

TRAUMA CARE SYSTEMS

Patterns and Characteristics of Trauma in a Developing Country

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Learning Objective: To divulge the importance of trauma epidemiology and trauma registry in the care and prevention of injuries.

Abstract

Objective: The first step in dealing with a problem such as trauma is to identify the injury patterns and characteristics. Therefore, we aimed to demonstrate the current status of trauma admissions to a Level I trauma center in a major city of a developing country to be used as a model in establishing effective interventions for reducing injuries and their adverse consequences. **Design:** Retrospective descriptive study. **Setting:** The emergency department of the Uludag University Medical Center. **Methods:** Data received from the trauma admission forms of all trauma patients presenting to the Emergency Department between January 1, 1996, and December 31, 2000. **Results:** Among the recorded major trauma patients (n = 4,527), 71.7% were men and 28.3% were women. The main cause of trauma was motor vehicle accidents (70.3%) followed by falls (14.8%), interpersonal violence (physical assault, firearm and stab wounds) (7.3%), and machinery or workplace accidents (3.9%). Among all age groups, male sex and motor vehicle accidents were the main causes of trauma. Skin and soft tissue lacerations, ecchymoses, abrasions, and hematomas (23.1%), multiple organ injuries (18.3%), and cranial injuries (15.3%) were the main trauma types. Almost half of all the trauma patients (48.9%) were hospitalized in various wards, 23.5% were sent home, 17.2% transferred to another hospital, and 1.9% died in the hospital. **Conclusion:** Our findings emphasize the importance of motor vehicle accidents and falls as the leading causes of trauma and the need for measures such as educating the public, raising the awareness of the community, and taking legislative action to prevent these trauma patterns. Directing the resources and the education of the health care personnel toward the management of the injuries caused by these trauma patterns can also help in decreasing trauma morbidity and mortality.

Trauma frequently affects the young population and is the leading cause of death in the first four decades of life, a period of maximum productivity. Trauma also causes permanent disability in nearly twice the number of deaths it causes.^{1,2} In the United States, it has been reported that trauma-related injuries are the fourth cause of death after heart diseases, cancer, and stroke among all age groups.^{3,4} In the United Kingdom, it was found that 24% of the survivors of motor vehicle accidents were exposed to disability for at least 6 months. The current picture shows us that we are facing a substantial loss in the productive age group and that trauma is the most expensive public health problem.^{2,5} In other words, apart from leading to death and disability, trauma also presents a substantial problem for a country from the socioeconomic perspective.

Trauma-related admissions to emergency units comprise a rather large group. In order to reduce the number of patients in this group, it is necessary to determine the common trauma patterns to be able to take specific measures such as improving environmental factors and educating families and the public. Improving emergency care systems and developing hospitals selected as regional trauma care centers are the second step to minimize potential trauma-related disabilities and mortality.³

Turkey is a developing country with a population of 67 million. Its gross national product (GNP) per capita is around 2,500 U.S. dollars; it spends only 3.5% of its GNP on health care. Uludag University Medical School has an 800-bed medical center that may be considered as the Level I (600–1,000 beds) trauma center of the Bursa province. Our university hospital serves a population of 11 million, 1 million of which are urban and 10 million of which are rural. Bursa, the fourth largest city and an important industrial region, is located in the west and relatively more developed part of Turkey. In the metropolitan area, there are eight state-owned, one military, and three private hospitals. Four of these state-owned hospitals are general hospitals (two for public and two for labor men and their families) that may be categorized as Level II (400–600 beds) and Level III (150–250 beds) trauma centers; the other four are specialty hospitals, namely, children's, oncology, gynecology and obstetrics, and respiratory disease. In the rural area, there are 12 Level III–IV hospitals (50–150 beds).

Emergency medicine is a fairly new specialty in our medical system (since 1993) and emergency medical services (EMS) have been established in major cities only since 1996. Therefore, many aspects of the emergency care of the trauma patient, including their transfer and transportation, are still in their infancy. The emergency departments of the state-owned or private general hospitals as well as the state ambulance services are staffed with general practitioners. Unfortunately, these physicians usually lack the skills to perform some emergency or life-saving procedures such as endotracheal intubation, cricothyroidotomy, or placement of chest tubes and have to depend on surgeons or anesthesiologists who are usually on-call at home.

In our province, ground ambulances are used for most of the transportation or transfer of trauma patients. Transportation to the hospital takes approximately half an hour within the metropolitan region and 1 to 2 hours from the rural areas.

