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Characteristics of pediatric injuries due to road traffic accidents and their effects on mortality

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Abstract

Background/Aim: Road traffic accident (RTA)-related injuries may cause morbidity and mortality in childhood. We aimed to investigate these injuries in terms of affected body regions, time of the accident, gender, and age, determine the factors affecting mortality, and evaluate the casualties' demographic features and discharge status.

Methods: This retrospective cohort study included patients aged under 18 years who were victims of RTAs and presented to the emergency department of our tertiary university hospital between 01/01/2015 and 31/12/2019. Patients' age, gender, time, and mechanism of the accident, affected body region, type of injury, and clinical outcomes were recorded and analyzed.

Results: A total of 137 pediatric patients met the inclusion criteria, among which 95 (67.2%) were males, and 42 (32.8%) were females. Five of the six patients who died were males. RTAs most occurred in summer (45.3%), in August (17.5%) and on Saturdays (25.5%). Among the affected systems, extremity injuries ranked first (36.5%), and head traumas ranked second (30.7%).

Conclusion: In our study, presentations with out of vehicle traffic accidents (OVTAs) (motorcycle, bicycle, agricultural vehicle, or pedestrian) were more common (75.1%). Pediatric RTAs caused many injuries, especially extremity traumas, which were more serious in children under 15 years of age. In these patients, intracranial hemorrhage, rib fractures, and liver lacerations were evaluated as more severe injuries. Because of the limited number of the cases, we could not investigate the effects of traffic accidents on child mortality.

Keywords: Emergency service, Pediatric trauma, Road traffic accidents

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Ethics Committee Approval
The Duzce University Ethics Committee approved this study with the 19/10/2020 dated and 2020/222 numbered decision. All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

Conflict of Interest
No conflict of interest was declared by the authors.

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Introduction

Road traffic accidents (RTAs) remain a significant global public health problem, with increased deaths, disabilities, and financial consequences [1]. In 2018, the World Health Organization (WHO) estimated that 1.35 million individuals died, and 20 to 50 million were seriously injured or disabled due to RTAs annually worldwide. RTAs are the leading cause of childhood deaths. A total of 55611 children were injured, and 665 children died due to RTAs in 2018. RTAs rank fourth among the global causes of death in children aged between 5-14 years. Among these deaths, 38% of the children were pedestrians [2-4].

Children are a particular risk group in RTAs, and serious RTA injuries are multifactorial [5]. Half of all deaths on the roads worldwide involve pedestrians, motorcycle, and bicycle riders. This is due to the lack of energy-absorbing safety devices during an impact [8]. Motor vehicle accidents in rural areas tend to be more severe. All these factors contribute to the increased death rate [6]. Children make up an essential part of the pedestrians. Studies have shown that young children have lower danger detection ability and are more prone to impulsive traffic actions. They have trouble assessing the car's approach speed, and therefore, interpret the car's distance as more than it is [7]. Pedestrian children are less visible to a driver due to their smaller body mass, and owing to their lesser body surface area, they are more exposed to multiorgan injury [8]. Another risk is that young children are not secured in child safety seats while traveling in motor vehicles [9].

RTAs rank first among trauma-related pediatric emergency service presentations [10]. Numerous scoring systems have been developed to use a common language in trauma patients. Scoring systems provide information about the relationship between treatment and outcomes [11]. Injury Severity Score (ISS) is the "gold standard" among anatomical injury severity indicators in the trauma population [12,13]. Glasgow Coma Score (GCS), one of the physiological scoring systems used in patient follow-up from the time of admission, is a simple, objective scoring system that can indicate consciousness level and is commonly used in the reliable evaluation of the degree of coma [14].

Trauma cases first present to emergency departments. Data on pediatric RTAs are limited in the literature. In this study, we aimed to investigate pediatric RTA cases in terms of affected body regions, time of the accident, gender, and age, determine the factors affecting mortality and evaluate demographic features and discharge status of the injured pediatric patients who presented to our emergency department within five years.

