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# The epidemiology and cost analysis of patients presented to Emergency Department following traffic accidents

Authors' Contribution:  
Study Design A  
Data Collection B  
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Literature Search F  
Funds Collection G

ABCDEF 1 **Gökçe Akgül Karadana**  
ACDE 1 **Nalan Metin Aksu**  
CDE 1 **Meltem Akkaş**  
BDF 1 **Canan Akman**  
ACDEF 2 **Akın Üzümcügil**  
ACEF 1 **M. Mahir Özmen**

1 Department of Emergency, Hacettepe University School of Medicine, Ankara, Turkey

2 Department of Orthopedics and Traumatology, Hacettepe University School of Medicine, Ankara, Turkey

**Corresponding Author:** Nalan Metin Aksu, e-mail: nmaksu@superposta.com  
**Source of support:** Departmental sources

**Background:** Traffic accidents are ranked first as the cause of personal injury throughout the world. The high number of traffic accidents yielding injuries and fatalities makes them of great importance to Emergency Departments.


**Material/Methods:** Patients admitted to Hacettepe University Faculty of Medicine Adult Emergency Department due to traffic accidents were investigated epidemiologically. Differences between groups were evaluated by Kruskal-Wallis, Mann-Whitney, and Wilcoxon tests. A value of  $p < 0.05$  was accepted as statistically significant.

**Results:** We included 2003 patients over 16 years of age. The mean age was  $39.6 \pm 16.1$  and 55% were males. Admissions by ambulance and due to motor vehicle accidents were the most common. In 2004 the rate of traffic accidents (15.3%) was higher than the other years, the most common month was May (10.8%), and the most common time period was 6 pm to 12 am (midnight). About half of the patients (51.5%) were admitted in the first 30 minutes. Life-threatening condition was present in 9.6% of the patients. Head trauma was the most common type of trauma, with the rate of 18.3%. Mortality rate was 81.8%. The average length of hospital stay was 403 minutes (6.7 hours) and the average cost per patient was  $983 \pm 4364$  TL.

**Conclusions:** Further studies are needed to compare the cost found in this study with the mean cost for Turkey. However, the most important step to reduce the direct and indirect costs due to traffic accidents is the prevention of these accidents.

**Key words:** cost analysis • epidemiology • traffic accident • Emergency Department

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## Background

As in other countries worldwide, the number of traffic accidents in Turkey is increasing each year, from 500,664 in 2000 to 1,034,435 in 2010 [1]. Traffic accidents are ranked first as the cause of personal injury throughout the world. The high number of traffic accidents yielding injuries and fatalities makes them of great importance to emergency departments (ED) [2].

It is thought that by determining common injuries resulting from accidents and by taking the necessary precautions, morbidity and mortality could be reduced.

The material damage resulting from accidents has a strong adverse effect on a country's economy. Physicians who are aware of the costs of traffic accidents will be able to take a more cost-effective approach to trauma.

By retrospectively evaluating the files of patients who presented at Hacettepe University Medical Faculty Adult ED because of traffic accidents between 2000 and 2010, this study aimed to determine the epidemiology of traffic accidents and to analyze the costs.

## Material and Methods

Approval for the study was granted by the Ethics Committee of Hacettepe University. It was determined that between 1 January 2000 and 31 December 2009, 3712 patients presented at Hacettepe University Adult ED following traffic accidents. Recorded information was available for 2003 patients aged over 16 years. For all the patients included in the study, a record was made of various demographic and epidemiological characteristics such as age, gender, arrival time, arrival condition, time to arrival at hospital, presence of any life-threatening condition, Glasgow Coma Score, Revised Trauma Score (RTS), findings and results, outcomes (admittance to hospital, self-discharge, death), and length of stay (LOS) in the ED. Injuries were evaluated separately as head, thorax, abdomen, extremities and other injuries. The pathology of the injuries was examined individually according to the location and recorded. The details of costs pertaining to that date with the patient file number were recorded.

Mean costs per capita were calculated separately for each year, and then the mean cost for each year was converted to American dollars according to the mean exchange rate for that year. The recorded data were evaluated using SPSS version 15.0 program. Differences between groups were evaluated by Kruskal-Wallis, Mann-Whitney, and Wilcoxon tests according to variable type and parametric test assumptions. A value of  $p < 0.05$  was accepted as statistically significant.