Keeping in mind the aforementioned status of our prehospital and in-hospital trauma care, this study aims to identify the characteristics and the types of major trauma seen in the Uludag University Medical Center, to compare these characteristics with similar national and international body of evidence, and to review potential efforts needed to minimize trauma-related disabilities and deaths in the region.

Methods

Trauma patients admitted to the emergency department (ED) of the Uludag University Medical Center during a 5-year period (January 1, 1996, to December 31, 2000) were included in the study. The study group that met the trauma center admission criteria comprised 4,527 trauma patients, each of whom completed a "trauma admission form" in the ED.⁶ Patients lacking the necessary information (more than two parameters of the study) in their trauma charts were excluded from the study.

Parameters evaluated in the study included age, sex, prehospital status, admission date and time, mechanism and intent of trauma, nature and severity of injury, and disposition destinations. Items that were missing on the trauma admission forms were documented as missing.

Patients were divided into six age groups: 0–15, 16–25, 26–35, 36–45, 46–55, and 56 years and over. The date of admission was recorded as month and year. Causes of trauma were classified as motor vehicle accidents, falls, interpersonal violence (stabs and gunshot wounds), machinery and workplace accidents, and others (in-house accidents, burns, injuries due to electricity, drowning, airplane crash, and unspecified and multiple causes).

The obtained data were entered into a personal computer and analyzed by Epi Info Version 1.1.2 (Epi Info is a statistical program distributed free by the World Health Organization) and SPSS 9.0 statistical programs (SPSS, Inc., Chicago, IL). Differences were tested by using the chi-square test.

Results

Among the 4,527 patients 71.7% (3,246) were male and 28.3% (1,281) were female. The mean age was 30.1 ± 0.3 years, with the youngest patient being 40 years old and oldest being 87 (median age, 28).

The number of trauma patients admitted to the hospital increased from 393 in 1996 to 1,183 in 2000 (Fig. 1). When monthly distribution of trauma admissions was analyzed, a peak in the summer season was observed (Fig. 2). A statistically significant relationship was found between the causes of trauma and the seasonal trauma peaks ($P = 0.004$).

According to individual analysis of causes of trauma, road traffic accidents were the leading cause (70.3%), followed by falls (14.8%), penetrating injuries that included firearm and stab wounds (7.3%), machinery accidents (3.9%), home/game accidents (0.9%), self-inflicted injuries (0.7%), and all the others (2.1%).

The details of the road traffic accidents, the leading cause of trauma, were in-vehicle traffic accidents affecting driver or passengers (66.5%), traffic accidents affecting pedestrians (21.6%), motorcycle accidents (5.8%), bicycle accidents (2.6%), tractor accidents (1.7%), and others (1.8%). The male sex was dominant in 93.2% of vehicle drivers, 98.7% of motorcyclists, and 91.4% of bicyclists. The sex distribution among pedestrians was 65.6% men and 34.4% women.

Injuries related to falling from high places included falling from trees (13.7%) and falling from balconies, walls, roofs, windows, and buildings under construction (87.3%).

Traumatic injuries caused by suicide attempts included falling from a high place (45.1%), gunshot wounds (22.6%), stab wounds (19.4%), and hanging (12.9%).

When association between sex and age groups was assessed, the number of men injured was higher than women (Fig. 3) in all age groups, but this was significantly higher in the 16- to 25- and 26- to 35-year-old age groups ($P < 0.05$).

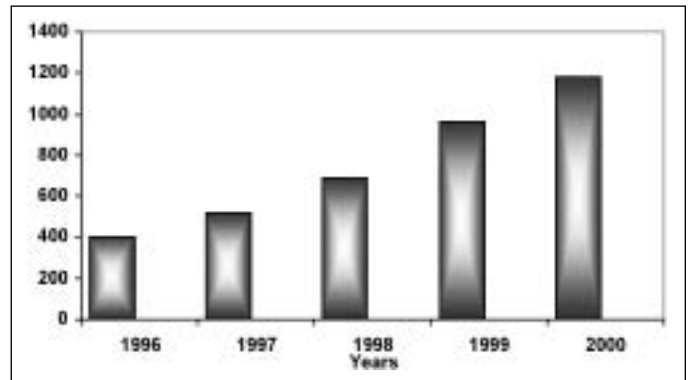


Figure 1. Yearly distribution of trauma admissions to the ED.

