

ORIGINAL ARTICLE

OPEN ACCESS

A Retrospective Analysis of the Cases Involving Road-Traffic Accidents in a Pediatric Intensive Care Unit

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Introduction: In this study, we aimed to emphasize the importance of preventive measures by examining the clinical features of the cases involving road-traffic accidents in the pediatric intensive care unit (PICU).

Materials and Methods: A total of 46 traffic-accident cases involving patients who were younger than 18 years and were admitted to PICU were examined retrospectively. The cases were evaluated for age, gender, the time and location of hospital admission, the type of accident, the sites of injury, the duration of intensive care, the requirement for inotropics, antiepileptics, antibiotics, transfusion, and ventilator, and mortality rates.

Results: The average age of patients was 8.54 ± 5.17 years; 67.4% of them were male ($n=31$). The out-of-vehicle traffic accidents were the most common type of accidents (71.7%) while the in-vehicle accidents were the least common type (13%). The PICU admissions due to traffic accidents were more frequent in summer (34.8%) and autumn (32.6%). Of the patients, 28 (61.9%) had trauma in a single region, and 18 (39.1%) had traumas in multiple regions. Among those with single-site trauma, the most frequent trauma site was head and neck (32.6%). The most frequent complications during the PICU stay were cerebral edema (24.7%) and intracranial hemorrhage (16.9%). Seven patients have died (15.2%) due to the reasons, most of which ($n=6$, 85.7%) were out-of-vehicle accidents involving vehicle-pedestrian collisions.

Conclusion: The study indicated that males were more frequently involved in road traffic accidents and that pedestrians had higher rates of serious injury and mortality. More effective training programs, security measures, legislation, and structural improvements are required regarding traffic accidents.

Keywords: Traffic accident, trauma, child, pediatric intensive care

Introduction

Thousands of people are injured or killed in road traffic accidents every day. Men, women, or children who walk, bike, go to school or work, play on the streets, or embark on a long journey can never return to their homes, leaving shattered families and communities behind (1).

Road-traffic accidents (RTAs) are among the most common pediatric morbidity and mortality worldwide. According to the most recent data of World Health Organization published in 2004, 30% of deaths among children aged 0-19 have been caused by injuries due to RTAs. The report also predicted

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Received: Jan 22, 2020 **Accepted:** Feb 28, 2020

Published: Mar 17, 2020

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The Ulutas Medical Journal © 2020



that, with the continuing urbanization and motorization, the injuries due to traffic accidents would be the fifth leading cause of deaths across the world and the seventh leading cause of disability-adjusted life years lost by 2030 (1, 2).

Death rates due to traffic accidents varies among countries and regions significantly. Overall, the rates are higher in low- and middle-income countries, which accounted for 93% of all traffic accidents involving children in 2004 (2). It was reported in 2010 that the rate of death due to traffic accidents was 14.7% among 0-to-14-year-old children in Turkey (3). According to the data published by the General Directorate of Security, there were 428,074 traffic accidents, 3,373 deaths, and 310,109 injuries which were reported in 2018 in Turkey (4).

Nonetheless, traffic accidents and injuries can be prevented. In high-income countries, a series of measures have contributed to a significant reduction in the frequency and impact of RTAs. These measures include enforcing limits for speed and alcohol consumption, regulations that require the use of seatbelts and helmets, and safer designs and the use of roads and vehicles (5). This study aimed to examine the clinical accident-related data for patients who were admitted to the pediatric intensive care unit (PICU) due to RTAs and to help to increase the awareness about a significant cause of preventable morbidity and mortality among children.

Materials and Methods

The study included the patients aged 0-18 years who were involved in RTAs, admitted to the Pediatric Emergency Service and then hospitalized in PICU at Bursa Yüksek İhtisas Training and Research Hospital, a tertiary care

center, in the past two years (between 01.01.2018 and 01.01.2020). Forensic reports and hospital records were examined retrospectively, following the approval of the study by the local ethics committee (2011-KAEK-25 2020 / 06-01). The patients over the age of 18 years whose files could not be located or who had significant data deficits were excluded from the study. The cases were evaluated with respect to age, gender, the time and location of hospital admission, the type of accident, the sites of injury, the duration of intensive care, the requirement for inotropics, antiepileptics, antibiotics, transfusion, and ventilator, and mortality rates. The types of accidents were categorized as in-vehicle traffic accidents (IVTA), out-of-vehicle traffic accidents (OVTA), an open-top vehicle accident (OTVA), including those involving bicycles or motorcycles. The injury sites were categorized as head-and-neck, extremity, trunk (thorax, pelvis, abdomen), and multiple regions.