Materials and methods

Study design and setting

In this retrospective cohort study, we included patients under 18 years of age who were victims of RTAs and presented to the emergency department of our tertiary university hospital between 01/01/2015-31/12/2019. Patients' age, gender, time, and mechanism of accident, body region, type of injury, and clinical outcomes were recorded and analyzed. Patients older than 18 years were excluded.

Our study protocol was approved by Duzce University Ethics Committee on 19/10/2020 with the decision numbered 2020/222.

Study population

Patients aged under 18 years who presented to the emergency department between 01/01/2015 and 31/01/2019 due to road traffic injuries (RTIs) were evaluated according to the demographic data such as age and gender, GCS, ISS, time of presentation, mechanism of the incident, site of injury, length of stay in the emergency department, department of referral, and duration of hospitalization. Statistical correlations were investigated between these parameters and mortality.

Statistical analysis

The normality of continuous data was examined with the Shapiro-Wilk test. The differences between the two groups were analyzed using the Mann-Whitney U test. The correlation between the two categorical variables was assessed with Fisher's Exact test. Continuous variables were expressed as median (IQR) and minimum-maximum values, while categorical data were presented as percentages. All statistical analyses were performed with IBM SPSS Statistics for Windows, Version 23.0 (Armonk, NY: IBM Corp, USA) software. $P<0.05$ was considered statistically significant.

Results

A total of 137 pediatric patients aged between 0-18 years who presented to the emergency department (ED) due to RTAs between 2015 and 2019 were included. These patients' median age was 14 (8.5-16) years, and 67.2% were males. Of all patients, 71.5% had an accident with motor vehicles other than motorcycles, bicycles, and agricultural vehicles (referred to as “other vehicles”). The least common presentation to the ED was due to bicycle accidents (n=6, 4.4%). Motorcycle, bicycle, and agricultural vehicle accidents were evaluated as out of vehicle road traffic accidents. Of the 98 patients who had RTA with the other vehicle types, 25 (18.2%) had out of vehicle traffic accidents, and 39 (28.5%) had in-vehicle traffic accidents. The remaining cases were unrecorded road traffic accidents since there was no information in the archive about their type. Of all accident victims, 55.5% presented between 4:00 – 11:59 PM.

RTAs most occurred in summer (n=62, 45.3%), in August (n=24, 17.5%), and on Saturdays (n = 35, 25.5%).

Extremity injuries were the most common (n=50, 36.5%), and chest injuries were the least common (n=10, 7.3%) following RTAs. The patients were most frequently diagnosed with extremity fractures (58.4%). Skull fracture and ICH were found in 15.3% and 14.6% of the patients, respectively. On the other hand, pneumothorax (PTX) or hemothorax was found in 7.3% and liver laceration, in 6.6%.

The maximum and minimum ISS and GCS values were 3-41 (median:11), and 3-15, respectively. GCS score was 15 in 120 patients.

The most consulted department was the neurosurgery clinic (n=105, 76.6%), followed by pediatrics (n=96, 70.1%) and orthopedics and traumatology (n=96, 70.1%). Patients were most hospitalized in the orthopedics and traumatology clinic (n=55, 40.1%). The minimum and maximum duration of hospitalization were one hour (n=2, patients who died within 1 hour of

admission) and 911 hours with a median value of 51 (24.5-110) hours.

Of the patients who presented to the ED due to RTAs, six (4.4%) died. The median age was 5.5 (4-11.75) years in patients who died and 14 (9-16) years in those who survived. Of the patients who died, 17% were females, and 83% were males. No statistically significant differences were found between ages and genders in terms of mortality (P=0.057, P=0.663, respectively) (Table 1).

