were employed (24.8%), and another quarter were

Table 1. Demographic characteristic of TBI patient's road traffic-related

Characteristics	N (%)	Characteristics	N (%)
Age, years		**Sex**	
<18	50 (44.2)	Male	81 (71.7)
19-29	14 (12.2)	Female	32 (28.3)
30-39	11 (9.7)	Total	113 (100.0)
40-49	10 (8.8)	**Employment status**	
50-59	13 (13.5)	Unemployed	54 (47.8)
>60	15 (13.3)	Employed	28 (24.8)
Total	113 (100.0)	Student	31 (27.4)
Period of the year		**Location**	
March	21 (18.6)	Urban	102 (90.3)
April	18 (15.9)	Rural	11 (9.7)
May	16 (14.2)	Total	113 (100.0)
June	23 (20.4)	**Work-related**	
July	15 (13.3)	Yes	3 (2.7)
August	20 (17.7)	No	110 (97.3)
Total	113 (100.0)	Total	113 (100.0)
Time of the injury		**Time of attendance**	
12 am – 8 am	11 (9.7)	12 am – 8 am	9 (8.0)
8 am – 10 am	8 (7.1)	8 am – 10 am	4 (3.5)
10 am – 12 pm	16 (14.2)	10 am – 12 pm	18 (15.9)
12 pm – 2 pm	15 (13.3)	12 pm – 2 pm	17 (15.0)
2 pm – 4 pm	16 (14.2)	2 pm – 4 pm	19 (16.8)
4 pm – 6 pm	17 (15.0)	4 pm – 6 pm	13 (11.5)
6 pm – 8 pm	13(11.5)	6 pm – 8 pm	12 (10.6)
8 pm – 10 pm	13 (11.5)	8 pm – 10 pm	13 (11.5)
10 pm – 12 pm	4 (3.5)	10 pm – 12 pm	8 (7.1)
Total	113 (100.0)	Total	113 (100.0)
Alcohol self-reported screening		**Place of injury occurrence**	
Yes (self-reported)	7 (6.2)	Home and residential institution	7 (6.2)
Yes (medical screen/police requirement)	70 (61.9)	School, sports area, recreation area	6 (5.3)
No	36 (31.9)	Medical service area	1 (0.9)
Total	113 (100.0)	Transport area (public highway, street or road, other related place)	89 (78.8)
Driver alcohol screen		Industrial, farm, construction area	5 (4.4)
Yes	19 (86.4)	Commercial area (non-recreational) and countryside	5 (4.4)
No	3 (13.6%)	Total	113 (100.0)
Total	22 (100.0)		
Seat belt use		**Location**	
Yes	32 (86.5)	Urban	102 (90.3)
No	5 (13.5)	Rural	11 (9.7)
Total	37 (100.0)	Total	113 (100.0)

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students (27.4%). Most cases were in June (20.4%), most of the injures registered between 2 pm–6 pm (29.2%). Medical care requirement mostly between 10 pm–4 pm (59.2%), peak hours between 2 pm–4 pm (16.8%).

The majority of injuries occurred in urban areas (90.5%), and the majority of these reached the hospital by ambulance (97.3%).

The most common location of TBI occurrence as result of road traffic was in a transport area, such as a public highway, street, or road or other related areas (78.8%). Only 2.7% were reported as work-related injuries. Alcohol self-reported screening for medical or police requirements was reported in 61.9%, although driver alcohol screening was reported for 86.4% (this does not reflect the BAC level, as this data are not available in the patient medical record). Assessing the type of transport and category of the road traffic participants **(Fig. 1)**, TBIs were often acquired in motor vehicle and public transport categories (38.1%), followed by cyclists (11.5%) and motorcyclists (7.1%). Pedestrians comprised the highest proportion of transportation-related TBI with 42.5%, followed by occupants of passenger car with 33.6% and drivers, riders, and operators with 23.9% **(Fig. 2)**. Pedestrian injuries were most common among children and the elderly and were two-thirds male. Almost half of TBIs among pedal cyclists were children, and 61% of TBIs among passenger car occupants were children. Males were more common among all types of transport that led to TBI (among drivers, riders, and operators (χ^2=20.6; p=0.008), nearly four times as many were male (77.8%) compared to females).

