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Study of Epidemiological Characteristics of Fatal Injuries Using Death Registry Data in Georgia

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ABSTRACT

Objective: This study aimed to evaluate epidemiological aspects of fatal injuries in Georgia.
Methods: This was a retrospective, descriptive study that included all traumatic injury deaths in Georgia from January 1 to December 31, 2018. The National Center for Disease Control and Public Health of Georgia's Electronic Death Register database was utilized in this research.
Results: Of the study fatal injuries, 74% (n=1489) were males. 74% (n=1480) of all fatal injuries were caused by unintentional injuries. Road traffic accidents (25%, n=511) and falls (16%, n=322) were the primary causes of mortality. During the research year, the number of Years of life lost (YLL) was associated with injuries and was increased to 58172 for both sexes (rate per 1000 population: 15.6). Most of the years were lost in the age group of 25-29 years (7515.37). Road traffic deaths accounted for 30% (17613.50) of YLL.
Conclusion: Injuries are still a major public health problem in Georgia. In 2018, 2012 individuals died from injuries across the country. However, mortality and YLL rates of injury varied by age and cause of injury. To prevent injury-related mortality, it is crucial to conduct ongoing research on high-risk populations.

Keywords: Georgia; Fatal injury; Epidemiology.

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Introduction

Injury is a serious health issue worldwide and a primary cause of death According to the World Health Orga[nization, injuries kill more than five million people worldwide each year [1, 2]. According to the latest data, more than 90% of all injury-related deaths took place in low-and middle-income countries [3-5]. Injury-related deaths in Georgia make up about 5% of all fatalities and are the fifth-leading cause of death. Injuries place a major burden on Georgians, not only in terms of mortality but also in terms of health care costs paid during Emergency Department visits as well as hospitalizations [6, 7].

Pre-hospital death is the term used to describe injury deaths that occur before reaching the hospital or at the scene of the accident, according to the majority of published reports [8-11]. Recent studies on the epidemiology of injuries in Georgia have focused primarily on in-hospital deaths. As a result, little is known about patients who die in the prehospital setting [12, 13]. Pre-hospital injury mortality could be attributed to a number of causes, the identification and study of which is important to develop preventive strategies [14, 15]. International experience shows that having access to high-quality injury data is a critical prerequisite for developing an effective injury prevention program. Analyzing the causes and conditions of injury may permit more focused planning of acute care and trauma prevention strategies [16, 17].

To provide a more detailed picture of the mortality consequences of a specific disease in a population, the Global Burden of Disease (GBD) study designed Years of Life Lost (YLLs). YLL is calculated by analyzing lost life years rather than the number of deaths. YLL metric enables differentiated injury prioritizing, particularly with regard to the recognition of age- and sex-specific requirements for prevention and care [18]. In this study, we estimated YLLs of fatal injuries in Georgia.

This study aimed to investigate the underlying causes of all injury-related deaths in Georgia within a year.

Materials and Methods

This was a retrospective, descriptive study that included all traumatic injury deaths in Georgia from January 1 to December 31, 2018. The National Center for Disease Control and Public Health of Georgia (NCDC)-Electronic Death Registration system was employed in this study.

To form a unified system of registration and registration of civil acts in Georgia, the death registration system has changed since 2011, particularly shifting from a paper-based to an electronic format. As a result, medical death certificates began to be filled out electronically and were automatically sent to the State Services Development Agency for registration [19]. Since 2017, the NCDC has been entrusted with the task of filling out a medical certificate and quality control of electronic system data. However, in each case of death, an electronic notification is sent to the Public Service Development Agency, which is in charge of registering the occurrence. In addition, the Public Service Development Agency reports deaths registered by a non-medical entity to the NCDC every month. In Georgia, it is mandatory to register all deceased persons.