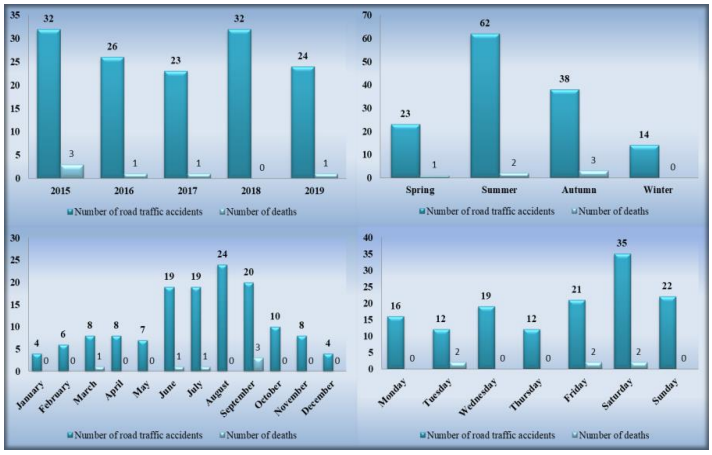
Table 1: Demographic features of the patients and general facts about RTAs

	Total (n=137)	Survived (n=131)	Died (n=6)	*P*-value
Age				0.057
Med (IQR)	14 (8.5-16)	14 (9-16)	5.5 (4-11.75)	
Min-Max	0-18	0-18	1-17	
Gender - n(%)				
Female	45 (32.8)	44 (97.8)	1 (2.2)	0.663
Male	92 (67.2)	87 (94.6)	5 (5.4)	
Vehicle type - n(%)				
Bicycle	6 (4.4)	6 (100)	0 (0)	0.253
Motorcycle	20 (14.6)	20 (100)	0 (0)	
Agricultural vehicle	13 (9.5)	11 (84.6)	2 (15.4)	
Other motor vehicles[a]	98 (71.5)	94 (95.9)	4 (4.1)	
Type of RTA with other motor vehiclees[b]- n(%)				
Pedestrian struck	64 (46.7)	64 (100)	0 (0)	0.516
In-vehicle RTA	39 (28.5)	37 (94.9)	2 (5.1)	
Not recorded	34 (24.8)	32 (94.1)	2 (5.9)	
Incident time - n(%)				
08:00-15:59	46 (33.6)	43 (93.5)	3 (6.5)	0.706
16:00-23:59	76 (55.5)	73 (96.1)	3 (3.9)	
00:00-07:59	15 (10.9)	15 (100)	0 (0)	

(IQR): Interquartile range, [a] other motor vehicles other than bicycle, motorcycle and agricultural vehicles, [b] Type of RTAs that occurred with other vehicles.

The number of traffic accidents and deaths at various times is shown in Figure 1.

Figure 1: Numbers of road traffic accidents and death according to different times



Mortality was significantly lower in patients diagnosed with long bone fractures, while it was significantly higher in patients diagnosed with ICH, rib fractures, and liver laceration (P=0.004, P=0.040, P=0.009, P=0.050, respectively). No mortality occurred among the patients diagnosed with extremity fractures, while near-mortality was higher by 12.4%, 47%, and 19.1% in the patients diagnosed with ICH, rib fractures, and liver laceration, respectively, than those who had no such diagnosis.

ISS was significantly higher, and GCS was significantly lower in the patients who died (P<0.001). The median ISS and GKS scores were 11 (6-16) and 15 (15-15) in the patients who survived, and 28 (20.25-29.75) and 3 (3-4.25) in those who died. Table 2 shows the analysis of all injury sites and diagnoses of the patients.