## Results

The study comprised an examination of 2003 patient files that could be accessed from a total of 3712 patients who presented at Hacettepe University Medical Faculty ED following traffic accidents between 1 January 2000 and 31 December 2009. The patients included in the study were 901 females (45%) and 1102 males (55%) with a mean age of  $39.68 \pm 16.15$  years (range 15–93 years).

When the years were examined, the most presentations following traffic accidents were in 2004 with 307 (15.4%), followed by 2005 with 287 (14.3%). The highest incidence was seen in the months of May, July, and June, with 217 (10.8%) in May and the lowest number of presentations was in February and March at 120 (6%) for each month. When the distribution of cases was calculated according to season, it was determined that the most of 28.4% of presentations occurred in the summer months.

In respect of the time of presentation, it was determined that the most presentations ( $n=671$ , 33.5%) were between 6 pm and 12 am (midnight) (Table 1).

In the evaluation of the time taken to reach the emergency department, it was determined that 51.5% presented within the first 30 minutes after the accident, 76.5% within the first 60 minutes, and 88.7% within the first 2 hours (Table 2). Most patients ( $1675=83.6%$ ) arrived at the ED by ambulance.

According to the manner of injury in the patient records, 1907 (95.2%) were from motor vehicle accidents (Table 3).

The most frequently seen trauma was head trauma (18.3%), followed by extremities (16.7%), thorax (7.3%), and abdominal trauma (3.5%).

LOS in the ED according to pathology is given in Table 4.

The results according to patient pathologies are given in Table 5.

Distribution of the outcomes according to the age, Glasgow Coma Scale (GCS) and Revised Trauma Scores (RTS) were given in Table 6.

The results according to type of injury are given in Table 7.

The results as to whether or not there were life-threatening conditions according to the forensic reports written in the ED are given in Table 8. Mortality occurred in 7 patients (0.4%) who had been given a non-life-threatening report.

The costs of 1998 patients in this study were evaluated and the costs of 5 patients were not evaluated. The mean cost was

**Table 1.** Distribution of patients according to the time of presentation.

Time of presentation	Number (n)	Percentage (%)
00.00–00.60	314	15.7
06.00–12.00	387	19.3
12.00–18.00	629	31.4
18.00–24.00	671	33.5
<b>Total</b>	<b>2001</b>	<b>99.9</b>
Unknown	2	0.1
<b>Total</b>	<b>2003</b>	<b>100.0</b>

**Table 2.** Time of arrival to Emergency Department.

Time (minute)	Number (n)	Percentage (%)	Cumulative percentage
<30 min.	665	33.2	51.5
30–60	324	16.2	76.5
60–120	157	7.8	88.7
>120 min.	146	7.3	100.0
<b>Total</b>	<b>1292</b>	<b>64.5</b>	
Unknown	711	35.5	
<b>Total</b>	<b>2003</b>	<b>100.0</b>	

**Table 3.** Distribution of patients according to manner of injury.

Manner of injury	Number (n)	Percentage (%)
Motor Vehicle	1907	95.2
Bicycle	13	0.6
Motorcycle	61	3.0
Train	21	1.0
<b>Total</b>	<b>2002</b>	<b>100.0</b>
Unknown	1	0.0
<b>Total</b>	<b>2003</b>	<b>100.0</b>

found to be 983.5±4364.4 TL; minimum 3 TL, maximum 84,941 TL. The costs for each year were converted to American dollars using the mean exchange rate for that year. The patient costs for each year are given in Table 9.

## Discussion

The study examined 2003 records that could be accessed from a total of 3712 patients who presented at Hacettepe University Faculty of Medicine Emergency Department following traffic

**Table 4.** The LOS in ED according to the pathologies (minute).

Pathology	Mean	Number (n)	Std. dev. (SD)	Median	Minimum	Max.
Head	848.5	315	3054.2	300	10	40320
Torax	1684.1	130	4642.0	480	30	40320
Abdomen	751.3	63	1634.3	330	10	12560
Extremity	586.0	280	1119.2	360	10	15800

**Table 5.** Outcomes according to the patient pathologies.

Pathology	Discharged	Hospitalized	Excitus	Leave the hospital
Extremity	164 (%49.0)	119 (%35.5)	26 (%7.8)	26 (%7.8)
Abdomen	11 (%15.7)	47 (%67.1)	10 (%14.3)	2 (%2.9)
Torax	48 (%32.9)	73 (%50.0)	19 (%13.0)	6 (%4.1)
Head	195 (%53.3)	120 (%32.8)	34 (%9.3)	17 (%4.6)

**Table 6.** Distrubution of the outcomes according to the age, Glasgow Coma Scales (GCS) and Revised Trauma Scores (RTS).