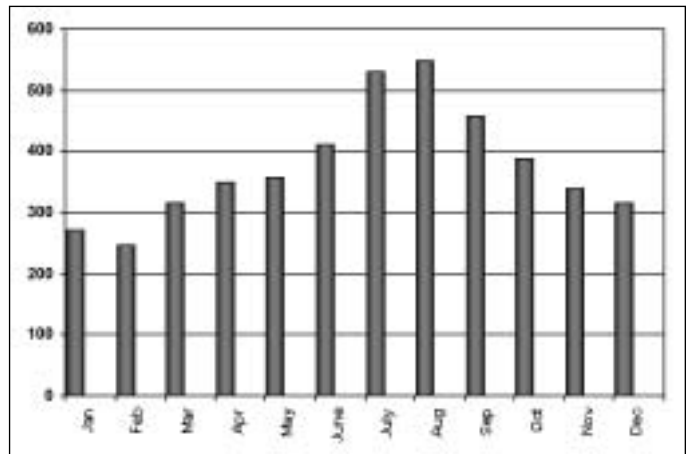


Figure 2. Monthly distribution of trauma admissions to the ED.

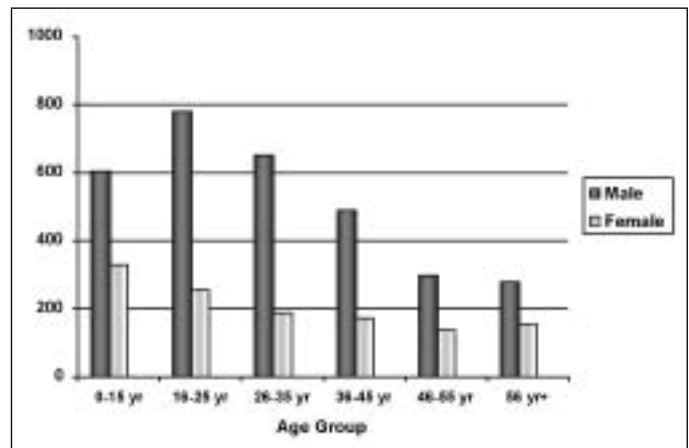


Figure 3. Age and sex distribution of the trauma admissions.

When association between sex and trauma causes was analyzed, it was observed that motor vehicle accidents, falls, workplace accidents, and penetrating injuries including gunshot and stab wounds were significantly more common among men (Table 1) ($P < 0.05$).

The leading cause of trauma in all age groups was motor vehicle accidents. While injuries related to motor vehicle accidents were the number-one cause (61%) in 0- to 15-year-old age group, falling from a high place (31%) was the next. In the 16- to 25-year-old age group, the leading cause of trauma was motor vehicle accidents (71%), followed by gunshot and stab wounds (11%). Motor vehicle accidents (70.1%) and falls (21.9%) were the main causes of trauma among patients 56 years and over.

The most frequent findings due to trauma were lacerations, ecchymoses, abrasions of skin, and swelling or hematoma in soft tissues (23.1%) followed by multiple thoracoabdominal injuries (18.3%), cranial injuries (15.3%), and extremity fractures (11.6%) (Table 2).

Table 1. Association between Sex and Cause of Trauma

Cause of Trauma	Male	Female	Total
Motor vehicle accidents	2,198	965	3,163
Falls	442	222	664
Interpersonal violence	293	35	328
Workplace accidents	165	10	175
All other trauma causes	129	38	167
Unrecorded trauma causes	21	9	30
Total	3,248	1,279	4,527

Table 2. Classification of Trauma Admissions to the ED by Injury Site

Injury Site	Frequency	%
Skin and soft tissue trauma	982	23.1
Multiple organ injuries	777	18.3
Cranial trauma	651	15.3
Extremity fractures	492	11.6
Torso trauma	314	7.4
Vertebral and spinal injuries	184	4.3
Abdominal injuries	122	2.9
Other	140	3.3
No identifiable injury	292	6.9

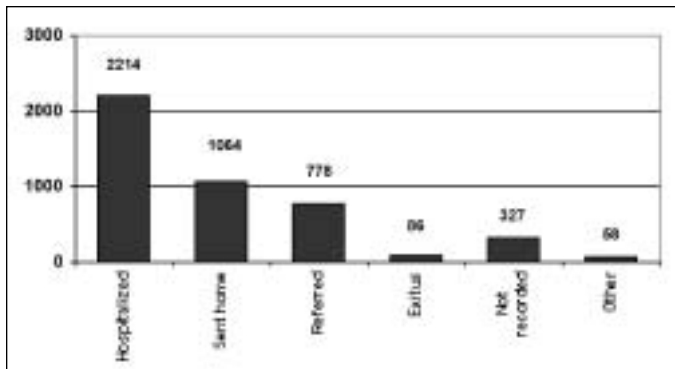


Figure 4. Discharge locations of trauma patients from the ED.