The data were analyzed using the SPSS program (Statistical Package for Social Sciences version 21, SPSS, Chicago, USA). Categorical variables were expressed as frequency (%); continuous variables were expressed as mean $\pm$ standard deviation (SD) when data have a normal distribution and as median (minimum-maximum) otherwise.

The chi-square test or Fisher's exact test was used for the comparison of groups in terms of qualitative variables. Two-group comparisons were performed with the Mann-Whitney U test; multiple-group comparisons were performed with the Kruskal-Wallis H test. Bonferroni correction was applied in multiple comparisons. In all tests, a *p*-value of <0.05 was considered statistically significant.

Results

In the period covered by the study, the total number of admissions to the pediatric emergency department of the hospital due to a road traffic accident was 547. Of these, 46 (8.4%) cases needed intensive care and met the inclusion criteria. The average age at the time of admission was 8.54 ± 5.17 years (range: 6-209 months), 63% being the school-age children (>7 years old). Of the patients, 31 (67.4%) were male, and 15 (32.6%) were female (Table-1).

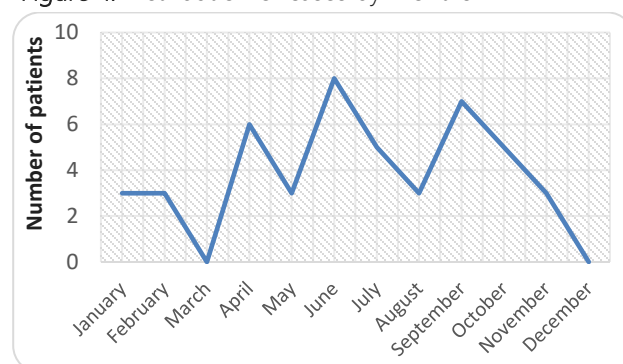
Table-1. Causes of accidents and mean age

Type of accident	n	%	Mean age (years)	Min-Max age (months)
Out-of-vehicle accidents	33	71.7	8.31 ± 4.78	13 - 195
Open-top vehicle accidents	7	15.3	14.58 ± 2.5	126 - 209
In-vehicle accidents	6	13.0	6.69 ± 5.81	6 - 168

Out-of-vehicle traffic accidents were the most common type of accident 71.7% (n=33) while IVTA was the least common type 13% (n=6). The patients who were involved in OTVA were significantly older than those involved in the other types of accidents ($p=0.015$). No significant difference was found among the patients involved in different types of accidents in terms of the age of the pediatric patient involved and the season when the accident happened ($p>0.05$). The distribution of PICU admissions due to traffic accidents by months is shown in Figure 1. The PICU admissions were most frequent in June (n=8, 17.4%) and during summer (n=16, 34.8%), and were followed by autumn (n=15, 32.6%) then. No significant difference was found between the seasons in terms of the frequency of different types of

accidents ($p=0.7$). Of the patients, 31 (67.4%) were from the provincial capital, 8 (17.4%) were from the provincial districts, and 7 (15.2%) were from outside the province.

Figure-1. Distribution of cases by months



Of the patients, 28 (61.9%) had trauma at a single site while 18(39.1%) had multiple traumas. Among those with single-site traumas, the most frequent site of trauma was head and neck (n=15, 32.6%). Overall, the sites of trauma were as follows: 38.2% (n=26) in the head and neck, 26.6% (n=18) in the extremities, and 35.2% (n=24) in the trunk. The median duration of PICU stay was 5 days (range: 2-63 days). No significant relationship was found between the type of accident and the length of PICU stay ($p=0.7$). The most frequent complications during PICU stay were cerebral edema (24.7%) and intracranial hemorrhage (16.9%) (Table-2).

Table-2. Distribution of complications detected in cases

Complication	n	%
Cerebral edema	16	24.7
Intracranial hemorrhage	11	16.9
Cranial fracture	9	13.8
Abdominal pathologies	9	13.8
Pneumothorax	8	12.4
Lung contusion	7	10.8
Convulsions	3	4.6
Sepsis	1	1.5
Aortic aneurysm rupture	1	1.5
Total	65	100