All information on deaths among Georgian residents is available in the Georgian Electronic Death Registry. The registry uses IRIS software to determine the underlying cause of death [20]. In the present study, we used data from the Registry for all deaths with an external cause of death in 2018. Injuries were identified using ICD-10 classifications using class XIX (S and T codes) and class XX for the type of injury (V-Y codes). The National database is based on the principle of double coding, in which a class XIX code indicating the nature of the injury is combined with a class XX code describing its cause [21]. External causes of injury are presented as an appendix to ICD–10 for the classification of external causes. For codes S and T, it is obligatory to use codes of external causes. ICD-10, with the external causes classification, is the general informative cluster for international mortality reporting and is widely used for categorizing hospitalized injuries.

The study variables included demographic information of the patient, the mechanism of injury, the type of injury, and the location of death. The following mechanisms of injury were defined by the International Classification of Diseases ICD-10: transport accidents, falls, exposure to mechanical forces, accidental non-transport drowning, submersion, unintentional suffocation, exposure to electric current, radiation, and extreme ambient air temperature and pressure, exposure to unspecified smoke, fire, and flames, contact with unspecified venomous animal or plant, exposure to forces of nature, accidental poisoning by and exposure to other and unspecified chemicals and noxious substances, intentional self-harm, assault, legal intervention and operations of war.

Injuries were classified into the following categories by their anatomical location: Injuries to the head, neck, and chest, as well as to the abdomen, lower back, lumbar spine, and pelvis, injuries to the upper and lower extremities, injuries involving several parts of the body, injuries to an unspecified part of trunk, limb or body. The results of a foreign body, thermal and chemical burns, poisoning by medicines, drugs, and biological substances, as well as toxic effects of non-medical substances, and other and unspecified effects of exposure to external causes[22]. The age ranges of the injured people were as follows: preschool age (0 to 5 years old), school-age (6 to 17 years old), active working age (18 to 24, 25 to 44, and 45 to 64 years old), as well as elderly(65 and over).

The place of death in the register database included a medical facility (death in a hospital or emergency department), at home (death of an injured person in a residential building), and others (death at the scene of an injury or while being transported to a medical facility).

The study calculated YLLs as a result of injuries. YLL was determined using the following formula:

$$\sum_{i=1}^{n} d_i * l_i$$

Where $\boldsymbol{i}$ represents each age group, d - is the number of deaths in each age group, and l - represents the standard life expectancy at age of death i (in years). By adding the YLLs in individuals within each age group, YLLs were divided into 18 age groups (ranging from 0 to 85 years, divided into five-year age groupings). The National Statistics Office of Georgia provided data on population life expectancy in each corresponding year group. The number of YLLs was classified according to sex and external cause of injury (mechanism of injury).

Statistical Analysis

The statistical data were analyzed using SPSS software, version 23.0 (SPSS Inc., Chicago, IL, USA). Besides, the characteristics of the injured individual and the injury were investigated. Differences in categorical variables were assessed with Chi-square tests of independence. The OR index was used to determine the relationship between variables. A p-value of <0.05 was considered statistically significant.

Results

During the study period, 2012 injury-related deaths were investigated, of which 97% (n=1951) were citizens of Georgia. Males accounted for 74% (n=1489) of all deaths, resulting in a male-to-female ratio of 2.85:1. The sex ratio varied depending on age groups (Figure 1). The patient's ages ranged from 0 to 98 years with a median and mode of 53 years, respectively. The standard deviation (SD) was 21.95. The modal age group was 65 years or over. More than 85% of all injury-related deaths were people over the age of 25, with the following proportions: 65 and over=601 (30%); 45-64 years=569 (28%), and 25-44 years= 532 (26%).

In terms of marital status, 40% of men (n=645) and 27% of women (n=136) were single, while 50% of men (n=729) and 46% of women (n=230) were married. Divorce rates were 2% (n=29; n=8) for both sexes. The proportion of widows among men was 3% (n=50), and 25% (n=124) were among women. In 82% of cases, education-related data were unavailable.

