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Investigation of children victims of road traffic injuries required intensive care

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Abstract

Children are considered vulnerable road users (VRUs) in the literature, with high mortality and morbidity rates in accidents, resulting in various injuries such as head and neck injuries, fractures, tears, and post-traumatic stress disorder. The study was conducted retrospectively among patients admitted to the Pediatric Intensive Care Unit between October 1, 2017, and January 1, 2022, in a Hospital in Bursa. Eighty-six children were admitted to the study. Of them, 74.4% were male and 25.6% female. The average age was 8.8±5.0 years. The accidents occurred predominantly in urban areas (67.4%), with 32.6% occurring in rural areas. Pedestrians were 68.6% of the victims. Most accidents happened on Sundays (22.1%) and weekdays (62.8%). The distribution of accidents by season showed that most accidents occurred in the fall (29.1%), followed by spring (26.7%), summer (25.6%), and winter (18.6%). The most common time for accidents was between 18:00 and 00:00 (59.3%), and preschool-age children were most involved (44.2%). The most frequent type of injury was multiple trauma (50%), followed by isolated cranial trauma (29.1%). Of 14.0% victims died, and two became permanent care patients. The findings provide valuable insights for developing policies to prevent accidents and reduce associated morbidity and mortality.

Keywords: Road traffic injury, child, accident analysis, surveillance, prevention

Introduction

Every year, 1.3 million people worldwide die due to road traffic accidents (RTAs), and approximately 3,700 people lose their lives every day due to this cause. According to U.S. data, Road Traffic Injuries (RTIs) are responsible for 15% of all non-fatal injuries and 66% of unintentional injury-related deaths among individuals aged 0-19 [1]. In 2018, Motor Vehicle Traffic Accidents (MVTC) led to around 600 deaths and 97,000 injuries among young children (ages 0-12) [2].

Children, in terms of their mobility, orientation, and age, are defined in the literature as vulnerable road users (VRUs), along with pedestrians, cyclists, individuals with disabilities, and the elderly [3]. They often experience high mortality and morbidity rates in accidents. The effects of accidents on children result in various injuries such as head and neck injuries, fractures (fx), lacerations, and post-traumatic stress disorder, leading to mental and physical health consequences [4]. In 2020, data from the London School of Economics and Political Science emphasized the socioeconomic impact of RTAs on children, stating that the annual cost in terms of life years lost in various countries amounted to $21.8 billion, including France, Spain, Italy, Chile, Brazil, Argentina, Puerto Rico, and India. RTAs burden national economies, accounting for 3% of the gross domestic product [5]. According to data from the Turkish Statistical Institute, the mortality rate for children aged 0-14 due to traffic accidents was 2.13 in 2019, compared to 1.41 in 2006. Moreover, 41.31% of the children who lost their lives were pedestrians, belonging to another vulnerable group [6].

Since roads and transportation were not as developed, RTAs have

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been identified as a significant child health issue [7]. Today, it is a growing public health concern with increasing importance, not only limited to developed countries but critical worldwide [8]. Despite its growing significance over the years, this issue has received limited attention in public health discussions, and pediatricians must devote more attention to it. Furthermore, it remains essential from a forensic medicine perspective. While our country has yet to give this issue the necessary attention, our study aims to identify children exposed to RTIs requiring intensive care in terms of epidemiological, demographic, environmental factors, and health outcomes. Through this, we intend to identify prominent risks, leading the way for control and prevention strategies.

Material and Methods

The study received approval from the Turkish Ministry of Health, General Directorate of Health Services COVID-19 Scientific Research Evaluation Commission and the Hospital Ethics Committee (Approval numbers: 2011-KAEK-25 2022/07-11). It was conducted retrospectively from October 1, 2017, to January 1, 2022, on patients treated for traffic accidents in a hospital in a province of Türkiye, Bursa, Pediatric Intensive Care Unit. We excluded individuals with either absent or incomplete clinical information.

Patients were admitted to the intensive care unit due to RTIs. Patient demographic information, such as gender, age, race, the season, the session of the day, time, crash type (pedestrian, car, tractor, bicycle, motorcycle), the duration of their stay in the intensive care unit, supportive intensive care measures, the overall duration of their hospitalization, and their final health outcomes were meticulously documented by reviewing medical records. Age categories were defined as follows: infants (1 month to 12 months), preschool-age children (1-5 years), school-age children (6-11 years), and adolescents (12-18 years). All patients included in the study were older than 1 year and younger than 19 years.