Table 2: Site of injury and diagnosis of the patients

		Total (n=137)	Survived (n=131)	Died (n=6)	*P*-value
Site of injury- n(%)					
GBT	No	104 (75.9)	100 (96.2)	4 (3.8)	0.631
	Yes	33 (24.1)	31 (93.9)	2 (6.1)	
Head	No	95 (69.3)	91 (95.8)	4 (4.2)	1.000
	Yes	42 (30.7)	40 (95.2)	2 (4.8)	
Chest	No	127 (92.7)	123 (96.9)	4 (3.1)	0.062
	Yes	10 (7.3)	8 (80)	2 (20)	
Abdomen	No	115 (83.9)	112 (97.4)	3 (2.6)	0.052
	Yes	22 (16.1)	19 (86.4)	3 (13.6)	
Extremity	No	87 (63.5)	81 (93.1)	6 (6.9)	0.086
	Yes	50 (36.5)	50 (100)	0 (0)	
Diagnosis- n(%)					
STT	No	126 (92)	120 (95.2)	6 (4.8)	1.000
	Yes	11 (8)	11 (100)	0 (0)	
Incision*	No	134 (97.8)	128 (95.5)	6 (4.5)	-
	Yes	3 (2.2)	3 (100)	0 (0)	
Amputation*	No	136 (99.3)	130 (95.6)	6 (4.4)	-
	Evet	1 (0.7)	1 (100)	0 (0)	
Long Bone Fracture	No	57 (41.6)	51 (89.5)	6 (10.5)	0.004
	Yes	80 (58.4)	80 (100)	0 (0)	
Head region diagnoses- n(%)					
Fracture	No	116 (84.7)	112 (96.6)	4 (3.4)	0.229
	Yes	21 (15.3)	19 (90.5)	2 (9.5)	
Trauma	No	129 (94.2)	123 (95.3)	6 (4.7)	1.000
	Yes	8 (5.8)	8 (100)	0 (0)	
ICH	No	117 (85.4)	114 (97.4)	3 (2.6)	0.040
	Yes	20 (14.6)	17 (85)	3 (15)	
Pneumocephalus *	No	134 (97.8)	129 (96.3)	5 (3.7)	-
	Yes	3 (2.2)	2 (66.7)	1 (33.3)	
Chest region diagnoses- n(%)					
Rib fracture	No	133 (97.1)	129 (97)	4 (3)	0.009
	Yes	4 (2.9)	2 (50)	2 (50)	
Pneumothorax - Hemothorax	No	127 (92.7)	123 (96.9)	4 (3.1)	0.062
	Yes	10 (7.3)	8 (80)	2 (20)	
Lung Contusion*	No	136 (99.3)	131 (96.3)	5 (3.7)	
	Yes	1 (0.7)	0 (0)	1 (100)	-
Abdominal diagnoses- n(%)					
Abdominal trauma	No	132 (96.4)	126 (95.5)	6 (4.5)	1.000
	Yes	5 (3.6)	5 (100)	0 (0)	
Liver laceration	No	128 (93.4)	124 (96.9)	4 (3.1)	0.050
	Yes	9 (6.6)	7 (77.8)	2 (22.2)	
Spleen laceration	No	132 (96.4)	127 (96.2)	5 (3.8)	0.203
	Yes	5 (3.6)	4 (80)	1 (20)	
Kidney laceration *	No	136 (99.3)	130 (95.6)	6 (4.4)	-
	Yes	1 (0.7)	1 (100)	0 (0)	
ISS					
Med (IQR)		11 (6-18)	11 (6-16)	28 (20.25-29.75)	<0.001
Min-Max		3-41	3-41	18-32	
GCS					
Med (IQR)		15 (15-15)	15 (15-15)	3 (3-4.25)	<0.001
Min-Max		3-15	3-15	3-8	

* It could not be analyzed due to the insufficient number of samples, (IQR): Interquartile range

No statistically significant differences were found between consulted departments, including neurosurgery, ophthalmology, pediatric surgery, plastic surgery, thoracic surgery, and ENT clinics in terms of mortality (P=0.178, P=0.308, P=1.000, P=1.000, P=1.000; respectively). Five of the 25 pediatric patients were admitted to the pediatric intensive care unit, and one of the two patients hospitalized in the Anesthesiology and Reanimation clinic died. There was a significant difference between hospitalization durations in terms of mortality (P<0.001). Table 3 shows the analysis of the consulted and hospitalized departments, and duration of hospitalization.