Unintentional injury-related deaths accounted for 74% (n=1480) of all fatal injuries, whereas intentional self-harm accounted for 12% (n=247), assault accounted for 3% (n=67), and in 11% of cases, the intent was unknown. The largest proportion of unintentional injuries occurred in preschool age (n=21, 91%), whereas the 25-44 years old age group had the lowest proportion (74%, n=397). Compared to other age groups, the age group of 25-44 years (n=77, 14%) had the highest risk of deliberate self-harm mortality. Regarding specific body parts, head injuries (18%) were the most prevalent, followed by injuries involving multiple body regions (17%). One-fifth of injury deaths (n=421) occurred in the Capital. The highest rates of injury mortality were documented in the highland areas of the country, including Racha-Lechkhumi and Kvemo Svaneti (92.70) and Mtskheta-Mtianeti (80.93).

The place of death in 32% of cases (n=642) was a medical facility, in 25% (n=501) of the cases, it was at home, in 33% (n=661) it was other places, and for 10% (n=208) the place of death was unknown. According to a study on the place of death by region of the country, the highest proportion of deaths in medical institutions was in the capital city Tbilisi (40%, n=169). The capital accounted for 21% (n=103) of all deaths at home. According to the mechanism of injury, falls (73%, n=230) and burns (53%, n=53) were characterized by high mortality rates in medical institutions (Table 1).

The leading causes of death were road traffic accidents (25%, n=511) and falls (16%, n=322). The distribution of injury mechanisms in age groups gave us a different image.

Road traffic injuries were the leading cause of death in all age groups except those aged 65 and over. A particularly high proportion was observed in preschool children. The proportion of road deaths has decreased with age. The share of falls in the death structure, on the other hand, increased with age and reached its highest point in the elderly group (30%, n=187). Relatively high rates of inanimate mechanical forces occurred in the age groups of 25-44 years and 46-64 years (11%, n=58; 10%, n=60) (Table 2).

The highest number of fatal traffic injuries occurred in Imereti (20%, n=101), Tbilisi (17%, n=84), and

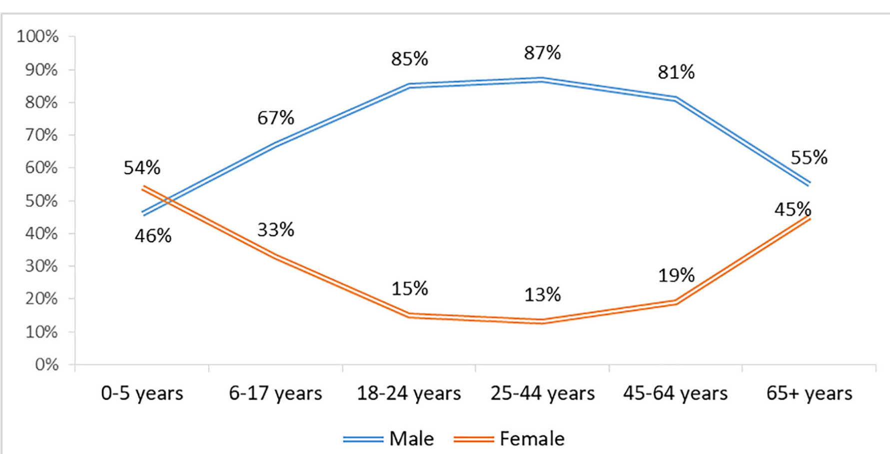

Fig. 1. Sex ratio for fatal injuries by age group, Georgia, 2018

Table 1. Distribution of fatal injuries by place of death and mechanism of injury, Georgia, 2018

Place of death	Death in the hospital setting	Death in the pre-hospital setting	OR (95% CI)	*p* value
Injury mechanisms	N (%)	N (%)		
Road traffic injury	192 (39)	306 (61)	0.81 (0.66-1)	0.0566
Fall	230 (73)	87 (27)	0.08 (0.63-0.11)	<0.0001
Exposure to mechanical forces	44 (23)	150 (77)	1.95 (1.38-2.78)	0.0002
Drowning and submersion	9 (3)	300 (97)	23.3 (11.9-45.5)	<0.0001
Burn	70 (53)	62 (47)	0.49 (0.35-0.69)	<0.0001
Poisoning	43 (43)	56 (57)	0.69 (0.46-1.04)	0.0737
Other	101 (26)	285 (74)	1.68 (1.31-2.1)	<0.0001