We performed descriptive statistics such as mean, minimum-maximum standard deviation and frequencies with percentages for basic analyze. Continuous numerical values were presented as mean ± standard deviation (range: minimum to maximum), whereas categorical and nominal data was presented in counts and proportions. We utilized normality tests to evaluate the data in terms of distribution. Lastly spearman and pearson correlation tests were utilized to investigate correlations between groups, with a significance level of $p<0.05$.

Results

Eighty-six patients were included in our study, who were followed with the diagnosis of a traffic accident in the Pediatric Intensive Care Unit between 01.10.2017 and 01.01.2022, for whom complete data could be accessed. Among these patients, 64 (74.4%) were male, and 22 (25.6%) were female. The mean age was 8.8±5.0 years. Of the cases, 72 (83.7%) were Turkish citizens, and 14 (16.3%) were immigrants. Among the accidents, 58 (67.4%) occurred in urban areas, while 28 (32.6%) occurred in rural areas. Of the victims, 59 (68.6%) were pedestrians, the others were a tractor, car, bicycle, motorcycle related crashes. Most accidents occurred on Sundays, constituting 22.1% of all accidents. While 62.8% of the accidents happened on working days, when adjusted for unit days, it was observed that the rate of accidents on weekends was more frequent than on a regular working day. Accidents were distributed across seasons, with the highest frequency in autumn at 29.1%, followed by spring at 26.7%, summer at 25.6%, and winter at 18.6%. Accidents were divided by 4 hours session starting from 00:00 and predominantly occurred between 18:00 and 00:00, accounting for 59.3% of all accidents. Accidents were most common in preschoolers, representing 44.2% of all cases.

The types of accidents often resulted in multiple traumas, accounting for 50% of all accidents, with isolated cranial traumas following at 29.1% followed by lower extremity (25.6%), upper extremity (16.3), pelvic (10.5%), vertebral and rib traumas (5.8%). Consulting departments were often multiple, encompassing 50% of the cases, followed by thoracic surgery at 15.1% and pediatric surgery at 11.6% (Table 1) Table 1 displays the most frequent variables of the day session, day type, season, ınjury type, and consultations.

In the frequency table generated considering the prevalence of multiple traumas in accidents, 50% of all accidents involved multiple traumas, 29.1% were isolated cranial traumas, 9.3% were isolated musculoskeletal traumas, 7.0% were intra-abdominal traumas, and 4.6% were respiratory system traumas. When evaluating without considering the multiplicity of accidents, 48.8% of all accidents included cranial injuries, which appeared in 19.2% of all patients. Musculoskeletal injuries accounted for 27.9% of all victims, occurring in 11.0%. Respiratory system injuries and intra-abdominal organ injuries constituted 22.1% and 16.3% of all injuries, respectively, occurring in 8.7% and 6.4% of all patients (Table 2). A separate figure is also provided for all injuries (Graph 1).

The outcomes of accidents were demonstrated as ICU stay duration, cost, and outcome status. The victims had an average ICU stay duration of 6.7±5.78 days. As a result, 14.0% of all victims were dead, 86% survived, and 2 of these survivors became permanent care patients. The hospital costs per victim averaged of 13,196 ± 39,829 (Table 3). In the age, ICU stay duration, and cost comparison, it was observed that costs significantly increased as ICU stay duration was prolonged ($p<0.01$). Furthermore, no significant relationship was found between costs and age, and between age and ICU stay duration, with p-values of 0.638 and 0.885, respectively (Table 4).

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Table 1. Sociodemographic features of road traffic injury patients in pediatrics intesive care unit

		n	Percent	Valid percent	Cumulative percent
Race	**Domestic**	72	83.7	83.7	83.7
	Immigrant	14	16.3	16.3	100.0
Gender	**Male**	64	74.4	74.4	74.4
	Female	22	25.6	25.6	100.0
Location	**Urban**	58	67.4	67.4	67.4
	Rural	28	32.6	32.6	100.0
Pedestrian	**Pedestrian**	59	68.6	68.6	100.0
	Total	86	100	100	100.0
Day type	**Working day**	54	62.8	62.8	62.8
	Sunday	19	22.1	22.1	22.1
	Total	86	100	100	100
Season	**Fall**	25	29.1	29.1	29.1
	Total	86	100	100	100
Time type	**18-00**	51	59.3	59.3	59.3
	00-06	19	22.1	22.1	81.4
Age type	**Preschooler**	38	44.2	44.2	44.2
	Elementary school student	24	27.9	27.9	72.1
	Middle-high school student	24	27.9	27.9	100.0
Injury type	**Multiple**	43	50.0	50.0	50.0
	Cranial	25	29.1	29.1	79.1
Consultations	**Multiple consultation**	43	50.0	50.0	50.0
	Thorax surgery	13	15.1	15.1	76.1
	Pediatric surgery	10	11.6	11.6	61.6