Table-3. Characteristics of fatal cases

Case #	Gender	Age (months)	Admitted in	Type of accident	Injury site	Complication
1	Male	157	Summer	Out-of-vehicle	Trunk and Extremity	Intracranial hemorrhage and Lung contusion
2	Male	127	Autumn	Out-of-vehicle	Head-neck and Trunk	Sepsis
3	Male	178	Summer	Out-of-vehicle	Head-neck and Trunk	Cerebral edema, Intracranial hemorrhage, and Lung contusion
4	Male	164	Autumn	Out-of-vehicle	Head-neck	Cerebral edema and Intracranial hemorrhage
5	Male	63	Autumn	Out-of-vehicle	Head-neck	Cerebral edema and Intracranial hemorrhage
6	Male	62	Summer	Out-of-vehicle	Head-neck and Trunk	Cerebral edema and Intracranial hemorrhage
7	Female	168	Winter	In-vehicle	Head-neck, Trunk and Extremity	Cerebral edema and Pneumothorax

Seven patients (15.2%) required inotropics, 22 (47.8%) antiepileptics, 35 (76.1%) antibiotics, 19 (41.3%) blood transfusion, and 15 (32.6%) ventilator support. Seven patients died (15.2%) due to reasons, most of which (n=6, 85.7%) were out-of-vehicle accidents involving vehicle-pedestrian collisions. The details of these cases are given in Table-3.

Discussion

This cross-sectional study examined pediatric patients who were involved in RTAs and found that male children were more frequently involved in RTAs. It was also found that the children were most frequently admitted to the PICU due to out-of-vehicle accidents involving vehicle-pedestrian collisions and that most of the patients who died as a result of RTAs were those with head and neck injuries due to out-of-vehicle accidents; those who had open-top vehicle accidents (involving bicycles or motorcycles) were older.

Trauma is one of the leading causes of childhood morbidity and mortality, and the causes and mechanisms of trauma vary by age. While domestic accidents and falls are among the most common causes of trauma in early

childhood, traffic accidents are more prominent in school-age children (6). Similar to several previous studies, the majority of cases in our study consisted of school children (63%)(5-8).

In the studies investigating traffic accidents involving children, it has been reported that male children were more frequently affected (9-11). Inconsistency with the literature, the majority of the cases (67.4%) involved males. Previous reports have attributed increased incidence of RTAs among male children to the fact that they are more active, spend more time outdoors, pay less attention to the traffic rules, and show more risky behaviors in traffic (6).

Grieva et al. (10) investigated 192 patients who were hospitalized for at least 24 hours due to traffic accidents and reported that 55% of the cases were out-of-vehicle accidents. In another study, two-thirds of the RTAs involving children were reported to be out-of-vehicle accidents (12). In out-of-vehicle accidents, age, vehicle design, and speed were suggested to be the most important factors that influence morbidity and mortality. Similar to previous studies, out-of-vehicle accidents were the most common type of accidents in this study.

Road-traffic accidents increase in the summer when children spend more time outdoors (7,8). In our study, in accordance with the literature, admissions to ICU due to RTAs were most common in summer (34.8%). We think that the decrease in RTAs in winter can result from factors such as drivers' being more careful and commuters' using public transportation more often due to the poorer weather, road, and visibility conditions.

In RTAs, the head and neck have been reported to be the most frequent sites of injury, followed by the extremities. Serinken et al. (6) found head and neck injuries in 27.8% of the RTAs while Embleton et al. (8) found in 20.2%. Overall, the head and neck region was the most common site of injury (38.2%) in our study. Head and neck injuries are recognized as a significant cause of mortality in traffic accidents. It was reported that head and neck injuries were more common in in-vehicle accidents when a child seat was not used (13). Similarly, the use of helmet was reported to decrease the head and neck injuries in bicycle/motorcycle accidents considerably (14).

The RTAs are the most common reasons for hospitalization due to traumas (15, 16). In studies investigating the RTAs involving children, Serinken et al. (6) reported a hospitalization rate of 15.5% while Embleton et al. (8) reported a rate of 32.3%. However, there are not enough data related to the rate of the PICU stay. In this study, 8.4% of the patients admitted to the emergency department due to RTAs required intensive care.

Traffic accidents are the most common cause of death in childhood (15, 16). In 2018, 10.6% of those who died in traffic accidents in Turkey were children, of whom 42.1% were in the 0-9 age group, 22.2% of whom were in the 10-14

age group, and 35.7% of whom were in the 15-17 age group (4). The mortality is especially higher in out-of-vehicle RTAs (17). In a study by Küçüker et al. (18), 41.2% of injuries, 43% of morbidity, and 60% of mortality were linked to out-of-vehicle RTAs. In the study by Serinken et al. (6), 59.4% of mortality was due to out-of-vehicle RTAs. In our study, the majority of the cases where the patient died (85.7%) involved out-of-vehicle accidents where vehicles hit pedestrians. In the studies by Toro et al. (19) and Grivna 2 et al. (10), most of the deaths due to traffic accidents were related to head trauma. Neuropsychological tests have shown that even the minimal head trauma may lead to an impaired frontal lobe function in accidents where a car seat is not used. Facial fractures and lacerations were also more common among children without a car seat (5). In our study, head trauma was present in the vast majority (85.7%) of the fatal cases. This finding demonstrates how critical the preventive measures are for reducing head and neck injuries in such accidents.