Table 2. Distribution of fatal injury mechanisms by age groups, Georgia, 2018

Age groups	0-5 years		6 -17 years		18-24 years		25-44 years		45-64 years		65+ years		*p*-value
Injury mechanisms	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	
Road traffic injury (V01-V99)	14	58	28	40	49	37	171	31	153	26	96	15	<0.001
Fall (W00-W19)	1	4	3	4	7	5	44	8	80	14	187	30	
Inanimate mechanical force (W20-W49)	1	4	3	4	9	7	58	11	60	10	27	4	
Animate mechanical force (W50-W64)	1	4	0	0	2	2	15	3	7	1	13	2	
Drowning and submersion (W65-W74)	0	0	7	10	10	8	13	2	26	4	10	2	
Unintentional suffocation (W75-W84)	0	0	1	1	10	8	46	8	33	6	20	3	
Exposure to electric current, radiation, and extreme ambient air temperature and pressure (W85-W99)	0	0	5	7	6	5	10	2	8	1	5	1	
Burn (X00-X19)	2	8	2	3	3	2	13	2	34	6	47	7	
Contact with unspecified venomous animal or plant (X20-X29)	0	0	0	0	0	0	0	0	3	1	0	0	
Exposure to forces of nature (X30-X39)	0	0	1	1	0	0	4	1	4	1	0	0	
Poisoning (X40-X49)	0	0	1	1	8	6	28	5	40	7	26	4	
Intentional self-harm (X60-X84)	0	0	3	4	11	8	44		45	8	43	7	
Other and unidentified factors	4	17	16	23	17	13	94	17	77	13	107	17	
Complications of medical intervention (Y40-Y84)	1	4	0	0	1	1	6	1	16	3	50	8	
Total	24	100	70	100	133	100	546	100	586	100	631	100	

Kakheti (11%, n=55). However, the highest rates per 100,000 populations were observed in Racha-Lechkhumi and Kvemo Svaneti (29.8; n=9), Kakheti (17.5; n=55), and Samegrelo-Zemo Svaneti (14.9; n=48). However, the lowest rates were found in Tbilisi and Imereti.

40% (n=203) of traffic accident casualties were car occupants, while 30% (n=154) were passengers. The proportion of passengers was particularly high in the age groups of 65 and older (43%, n=41), and 45-64 years (40%, n=61). Preschool children made up a large number of car occupants (57%, n=8).

The highest number of fatal injuries occurred in summer (29%, n=573), whereas the lowest was in winter (23%, n=454). Compared to other age groups, the difference between seasons was more pronounced in preschool children than in other age groups, and less in 45-64 years old. There were more fatal injuries in the age groups of 18-24 years and 65 or over in winter than in spring. A study of fatal injuries also found differences by month as well. The most significant differences were observed at the age of 0-5 years, with the majority of cases occurring in July (25%, n=6) and May (21%, n=5). Nearly half of the fatal injuries in school-age children occurred in April (13%, n=9), August (13%, n=9), and September (13%, n=9). One-third of the fatal injuries in the 18-24 age group occurred in August (14%, n=18) and September (14%, n=19). The largest number of fatal injuries in the 45-64 age group was in April (10%, n=57) and November (10%, n=56). For the elderly, a third of the cases were reported in June (10%, n=62), August (10%, n=66), and November (10%, n=62).