Table 2. Injury types of children victims causing by road traffic accidents

Injury		**Frequency**	**Percent (Patients) n=86**	**Cumulative**
Including multiple injuries	**Multiple**	43	50.0	50.0
	Cranial	25	29.1	79.7
	Musculoskeletal	8	9.3	89.0
	Intraabdominal	6	7.0	96.0
	Respiratuvar	4	4.6	100
		Frequency	**Percent (Injury) n=219**	**Cumulative (Patients) n=86**
Not including multiple injuries	**Cranial**	42	19.2	48.8
	Musculoskeletal	24	11.0	27.9
	Respirotary	19	8.7	22.1
	Intraabdominal	14	6.4	16.3
All injury types	**Skull fx**	27	12.3	31.4
	Lung Contusion	24	11.0	27.9
	Lower extremity	22	10.0	25.6
	Cerebral Eudema	17	7.8	19.7

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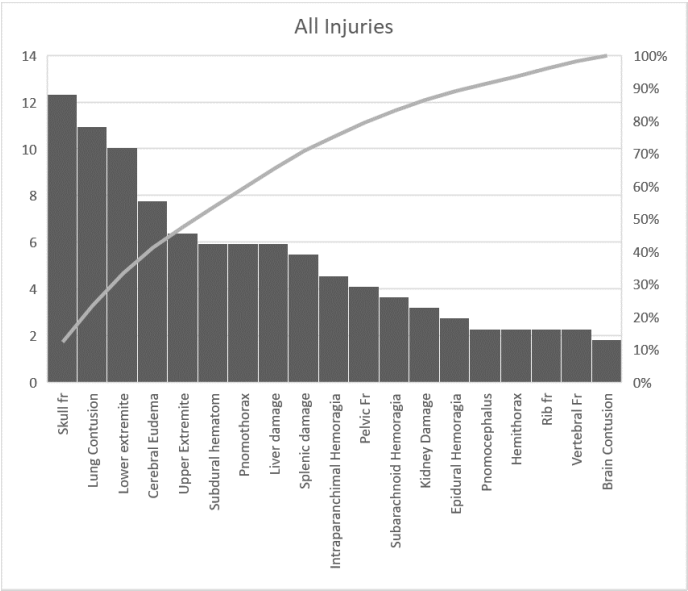

Figure 1. Injury types of all children patients

Table 3. Consequences of road traffic accidents

Outcomes	
Intensive care duration (day)	6.07±5.78
Cost (tl)	13.196±39829
Prognosis survive/ exitus n(%)	74 (86.0)/12 (14.0)

Table 4. Corelations of distinct variables

		Age	Hospitalization time	Cost
Age	**Correlation coefficient**	1.000	.016	-.051
	Sig. (2-tailed)	.	.885	.638
	N	86	86	86
Hospitalization time	**Correlation coefficient**	.016	1.000	.772**
	Sig. (2-tailed)	.885	.	.000
	N	86	86	86
Cost	**Correlation coefficient**	-.051	.772**	1.000
	Sig. (2-tailed)	.638	.000	.
	N	86	86	86

**Correlation is significant at the 0.01 level (2-tailed)

Discussion

Epidemiological characteristics and risk factors for injuries vary by age group in children and adolescents [9,10]. Although many studies have investigated gender, age groups, types of travel, types of accidents, types of injuries, and clinical outcomes of accident victims, these studies are mainly conducted in Western countries where records are well maintained [1]. To the best of our knowledge, studies in Türkiye regularly address the causal epidemiology and clinical characteristics of traffic accidents. Besides being a methodological precursor and guide for advanced studies focusing on accidents and their epidemiological characteristics, this study serves as epidemiological data, which is essential to ensure the continuity of research and the continuous tracking of statistics on a causal level in order not to underestimate the national and global burden of accidents.