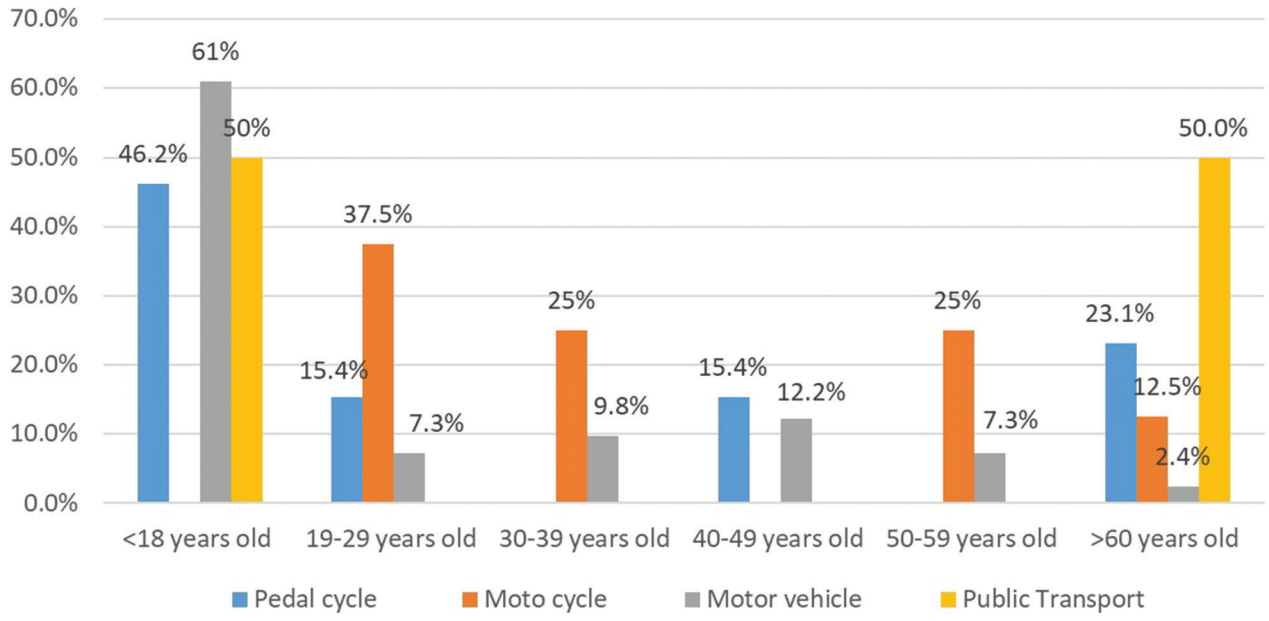

Figure 1. Frequency distribution of the head injuries by type of transport.