Data analysis revealed seasonal differences in the main mechanisms of injuries in 2018. Road traffic accidents (28%), falls (27%), exposure to animate mechanical force (34%), drowning (45%), and exposure to electricity, radiation, temperature, and pressure. (47%) were the leading causes of injury-related deaths in the summer. In the spring,

Table 3. Distribution of fatal injury mechanisms by season, Georgia, 2018

Injury mechanisms	Spring	Summer	Autumn	Winter	Total	*p*-value
	N (%)	N (%)	N (%)	N (%)	N (%)	
Road traffic injury	132 (26)	140(28)	130(25)	109(21)	511(100)	<0.001
Fall	79(25)	87(27)	79(25)	77(24)	322(100)	
Exposure to mechanical forces	53(27)	56(28)	50(25)	40(20)	199(100)	
Drowning/suffocation/threats to breathing	81(25)	148(45)	44(13)	54(17)	327(100)	
Burn, electric current, radiation, and extreme ambient air temperature and pressure	33(24)	33(24)	24(18)	46(34)	136(100)	
Poisoning	25(24)	18(17)	25(24)	36(35)	104(100)	
Complications of medical intervention	42(60)	21(30)	18(26)	9(13)	90(100)	
Other and unidentified factors	66(20)	70(22)	104(32)	83(26)	323(100)	
Total	511(25.4)	573(28.5)	473(23.6)	545(22.6)	2012(100)	

Table 4. Years of life lost as a result of traumatic injury (YLL), Georgia, 2018

Age group	Life expectancy at birth	N	Sex			Mechanism of injury					
			Both sexes	Male	Female	Fall	Road traffic injury	Poisoning	Unintentional suffocation	Exposure to mechanical force	Other
0-4	73.5	23	1690.2	734.9	955.3	367.4	661.4	0.0	0.0	73.5	587.9
5-9	69.6	21	1461.5	904.7	556.7	69.6	556.7	69.6	0.0	69.6	696.0
10-14	64.7	27	1746.0	1293.3	452.7	129.3	646.7	0.0	64.7	258.7	646.7
15-19	59.7	50	2987.0	2210.3	776.6	179.2	1135.0	119.5	179.2	358.4	1015.6
20-24	54.9	106	5817.7	4994.5	823.3	219.5	2250.3	329.3	548.8	329.3	2140.5
25-29	50.1	150	7515.4	6363.0	1152.4	701.4	3156.5	350.7	551.1	150.3	2605.3
30-34	45.3	122	5532.1	4625.2	906.9	408.1	1541.7	226.7	498.8	136.0	2720.7
35-39	40.6	128	5197.7	4629.2	568.5	284.3	1258.8	203.0	527.9	162.4	2761.2
40-44	36.0	145	5213.2	4745.8	467.4	503.3	1546.0	395.5	323.6	107.9	2337.0
45-49	31.5	120	3778.9	3023.1	755.8	503.9	1039.2	283.4	157.5	94.5	1700.5
50-54	27.2	162	4399.6	3720.6	678.9	678.9	1059.2	244.4	271.6	325.9	1819.6
55-59	23.1	165	3810.5	3140.8	669.7	508.1	923.8	207.9	461.9	161.7	1547.3
60-64	19.3	147	2832.7	2216.0	616.6	327.6	790.1	250.5	192.7	77.1	1194.7
65-69	15.7	137	2144.2	1612.1	532.1	360.0	469.5	109.6	234.8	47.0	923.4
70-74	12.3	98	1201.6	784.7	416.9	318.8	233.0	49.0	110.4	24.5	465.9
75-79	9.0	137	1238.7	687.1	551.5	262.2	208.0	81.4	54.3	9.0	623.9
80-84	6.5	136	879.2	433.1	446.1	342.6	103.4	25.9	45.3	6.5	355.6
85+	4.3	138	593.2	227.8	365.4	240.7	34.4	8.6	25.8	12.9	270.8
Total		2012	58039.1	46346.3	11692.8	6405.0	17613.5	2955.0	4248.1	2405.1	24412.4

the impact of inanimate mechanical force (28%), intentional self-harm by hanging, strangulation, and suffocation (34%) were more common. Burns (34%), other accidental threats to breathing (32%), and poisoning (36%) were prevalent in the winter (Table 3).

During the research year, the number of YLL related to injuries was 58039 for both sexes (rate per 1000 population=15.6). The majority of the years were lost between the age group of 25-29 (7515.4). Road traffic deaths account for 30% (17613.5) of YLL (Table 4).