Factors that increase the likelihood of accidents among children and teenagers can be grouped into different categories, including the characteristics of the individuals affected (such as age, gender, education, and susceptibility), factors that contribute to accidents (such as the design of equipment), and elements related to the environment and society (like socioeconomic status and road design) [9,11]. However, a limited number of studies exist in Turkish society regarding age-specific preventive strategies for children and adolescents and age-specific accident analyses, which leads to an underestimation of the national burden of accidents [6]. Larger samples that include factors such as the type of road user, severity of the injury, and socioeconomic status of children and adolescents' parents are necessary for a comprehensive evaluation and prevention of fatal traffic accidents.

Children and adolescents are considered vulnerable participants in road traffic, and they can experience RTIs in different roles, such as passengers, pedestrians, cyclists, and motorcyclists [12]. In our study, pedestrians dominate among these categories. Children and pedestrians are the most sensitive groups among all road users—numerous studies in the literature support this. In 2022, 32% of child fatalities due to traffic accidents in the EU were pedestrians, and 3% were cyclists. Pedestrian rates were around 20% across all age groups [13]. In low-income countries, the rate of child pedestrians injured in accidents is around 30-40%, while in developed countries, it's 5-10% [14]. Children are often careless as pedestrians, and cyclists and their small size can make them less visible, leading to accidents. In our study, pedestrians constitute a significant portion, emphasizing the need to investigate the causes of pedestrian injuries [15]. In our study, pedestrians constitute a significant portion, emphasizing the need to investigate the causes of pedestrian injuries. A thorough investigation should delve into factors like limited economic resources, inadequate supervision, increased traffic congestion, and the practice of parking on sidewalks as potential causes [16-18].

Pediatric passengers in vehicles are an essential proportion of accidents. Children traveling in motor vehicles are also at risk because these vehicles are designed for adults, and safety measures during motor vehicle crashes (MVCs) do not sufficiently protect children [19]. It's crucial to enforce child passenger seat laws and implement effective interventions for proper use to ensure the safety of child passengers. Ensuring the correct utilization of child seats is crucial for mitigating injuries among young passengers in motor vehicles [20,21].

The findings of this study provide insight into the clinical, sociodemographic, and epidemiological characteristics of accidents, as well as injury types, among children and adolescents in different age groups in a specific region of Türkiye. Victims were most commonly from the preschool age group (0-6 years).

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This discovery is consistent with earlier studies that highlight the heightened vulnerability of the 0-6 age group to fatalities resulting from road traffic incidents [22]. However, there was no observed increase in hospitalization duration or costs with increasing age. There were no notable variations noted in the rates of surgeries or fatalities. In contrast, contrasting studies have identified a positive association between advancing age and increased occurrences of deaths or hospitalizations [3]. In Fix and colleagues' [4] extensive and up-to-date research, the number of children who died from RTIs between 0-9 was higher than the 10-14 age group. However, in the 2-year-old age group, mortality rates per 100,000 were similar to each other.

In our current study, the cumulative percentage up to elementary school constitutes the majority of all accidents, with a percentage of 72%. According to the World Report on Child Injury Prevention Report 2008, in low- and middle-income countries, the fatality rate per 100,000 due to RTIs was higher for children aged 1–4 and 5–9 years compared to children aged 10–14 years. However, in high-income countries, the fatality rate per 100,000 due to RTIs was higher for children aged 1–4 and 5–9 years than for children aged 10–14 [14]. Once more, in contrast to our discoveries, the fatality rate resulting from RTIs among children between 10 and 14 years old was greater in Australia compared to children aged 0 to 4 and 5 to 9 years old [22]. The age-specific accident frequency rates align with this situation, necessitating the need for age-specific studies [13]. According to a study covering Europe, 50% of all children who died in traffic accidents were in the 0-14 age group, and 30% of the fatalities occurred in the 0-9 age group, which includes preschool and elementary school periods [23]. This ratio was reflected as 50% in the EU data for the 0-9 age group [13].

According to Hoye et al. [24], head injuries constitute the majority of hospitalizations and fatalities; this highlights the necessity of mandatory bicycle helmet legislation to effectively reduce head injuries caused by bicycle-related RTIs. While our study predominantly focuses on pedestrians, the sample includes cyclists and possibly motorcyclists. Head trauma is the most frequent injury in all traumas and injuries, ranking first. Helmet usage has been mandatory in our country for some time and is subject to traffic enforcement to mitigate mortality and morbidity. However, a national study has yet to be available that illustrates the frequency of safety equipment usage in the community.