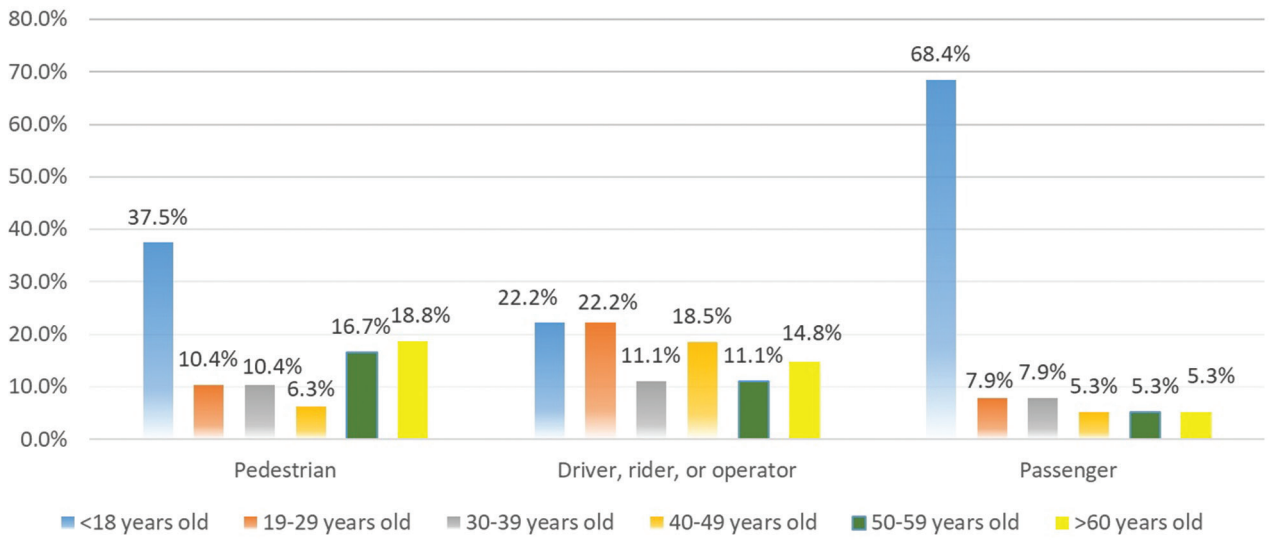

Figure 2. Frequency distribution of the head injuries by road traffic participants.

Outcome of road traffic events with traumatic brain injury

Road traffic victims got different types of injuries **(Table 2)**, the majority (98.2%) with soft tissue injury of the scalp, face, or neck (43.2% of them among pedestrians, following passengers with 32.4% and drivers with 24.3%). From the total, 79.6% of patients suffer fractures of the skull. Characterized with concussion were 92.04% (43.2% of them among pedestrians, followed by passengers with 25.0% and drivers with 32.7%). There were 79.6% cases with fractures of the skull, 61.1% cases with traumatic cerebral edema, and 45.1% cases with fractures of the facial bones. Of the total TBI road traffic-related cases, 96.5% had abnormal CT scan, 33.6% lost their consciousness (44.4% among drivers, 35.4% among pedestrians, and 23.7% among passengers), although 21.2% were suspected of losing consciousness. Consciousness alteration (alteration of consciousness is considering any measure of arousal other than normal: confusion, disorientation, delirium, poor balance, difficulty walking, lightheadedness, etc.) was confirmed for 17.7 % and 44.2% were suspected. Post-traumatic amnesia was diagnosed for 26.5% of patients, while 30.1% were suspected for post-traumatic amnesia. One percent of 4.4% were scheduled for surgery, although 34.5% were suspected for a surgery. After receiving proper medical care, 65.5% of the patients were sent home, 19.5% followed rehabilitation, and 14.2% lost their life (93.3% of whom were males). The main causes of deaths (15, 13.3%) were head injury/secondary intracranial damage (46.7%), head injury/initial injury (40%) and systemic trauma (13.3%).