Seven cases in our study (15.3%) involved open-top vehicle accidents. These cases were found to involve older children compared to those involved in other types of RTAs. The pediatric patients were the motorcycle users in four of these cases, and bicycle users in three cases. In Turkey, the age to get a motorcycle license is 18; thus, none of the patients had a license since they were all younger than 18. While it was expected that the patients in these cases were older, these cases have also demonstrated that adolescents do not always comply with traffic rules and restrictions. In our study, no death was recorded in open-top vehicle accidents. However, serious injury and mortality rates were reported to be high in

open-top vehicle accidents involving another moving vehicle. Roehler et al. (20) found that driver restraint use is a significant, independent predictor of restraint use among young passengers in both fatal and nonfatal crashes in a large meta-analysis examining motor vehicle accidents and covering the years 2011-2015. Besides, the use of a helmet can reduce the risk of head, neck, and severe brain injuries by 63% to 88% (21). For instance, in some countries such as Canada and Australia, the use of helmets is mandatory for bicycle riders (22). In a review of five studies, legislative actions have been reported to increase the use of helmet significantly and to reduce head and neck injuries and related deaths (23). However, the studies in Turkey and in other countries have shown a limited use of helmets by bicycle riders. Puranik et al. (24) reported the rate of helmet use to be 1.4% in a study of 211 cases admitted to the emergency department due to bicycle accidents. In a study of 61 cases, Güzel et al. (25) reported that none of the bicycle riders used helmet. This finding indicates that children do not have an awareness of safe bicycle riding behaviors and that the authorities do not take adequate measures.

Several studies mentioned that the seating positions of the passengers in the vehicle affected the rate of injury and death and that these risks were reduced in those sitting in the rear seats (26). In the vehicles with advanced front seat security systems and second-generation airbags, it is ensured that all children between the ages of 0 and 12 should sit in the back. It has been reported that after eliminating confounding factors such as the nature of accident, vehicle, and child, 50-66% fewer injuries occur in the children sitting in the back compared to those sitting in front (27). Besides,

Elliot et al. (28) have shown that child seats facing the rear window reduce the mortality by 28% in children aged 2-6 years.

The children who grow up in poor socioeconomic environments may experience accidents more often. This situation might be explained by factors such as the maintenance of roads, traffic lights, pavements, drivers with lower safety awareness, insufficient safety measures in areas such as playgrounds where children spend a great deal of time, and the lack of parental supervision and guidance (5). Since traffic accidents are known to increase in summer, extra measures should be taken in these time periods. It has been found in various parts of the world that traffic accidents increase at the times of the day when children arrive and leave schools (7). Increasing the traffic and security measures during these hours may help in avoiding accidents.

The main limitation of our study was the difficulties in confirming the accuracy of the findings due to the retrospective study design. Another limitation was that the study was conducted in a single center and that only patients in PICU were included.

Conclusion

This study demonstrated that out-of-vehicle accidents caused more serious injuries and death than the other types of traffic accidents, and these mostly involved the head and neck injuries.

Various approaches should be employed to prevent injuries due to RTAs, including the improvement and management of road infrastructure, the provision of safer vehicles, regulations, provision of adequate healthcare services, child welfare services, and urban area and environmental planning. Vehicles should

have booster seats and seat belts suitable for different ages and weights at all positions in the front and rear seats. In addition, the use of helmets is critical in preventing head and neck injuries and possible deaths in bicycle/motorcycle riders.

Houses, residential areas, driveways, drop-off, and pick-up locations, city centers and highways should be evaluated not only by traffic engineers, city planners, and architects but also by security experts before new plans are approved. Finally, there is an urgent need for a comprehensive regulation about the education of children and their caregivers to ensure the use of child safety and restraint systems and for the implementation of road safety measures.

Conflict of Interests

The authors have declared no conflict of interest for the present article.

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How to cite?

Korkmaz FK, Tutanc M. A Retrospective Analysis of the Cases Involving Road-Traffic Accidents in a Pediatric Intensive Care Unit. *Ulutas Med J*. 2020;6(1):15-22

DOI: 10.5455/umj.20200212091916