Results	Number (n)	Mean age	RTS	GCS
Discharged	1639	38.52±15.32	11.98±0.41	14.69±0.53
Hospitalized	248	44.65±18.43	11.16±2.29	13.34±3.67
Exitus	48	50.48±19.77	4.23±5.12	5.96±4.86
Left without permission	68	42.07±16.92	11.84±1.00	14.65±1.61
<b>Total</b>	<b>2003</b>	<b>39.68±16.15</b>	<b>11.69±1.69</b>	<b>14.53±2.15</b>

**Table 7.** The Outcomes according to the type of the injury.

Type of injury	Discharged	Hospitalized	Excitus	Leaved the hospital
Motor vehicle	1569 (%82.3)	229 (%12.0)	46 (%2.4)	63 (%3.3)
Bicycle	10 (%76.9)	2 (%15.4)	0 (%0.0)	1 (%7.7)
Motorcycle	47 (%77.0)	9 (%14.8)	1 (%1.6)	4 (%6.6)
Train	12 (%57.1)	8 (%38.1)	1 (%4.8)	0 (%0.0)
<b>Total</b>	<b>1638 (%81.8)</b>	<b>248 (%12.4)</b>	<b>48 (%2.4)</b>	<b>68 (%3.4)</b>

accidents between 1 January 2000 and 31 December 2009. The patients were 901 females (45%) and 1102 males (55%), which is similar to the sex distribution found in the literature.

The age of patients in the study ranged from 15 to 93 years, with a mean age of 39.68±16.15 years. Aygençel et al. reported a mean age of 35.8±14.3 years, Marmor et al. reported

**Table 8.** The outcomes according to the forensic reports.

Life-threatening condition	Discharged	Hospitalized	Excitus	Leaved the hospital
No	1598 (%88.2)	146 (%8.1)	7 (%0.4)	60 (%3.3)
Yes	41 (%21.4)	102 (%53.1)	41 (%21.4)	8 (%4.2)
<b>Total</b>	<b>1639 (%81.8)</b>	<b>248 (%12.4)</b>	<b>48 (%2.4)</b>	<b>68 (%3.4)</b>

**Table 9.** Distributions of the costs according to the years (TL).

Years	Mean (TL)	Number (n)	SD	Median	Min.	Maks. (TL)	Mean (Dolar)
2000	286	83	812	87	3	6805	459
2001	322	174	905	79	3	6363	264
2002	652	104	1339	181	4	10156	435
2003	970	177	6436	203	7	84941	649
2004	613	307	2017	170	14	24635	428
2005	990	286	3938	148	12	53294	738
2006	1111	280	4042	144	17	49613	777
2007	1133	196	2967	223	3	19397	872
2008	1019	170	3461	196	16	32402	790
2009	2119	221	8512	172	16	82213	1368
<b>Total</b>	<b>984</b>	<b>1998</b>	<b>4364</b>	<b>157</b>	<b>3</b>	<b>84941</b>	<b>755</b>

27 years, and Çetinoğlu et al. reported 35 years [3–6]. This mean age of traffic accidents affects the young and productive population; therefore, in addition to financial loss, there is thought to be a loss to the workforce and daily functioning.

When the number of traffic accidents was examined according to year, the lowest number was 83 (4.1%) in 2000. This result may be due to a lack of records in the past and it is thought that positive steps have been taken over the years in improving recording systems.

Highest numbers of presentations occurred in May, July, and June. In a study by Varol et al., the most accidents occurred in August (17.9%). The observation that most traffic accidents occur in the summer months agrees with data in the literature.