The majority of the trauma patients were sent from the ED to various surgical wards or to the intensive care unit (ICU) (48.9%); 23.5% were sent home, 17.2% were transferred to other hospitals, 1.9% were dead on arrival or died in the ED, and 1.3% refused further investigation or observation in the ED and left the hospital. Final destination was missing in 7.2% of the trauma admission forms. Figure 4 shows the discharge location of this group of patients.

Discussion

The types and causes of trauma may vary from one country to another and also within different regions of a single country. Trauma is the leading cause of death in the young population in Turkey, as in the Western societies, but the pattern is somewhat different in Turkey. As our study points out, the most frequent cause of trauma among all age groups and both sexes was motor vehicle accidents (70.3%) followed by falls, gunshot and stab wounds, and workplace accidents. Another study from Turkey also cited motor vehicle accidents as the leading cause of trauma in its region.⁷ A similar study in Iran reported that the most frequent causes of trauma were also motor vehicle accidents and falls.⁸ Trauma due to road traffic accidents, a problem resulting in substantial economic, social, and emotional loss all over the world, is said to be a more evident public health problem especially in developing countries without adequate infrastructure,^{7,9} but studies from the Western world also cite motor vehicle accidents as the leading cause of trauma.^{5,10} On the other hand, a study from Australia reported that the major type of nonfatal injuries was falls and the major type of fatal injuries was suicide attempts and motor vehicle accidents.¹¹

Injury death rates due to motor vehicle accidents is 3 per 10,000 per year in Turkey. This rate may seem close to the rate in the developed nations, which is 2 per 10,000 per year, but actually it is much higher when the number of motor vehicles per 1,000 people is considered, which is 150 in Turkey as opposed to 500 in developed countries. According to a recent report on police statistics, there were 7,000 immediate deaths due to motor vehicle accidents in 1 year and the cost of the road traffic accidents to the Turkish society was 12 billion dollars.

A number of factors such as the status of the infrastructure, the ratio of the number of motor vehicles to the population, and education level and socioeconomic conditions of the public lead to variations in trauma causes among countries or regions. In our region, the reason for motor vehicle accidents as the leading cause of trauma is probably the result of many factors such as excessive number of motor vehicles, inadequate infrastructure, public ignorance and lack of discipline to obey laws and regulations, inadequate inspections and control mechanisms, increased population, and deep cultural differences among different segments of the society due to rapid urbanization and migration.

The use of safety belts and crash helmets decreases the number of trauma-related injuries and deaths.^{12,13} One finding in our study that proves the detrimental effects of public ignorance and lack of discipline to obey laws and regulations and inadequacy of proper official inspections and control mechanisms on trauma is the rate of safety belt use by in-vehicle trauma patients. The compliance with safety belt use in our region is 5%. We believe that at least some of the major cranial and thoracoabdominal injuries could have been

prevented if this compliance rate were higher. Had there been regulations requiring the presence of airbags in automobiles in Turkey, we are sure that the trauma patient characteristics would also change, and that major cranial and torso trauma would decrease. Although we do not have enough data and studies about seat belt, helmet, and airbag use throughout the country, we believe that increasing public awareness in this matter will decrease deaths and disabilities due to motor vehicle accidents in Turkey.

The percentage of male trauma patients admitted to the ED is nearly 2.5 times higher than that of female patients (71.7% vs. 28.3%, respectively). This ratio is consistent with the literature. A study done in Uganda reported that 72.3% of the 5,210 admissions from trauma were male and 27.7% were female.¹⁴ This follows World Health Organization data, which report that injuries and traumatic deaths are more common in men than women.⁹

More men were injured as a result of trauma compared with women, and the association between sex and age was significant in this respect. Traumatized individuals are primarily young and middle-aged men. Other studies have also reported that trauma mainly affects productive age group and men.^{8,9,11} The reason that men are more affected by trauma may partially be explained by the high number of male drivers compared with female drivers, despite an increase in female drivers in recent years.

Motor vehicle accidents are the leading cause of injury in all age groups. In order to reduce mortality and morbidity related to motor vehicle accidents in childhood, it would be useful to educate the parents to use baby and child restraints and to supervise or accompany child pedestrians.