Table 2. Clinical features of TBI patient's road traffic-related

	N	%
CT scan result		
Abnormal	109	96.5
Normal	4	3.5
Total	113	100.00
Specific type of injury		
Soft tissue injury to the scalp. face. or neck	111	98.2
Fracture of the skull	90	79.6
Fracture of the facial bones	51	45.1
Fracture of the cervical spine	10	8.8
Dislocation/sprain of joint or ligaments of the head	7	6.2
Concussion	104	92.0
Traumatic cerebral edema	69	61.1
Focal traumatic brain injury (hematoma)	3	2.7
Epidural hemorrhage	3	2.7
Traumatic subdural hemorrhage	1	0.9
Secondary diffuse traumatic brain injury	7	6.2
Loss of consciousness		
Yes	38	33.63
No	51	45.13
Suspected	24	21.24
Total	113	100.00
Consciousness alteration		
Yes	20	17.7
No	43	38.1
Suspected	50	44.2
Total	113	100.00
Post traumatic amnesia		
Yes	30	26.5
No	48	42.5
Suspected	34	30.1
Unknown	1	0.9
Total	113	100.00
Scheduled for operation		
Yes	5	4.4
No	69	61.1
Suspected	39	34.5
Total	113	100.00
Discharge disposition		
Home	74	65.5
Rehabilitation	22	19.5
Dead	16	14.2
Unknown	1	0.9
Total	113	100.00
Cause of death		
Head injury/initial injury	6	40.0
Head injury/secondary intracranial damage	7	46.7
Systemic trauma	2	13.3
Total	15	100.00

DISCUSSION

Our study highlights the complexity of road-related injuries and the burden of traumatic brains as an outcome, in the Republic of Moldova, due to the development of the pilot TBI register. Road traffic was responsible for nearly a third of all TBI patients in the registry. The results showed males, children and adults aged 30-49 years old had the most cases of TBI and pedestrians and vehicle occupants made up the largest proportions of cases by travel mode. The existing country crash database, the Automated Information System "State Road Accidents Register" of the Ministry of Internal Affairs has been used since 2014. Still, it has not been further enhanced and thus does not offer comparable data with the region countries.

TBI-related data are complex to assess or even not available in middle-income countries, such as the Republic of Moldova.[9] In the Eastern Partner Countries and European Union – 27 regions, Moldova has the 3rd highest road crash fatality rate (9.24 per 100,000 inhabitants), higher than that of the Eastern Partner Countries and European Union – 27 average fatality rates by 10.4% and 54.5%, respectively.[10]

Law enforcement and regulations are available in Moldova (speed limit, motorcycle helmet, child restraint,

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drink-driving, seat-belt, and mobile phones while driving). However, speed limits and drink-driving laws are only moderately enforced, and 12% of all road traffic deaths are recorded to involve alcohol.[10,11] However, the data from our study lead to non-compliance with these policies, for which traffic-related injuries reach high levels.

The current study shows that road traffic-related TBIs account for almost one-third of all TBI cases seeking medical care at trauma units. Despite the fact that our results showed a high rate of injuries in the second part of the day (2 pm–6 pm, 29.2%), a good amount of them required medical treatment between peak hours 2 pm–4 pm (16.8%), thus burdening the medical system. TBI's serious medical outcome was associated with road traffic-related injuries throughout the medical examinations, requiring further extended care rehabilitation. Access to specialized medical services in a shorter time results in less severe cases of TBI[12], so it is important to understand health system burdens, predictors of delayed care over time, and how the health outcome and degree severity are linked to the patient's time of arrival at the ED.

Previous literature indicates that around 50 million people suffer from TBIs worldwide every year, of which over 80% are in developing countries.[7] Even while falls and car accidents are the most frequent causes of injury[12], traumatic brain injuries are disproportionately more common in low- and middle-income nations, where TBI rates are three times greater than in high-income ones[5,13,14]. The results of our study confirm this, so that the first two major causes in TBI remains due to falls (53.5%), and road traffic-related (30.7%).

Considering the extent of the data obtained in comparison with the global statistical data, these specific injuries are preventable, the responsibility of the population, as well as the involvement of the state could directly contribute to lower accident rates, deaths, long recoveries and extra expenses.

A strong point of our study is that we were able to use data from a pilot TBI Registry to identify key TBI insights, such as the overall burden and distributions by socio-demographic crash characteristics. However, this study has some limitations. Included data was only from a limited time window and had limited data available within the registry, so it would be helpful for future studies to expand upon this work with additional years of data and more details on cases and their outcomes. In addition, we find low data availability in the patient medical records, variables that could bring more clarity to the TBI pattern among the study population, but this would be another strong argument for implementing a national injury registry.