Most presentations were between the hours of 6 pm and 12 am. This may be due to evening rush-hour traffic congestion, limited visual fields at night, and human error due to tiredness, lack of attention, and alcohol intake. The hours of most presentations were found to be 6 pm to 12 am (midnight) in a study by Aygencel et al., 8 am to 4 pm by Marmor et al., 12 pm (noon) to 6 pm by Beyaztaş et al., and 3 pm to 7 pm by Mishra et al. [3,4,7,8].

In the current study, 1607 patients (83.62%) were brought to the ED by ambulance. This rate was given as 60.3% in a study by Aygencel et al. and as 52.5% in a similar study [3,9]. In a previous epidemiological study of trauma in Turkey, patient transfer by ambulance was found to be 10% [10]. The increase in this rate is thought to be due to use of the “112” ambulance system having become effective and public awareness of first aid and emergency procedures.

The ED was reached within the first 30 minutes after the accident by 51.5% of the patients in the current study. In a study by Wong et al., the mean period before reaching hospital was 28 minutes [11]. The period before reaching hospital is known to be significant for mortality and morbidity.

Of the patients in the current study, 95.2% were involved in motor vehicle accidents and 3% with motorcycle accidents. The mortality rate associated with the motor vehicle accidents was 46 (2.4%) and 1 (1.6%) with motorcycle accidents. Eken et al. showed a mortality rate in motorcycle accidents of 5.7% [12]. In a study by Mon et al., the injury and mortality rate of motorcycle accidents was 3.5 times higher than that of other motor vehicle accidents [13]. The result of the current study is at the expected level as there is widespread motorcycle use in Ankara.

The most frequently determined pathology was head trauma (18.3%), followed by extremity trauma (16.7%), and these results agree with the literature [14,15]. Taking these results into consideration, precautions giving protection in the event of an accident should be considered a priority in motor vehicle safety equipment. In a study by Weninger et al., head trauma occurred in 66% of patients, thoracic trauma in 55%, abdominal trauma in 55%, spinal trauma in 27%, at least 1 long bone fracture in 70%, and multiple fractures in 51% [14]. A reason that these rates are higher than those of the current study could be that only high velocity motor vehicle accidents were included in that study.

In the current study, 1639 patients (81.8%) were discharged from the ED, 248 (12.4%) were hospitalized, and 48 (2.4%) died. Aygençel et al. reported that 89.7% of patients were discharged from the ED, 8.4% were hospitalized, and 1.1% died. It is necessary to have monitoring in different departments of patients who have been stabilized by initial interventions, both in terms of patient morbidity and ED turnover.

In the current study, the average LOS in the ED was 403±1416 minutes, with a median of 180 minutes. In a study by Mishra et al., 10% of cases spent less than 1 hour at the hospital, 41.6% spent 1–6 hours, and 48.3% spent more than 6 hours [8]. In the current study, only LOS in the ED was calculated and the total LOS in the hospital was not included. The longest LOS in the ED was 40320 minutes (28 days). This excessive period and the low rate of hospitalization may be associated with a bed shortage in our hospital.

In the current study, the mortality rate was seen to increase with increasing age. This is an expected outcome due to factors

such as comorbidities and weaker compensation mechanisms in the elderly.

Traffic accidents constitute the great majority of criminal cases that present at the ED. Of criminal cases presenting at the emergency department, 44.3% were traffic accidents as reported by Gürbüz et al., 31.9% by Yavuz et al., and 34.1% by Arslanoğlu et al. [2,16,17]. In the current study, 7 patients (0.4%) died who had been given an emergency department report that there was no life-threatening condition. In the light of this result, it is thought that it is necessary to be very thorough in the preparation of forensic reports, and physician training on the writing of such reports should be reinforced.

## Conclusions

Annual losses to the Turkish economy of 350–450 million dollars are caused by traffic accidents [3]. In the current study, the mean cost per capita was found to be 983±4364 TL (755±3357 dollars). If labor force and functional losses are considered, this amount could be much higher. This figure was found to be 6395 Euros by Sheridan et al., 1910 pounds sterling by Morris et al., and 3600 Euros by Jacobs et al. [15,18,19]. When compared with these studies, the mean cost of the current study was lower, which may be due to differences in economic status and costs of healthcare in various countries. Further studies are required to compare the mean costs determined in the current study. Removing unnecessary tests would reduce costs, but the basic solution is to increase preventive measures against traffic accidents and driver education must be improved.

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