Table 3: Departments of consultation, hospitalization status, findings of the department and time of hospitalization

		Total n=137	Survived n=131	Died n=6	*P*-value
Consulted departments- n(%)					
Neurosurgery	No	32 (23.4)	30 (93.8)	2 (6.3)	0.624
	Yes	105 (76.6)	101 (96.2)	4 (3.8)	
Ophthalmology	No	130 (94.9)	124 (95.4)	6 (4.6)	1.000
	Yes	7 (5.1)	7 (100)	0 (0)	
Pediatric Surgery	No	41 (29.9)	41 (100)	0 (0)	0.178
	Yes	96 (70.1)	90 (93.8)	6 (6.3)	
Plastic surgery	No	129 (94.2)	124 (96.1)	5 (3.9)	0.308
	Yes	8 (5.8)	7 (87.5)	1 (12.5)	
Thoracic surgery	No	133 (97.1)	127 (95.5)	6 (4.5)	1.000
	Yes	4 (2.9)	4 (100)	0 (0)	
Orthopedics	No	41 (29.9)	39 (95.1)	2 (4.9)	1.000
	Yes	96 (70.1)	92 (95.8)	4 (4.2)	
ENT	No	128 (93.4)	122 (95.3)	6 (4.7)	1.000
	Yes	9 (6.6)	9 (100)	0 (0)	
CVS*	No	135 (98.5)	129 (95.6)	6 (4.4)	-
	Yes	2 (1.5)	2 (100)	0 (0)	
O&G*	No	136 (99.3)	130 (95.6)	6 (4.4)	-
	Yes	1 (0.7)	1 (100)	0 (0)	
Urology*	No	136 (99.3)	130 (95.6)	6 (4.4)	-
	Yes	1 (0.7)	1 (100)	0 (0)	
GS*	No	134 (97.8)	128 (95.5)	6 (4.5)	-
	Yes	3 (2.2)	3 (100)	0 (0)	
PICU*	No	136 (99.3)	130 (95.6)	6 (4.4)	-
	Yes	1 (0.7)	1 (100)	0 (0)	
Clinics of Hospitalization- n(%)*					
Pediatric Intensive Care		25 (18.2)	20 (80)	5 (20)	
Anesthesiology and Reanimation		2 (1.5)	1 (50)	1 (50)	
Neurosurgery		30 (21.9)	30 (100)	0 (0)	
Neurosurgical Intensive Care		1 (0.7)	1 (100)	0 (0)	-
Pediatric Surgery		19 (13.9)	19 (100)	0 (0)	
Thoracic Surgery		2 (1.5)	2 (100)	0 (0)	
Obstetrics and Gynecology		1 (0.7)	1 (100)	0 (0)	
Ear-Nose-Throat Diseases		2 (1.5)	2 (100)	0 (0)	
Orthopedics and Traumatology		55 (40.1)	55 (100)	0 (0)	
Duration of hospitalization (hours)					
Med (IQR)		51 (24.5-110)	53 (26-111)	1.5 (1-11.25)	<0.001
Min-Max		1-911	3-911	1-36	

* It could not be analyzed due to the insufficient number of samples, (IQR): Interquartile range

Discussion

In this retrospective study, presentations of vehicle traffic accidents (motorcycle, bicycle, agricultural vehicle, and pedestrian) were higher (75.1%). A low mortality rate was observed in the patients because most vehicles cannot over speed due to geographical conditions. Pediatric RTAs caused many injuries, especially extremity traumas, and were more serious under 15 years of age. In these patients, intracranial hemorrhage, rib fractures, and liver lacerations were evaluated as more serious injuries.

Classification according to the affected body region can help estimate the death rate in RTA patients. The literature has proposed that patients with severe cerebral and abdominal injuries have a high mortality rate. Clinically significant traumatic brain injury and abdominal injury have been observed with musculoskeletal system injuries [15]. It was reported in another study that solid organs such as the spleen, liver, and kidneys are the most damaged organs [16,17]. In the present study, supporting the literature, head trauma was found in 50%, and abdominal and thoracic trauma, in 33% of the patients who died. When the body was regionally examined, extremity trauma ranked first, head trauma second, and abdominal trauma, third. Of the patients with head trauma, six also had extremity injuries and five had abdominal injuries. Isolated region traumas were more common among our patients. Of the patients with an abdominal injury, 9 had liver lacerations, five had spleen lacerations, and one, kidney laceration.