On the other hand, in one of the studies highlighting accidents in Korean society, although it appears relatively high compared to other Asian countries, the usage rate of safety devices in this population is low. Furthermore, when compared to adults, the probability of using mandatory safety belts and helmets in children and young motorcycle riders is lower, which is also common in Asia [25,26]. Furthermore, the inadequate use of safety measures in Türkiye due to contextual conditions, lack of belief in their effectiveness, discomfort, and lack of habit provides the rationale for discussing ways to prevent accidents [27]. In Türkiye, a portion of drivers and a majority of front-seat passengers do not wear seat belts within city limits. Compared to drivers and front-seat passengers, the use of seat belts by rear passengers is still infrequent, and similarly, the rate of child seat usage is meagre. In Türkiye, a series of measures, including those around school areas, are subject to the oversight of the Ministry of Health, and schools are inspected in terms of school health in these regards. Even though accident intensity increases after 18:00, the relationship between accidents occurring during daylight hours and school surroundings should be considered and thoroughly investigated.

Furthermore, in gender-based comparisons, previous studies have demonstrated that male children are at greater risk due to their preference for more hazardous behaviors (such as unsafe crossing behavior, playing on roads, and reckless crossing) and having a higher overconfidence [28]. According to the World Report on Child Injury Prevention 2008, male children have a higher death rate from traffic accidents than females [14]. When comparing accident frequencies, the same report found that males were identified at twice the rate. This trend was also similar in Europe. This trend was also similar in Europe. In a study covering EU countries, male mortality rates were higher. In all accidents, the male rate was 78%, while among children, it was 61% [13].

Therefore, our current study's observation of males being nearly three times more frequent in accidents supports this trend and serves as evidence for the risky behaviors associated with males. In Öztürk's study, based on national data from the Turkish Statistical Institute, it was found that between 2006 and 2019, 63% of children who died in traffic accidents in Türkiye were male. Moreover, this pattern persisted every single year [5].

Based on the 2022 data obtained from 27 EU countries, 45.0% of children under 15 who died from RTIs were from rural areas, 44.0% were from urban areas, and 9.0% were from highways [12]. According to Öztürk's study, based on the national data from the Turkish Statistical Institute, between 2006 and 2019, 54.72% of children under 15 who died in Türkiye were on urban roads, while 45.28% were on rural roads [6]. According to the EU data, 33% of accidents occurred on weekends, and 7% occurred at night. The distribution between urban and rural areas was almost equal. Among children across all age groups, these percentages were 38% and 54%, respectively (6% occurred on intercity highways) [13].

Our study was evaluated considering some limitations. The first limitation arises from the limited number of admitted accident victims to the hospital, which is an unpredictable circumstance. Additionally, being a single-center study diminishes the generalizability to the entire population. These factors hindered the possibility of conducting comprehensive statistical analyses in the planned cross-sectional design and prevented the development of a cause-and-effect relationship. Consequently, even though the study had to be presented in a descriptive design, it was essential to highlight the demographic, temporal, and environmental characteristics of this sensitive group affected by this public health issue. The aim was to draw attention to the

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complex nature of this problem.

Conclusion

In conclusion, our study identified several recurring characteristics in accidents, including male gender, pedestrians, Sunday incidents, the time frame of 18:00, and the preschooler age group. Attention should be directed towards head injuries resulting from accidents, often accompanied by multiple traumas that require multiple consultations. As the length of hospital stays increases, so do costs; however, age alone does not appear to determine costs. Thus, our study provides a foundation for the formulation of necessary policies to prevent accidents and highlights the importance of demographic and epidemiological characteristics. Particularly for younger age groups, it is imperative to emphasize the significance of pedestrian accidents. Understanding the reasons behind pedestrian accidents, the prevalence of accidents during the evening hours, the higher likelihood of accidents during weekends, and the increased susceptibility of male children to accidents will be crucial in developing measures to prevent severe injuries and fatalities. Action needs to be taken to prevent such incidents and implement measures for the safety of these vulnerable groups.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
The study received approval from the Turkish Ministry of Health, General Directorate of Health Services COVID-19 Scientific Research Evaluation Commission and the Hospital Ethics Committee (Approval numbers: 2011-KAEK-25 2022/07-11).

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