Discussion

We examined all fatal injuries in Georgia during 2018. According to the findings, men are more likely than women to die as a result of injury. These findings were consistent with previous studies from different countries [23-26]. A previous study on hospitalization in Georgia also found men's dominance in hospital injury-related mortality [12]. Gender disparities in injury mortality can be explained by the fact that men are more prone than women to engage in risky health behaviors [27, 28]. However, a better understanding of male-female or other group differences could aid in injury prevention.

In the present study, road traffic injuries had the highest rates of fatality. These findings were comparable with previous studies conducted in middle-and low-income countries [29, 30]. Road traffic accidents were estimated to be the eighth leading cause of death globally for all age groups, with the majority of fatalities occurring in low and middle-income countries [31]. Scientific literature suggests that unsafe vehicles, unsafe road infrastructure, inadequate traffic law enforcement, and inadequate post-accident treatment are all considered to explain the disparity in road traffic mortality across countries with different income levels [32]. In Georgia, concrete initiatives have been taken to improve road safety [33]. Nevertheless, the number of road traffic accidents and fatalities remains unacceptably high. In our study, car occupants accounted for the highest number of road accident fatalities, as has been reported in a previous study [34]. The present study indicated that people in the most active and productive age groups were victims of road traffic injuries, causing serious economic loss to the country. The WHO found similar findings in the GLOBAL STATUS REPORT ON ROAD SAFETY [35].

According to the results of the present study, two-thirds of fatal injuries occurred at the scene of the accident or while being transported to a medical facility. The proportion of road traffic injuries that resulted in pre-hospital mortality was higher in certain regions. To explain this disparity, future studies should focus on road traffic injuries and equal access to health care services. Understanding the epidemiology of prehospital mortality is critical for monitoring and improving the trauma care system's performance.

During the study period, we observed seasonal changes in injury mortality. There was a summer peak for road traffic injury, falls experienced a peak for drowning, and a winter peak occurred for suffocation, burns, and poisoning. Previous publications described seasonal fluctuations in severe traumatic injuries [36-38]. However, more investigation and analysis over longer time frames are required to determine the seasonality of injury mortality in Georgia.

Our study revealed that the rate of years of life lost (YLL) as a result of injuries (15.2 per 1000 population) exceeded earlier studies in the Netherlands, the United Kingdom, and Norway, and was comparable with the rates in Denmark and Ireland. The high-risk group for YLL was the age group 25-39 years, which accounted for one-third of all YLL. The results were consistent with those of a study conducted in the aforementioned European countries [39].

This study was the first to be conducted on fatal injuries in Georgia, and it documented both in-hospital and pre-hospital trauma fatalities. Our study, however, did not provide detailed data on the time of death and clinical information of the injured. The findings of the present study can be used to develop strategies to reduce fatal injuries in the country. The findings can also be used to assess the cost of injury in low- and middle-income countries (LMICs).

Conclusion

Injuries are a major public health issue in Georgia. In 2018, there were 2012 injury-related fatalities nationwide (54 per 100, 000 population). However, injury mortality and YLL rates varied by age and cause of injury. The high injury mortality rate in the pre-hospital setting highlights the need for further research focusing on the period between injury occurrence and emergency department admission, as well as other factors influencing the outcome of traumatic injuries. To prevent injury-related mortality, it is crucial to conduct ongoing research on high-risk populations.

Declarations

Ethics approval and consent to participate: The Georgian National Centre for Disease Control and Public Health Institutional Review Board approved the study protocol (IRB # 2018-04914.12.2018) in accordance with Georgian legislation and the ethical standards as stated in the Declaration of Helsinki. This study was exempt from the requirement of informed consent owing to the retrospective study design.

Consent for publication: All authors agree with the publication of this article.

Conflict of Interest: The authors report no conflicts of interest in this work.

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Authors' Contribution: N.C. researched literature and conceived the study. K.A. was engaged in data analysis, M.K., and N.P. were involved in protocol development, and M.J. was involved in gaining ethical approval. N.C. wrote the first draft of the manuscript. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

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