According to the Turkish Statistical Institute (TSI) data, accidents are more common on the roads without traffic lights, traffic signs, or traffic officers. No specific pediatric data could be found [18]. This study was conducted in a rural area with underdeveloped socioeconomic conditions. Mortality is less common in patients following RTAs in a rural area due to vehicles which cannot overspeed because of geographical conditions. Pedestrians, bicycle, and motorcycle drivers are very vulnerable to severe injuries. Risky time zones when RTAs have occurred more commonly included school entrance and exit periods in both morning and afternoon and work rush hours [19].

In a study from our country by Kucuker et al. [20], 41.8% of the injuries were due to in-vehicle accidents and 41.2% due to out of vehicle accidents, whereas in our study, 43% of morbidity and 60% of mortality occurred due to out of vehicle traffic accidents. In another study from our country, RTAs occurred most frequently on weekends and summer days at 12:01 PM and 6:00 PM when traffic was heavy. The accidents occurred out of a vehicle in 57.5% and in-vehicle in 42.5% [21,22].

Supporting the literature, in our study, 103 (75.1%) patients presented to the emergency service due to out of vehicle RTAs (motorcycle, bicycle, agricultural vehicle, or pedestrian). Forty-six patients presented to the emergency department between 08:00 AM and 4:00 PM, and 76 between 4:00 PM and 11:59 PM. The higher rate of RTAs in the evening can be explained by rush hours due to both work and school exit. Besides, in our study, the accidents occurred most on the weekends in summer. Differently, 33.3% of the deaths occurred due to an agricultural vehicle and 66% due to other motor vehicles. This was attributed to the seasonally prolonged summer days, increased time of harvest in agriculture, and children spending more time outdoors. For these reasons, we think that extra measures should be taken regarding traffic in the summer.

Several trauma scoring systems were developed to reduce the rate of morbidity and mortality in children with trauma, including ISS and GCS [12]. After admission to the hospital, the main mortality risk factors include being male, under 15 years of age, and coma. Death risk related to a low GCS has gradually increased, and 54% of those in a severe or deep coma died in the hospital. Most of the patients had a normal GCS, but 1.9% of all RTA victims were in severe or deep coma in our study, consistent with the literature [23].

In another study, the rate of RTAs increased with age, and those aged between 15-19 years were at the highest risk. This was attributed to the change in the used roads as children grow due to increased risk-taking behaviors and distractibility, and the fact that young people are more active in social life. The rate of mortality was higher in males compared to females [24]. In a study from our country, there was male gender dominance in RTAs, and this result was per Turkey Statistics [25,26]. In RTAs, young males more predominantly died [27,28]. Our results were similar to those of the studies conducted in Ethiopia and Gambia that found low rates of admission and mortality [29,30].

The entire bodies of the children are affected by traumas since they have a small body mass and body surface area. Lacerations, penetrating injuries, crush injuries, visceral damage, fractures, and amputations may be seen in pediatric RTAs, which may affect all body regions. In a study conducted from July 2005 through July 2017, the most frequently injured body regions in

RTA patients included lower extremities, chest, upper extremities, head, and spine [16]. In a study by Kourouma et al. [23], 86% of the patients were treated in the emergency department without being admitted to the hospital services. The predominant injury included soft tissue and fractures in about 10% of the patients, mainly in the extremities. Head and lower extremities were the most common anatomic regions of injuries. We evaluated hospitalized patients only. Limb and head trauma were the most common. STT rates were low in patients. According to our study, lower extremity fractures were more common and upper extremity fractures were less common. These results are in accordance with the previous studies in the literature.

In another study from our country, patients were hospitalized in the orthopedics and traumatology (n:124, 36.3%) and neurosurgery (n:87, 25.5%) departments, supporting our data, and the regions most exposed to trauma in patients were the head-neck and extremities [31].

Limitations

Its retrospective nature and limited number of patients were the two main limitations of this study.

Conclusion

Pediatric RTAs are more common under the age of 15 years and outside the vehicle. Although limb injuries are most common, more serious injuries such as intracranial hemorrhage, rib fractures, and liver lacerations are also possible. We could not detect the effect of RTAs on child mortality because of the limited number of cases.

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