CONCLUSIONS

This is the first study of road traffic-related TBIs conducted in the Republic of Moldova. Specific patient, demographic, and crash characteristics frequently associated with TBI as a result of road traffic crashes were identified. These findings can be used to target efforts to decrease the number of road traffic-related TBIs and to make progress towards reducing the incidence of road traffic-related TBIs among the population. The results allow us to draw some conclusions on the urgency of prevention strategies, by strengthening the multidisciplinary efforts in this area. This study provides a first look at the road traffic-related TBIs in the country and demonstrates the usefulness of understanding the magnitude and scope of a specific injury topic area. Creating a high-performance national TBI registry would allow the generation of more complex and detailed analyses to inform future road safety strategies and action plans.

Ethics approval

This study was approved by the Ethic Committee of Nicolae Testemitanu State University of Medicine and Pharmacy, decision No. 44 of 15 March 2018. All methods were carried out in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards, as well as the national law.

Consent for publication

Not applicable

Conflict of interests

All the authors of this manuscript have no competing interest.

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Author contributions

All authors have made significant intellectual contributions to the manuscript. S.C. drafted the manuscript, established the conception and design of the study, analyzed and interpreted the data. C.J.H. assessed the obtained data, drafted the manuscript and had a significant revision of the manuscript with significant intellectual involvement. S.C. and A.C.S. were major contributors to the writing of the manuscript and performing statistical analyses and data inter-

pretation. M.A.C. and C.P.A. contributed to the data interpretation and had finally revised and critically reviewed the article. All authors have critically revised the manuscript for important intellectual content and have given final approval of the version to be published.

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Черепно-мозговые травмы в Молдове: перекрёстный анализ данных медицинского регистра

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Резюме

Цель: Целью данного исследования было оценить демографические данные и профиль аварийности пациентов с черепно-мозговой травмой (ЧМТ), связанных с дорожно-транспортным происшествием и получавших лечение в двух отделениях неотложной помощи в Республике Молдова, а также определить области для профилактики.

Материалы и методы: Проспективное исследование проведено с использованием данных медицинских карт пилотного регистра ЧМТ отделений неотложной помощи двух крупных больниц Молдовы. В выборку исследования вошли пациенты с ЧМТ, связанной с механизмами дорожного движения, в период с 1 марта по 31 августа 2019 года.

Результаты: За период исследования в регистр ЧМТ было включено 368 пациентов, из них у 113 (30.7 %) ЧМТ вызвана дорожным движением. Наибольшую долю среди пациентов с ЧМТ, связанных с дорожно-транспортным происшествием, составляли дети в возрасте до 18 лет (44.2 %), люди в возрасте 30 – 49 лет (18.6 %) и мужчины (71.7 %). Большинство (78.8%) травм ЧМТ произошло в транспортной зоне (улица, дорога, шоссе и т.п.), у детей до 18 лет, при ходьбе (36.7 %) или при передвижении на легковом транспортном средстве (68.4 %). Наибольшее количество случаев приходится на пешеходов (42.5 %), за ними следуют пассажиры (33.6 %) и водители (23.9 %). Более двух третей всех случаев были проверены на алкоголь. Большинство случаев произошло в июне (20.4 %) и между 14:00 и 18:00 часами (29.2 %) в течение периода исследования.

Заключение: Это первое исследование по изучению черепно-мозговых травм, связанных с дорожно-транспортным происшествием, в Республике Молдова, которое подчёркивает высокий уровень травматизма среди мужчин, детей и населения среднего возраста. Результаты этого исследования помогут поддержать развитие национального реестра ЧМТ в стране и могут стать аргументом в пользу принятия комплексных мер по профилактике дорожно-транспортного травматизма, ориентированных на наиболее пострадавшие группы населения.

Ключевые слова

водитель, пассажир автомобиля, черепно-мозговая травма, пешеход, пассажир