The second major cause of trauma after motor vehicle accidents in the 0- to 15-year-old age group is all types of falls. The number of falls decreases with advancing age and rises again in the elderly (56 years and over). The literature reports are similar, with falls being more frequent in childhood.^{15,16} Developing various protection mechanisms for target age groups at risk would be effective in decreasing the incidence of falls. Educating mothers and families and caretakers, eliminating potential causes of falls, placing barriers in appropriate settings, and adequate supervision would be useful in helping to prevent falls.¹⁷ Factors implicated in the excess number of morbidity and mortality due to falls in advanced age include chronic health problems in the elderly, environmental conditions posing high risk, and delay in medical care.¹⁸

Falling from trees constitutes 13.7% of all the falls. This is because of the number of falls from olive trees while harvesting the fruit in the late summer and early fall season and is a unique epidemiologic factor for the Bursa region. If these workers can be provided with better means of harvesting olives, many of these unfortunate injuries can be prevented.

It is evident that motor vehicle accidents and falls are more frequent in the summer season. Only 13.7% of falls are from trees, which, as mentioned, are more frequent in the late summer and early fall (adult falls). The rest of the falls are from windows and balconies and they are more frequent in the summer season (child falls). No significant seasonal difference was observed for other causes of trauma. There are other studies in which are found a similar correlation between the summer season and a high incidence of injuries due to road traffic accidents and falls. On the other hand, a study from Iran reported that motor vehicle accidents mainly occurred in the winter.⁸ In a study conducted in Brazil to

determine the incidence of childhood injuries, it was reported that accidents occurred more in the summer season (38.1%) when schools were closed.¹⁹ There are other studies reporting that falls in children occur more commonly in the summer season,^{20,21} but Benoit et al²² found a significantly higher number of childhood falls in the spring. The seasonal increase in trauma admissions in our study is from two reasons, one of which is the increased traffic on the roads in the summer. Bursa is on the main highway from Istanbul to Izmir, the first and third largest cities of the country, respectively. The other reason is also unique to the region. Injuries due to adult falls are increased in the late summer, especially those reported in the rural areas, because at this time of the year people climb up the trees to collect olives and other fruits.

The number of trauma patients admitted to the ED of the Uludag University Medical School within the last 5 years (1999–2004) has increased significantly. The reason for this increase is probably twofold. First, Bursa is a developing area undergoing rapid economic change and urbanization and, parallel with this, the rate of trauma is also increasing in the region. Second, our trauma unit was established in 1994 and the state EMS system was started in Bursa in 1995; both systems gradually developed, which also increased our trauma admissions.

The most frequent types of injuries reported in the trauma admission forms were skin and soft tissue lacerations, ecchymoses, abrasions, and hematoma, followed by multiple organ injuries, cranial injuries, and extremity fractures.

Moini et al⁹ reported the most frequently injured body sites as external body surfaces (53%), head/neck (43%), and extremities (42%). Differences in the classification and evaluation of anatomic localization of injuries in different studies may lead to a variation among the results. There are a number of studies investigating the relationship between injury site and age or injury mechanism. In most of these studies, however, the primary injury sites were the head and the extremities.^{19,23–25}

Nearly one-fourth (24%) of the patients admitted to our ED were discharged from the ED and sent home with discharge instructions such as to go to a hospital if they have headache, vomiting, weakness of a limb, or a change in their condition. Nearly half of the patients (49%) were hospitalized in different wards, and the remaining one-fourth were referred to other hospitals, died, or lost to follow-up with outcomes unknown. A study conducted in Jamaica by McDonald et al²⁶ reported that 16% of the trauma patients admitted within 1 year (1996) were hospitalized. On the other hand, in a study conducted in two separate hospitals of Uganda, 61% of 5,210 injured patients admitted to the ED were sent home after appropriate treatment, 37% were hospitalized, and 0.8% were dead on arrival.¹⁴ Hospitalization rate among trauma patients admitted to our hospital appears to be high. The reason for this is that our center is the biggest in the region and there are many severe and complicated trauma cases referred from other hospitals.

Conclusion

Currently, trauma constitutes a major health problem in Turkey. For appropriate trauma care, the EMS system and regionalized trauma care must be established throughout the country, but this is expensive and will take time. Therefore, development of effective trauma-preventive strategies should be the major thrust in developing countries. The first step in

developing such strategies is to identify the patterns and characteristics of trauma patients in various regions.

This study has revealed the trauma profile of our region. Road traffic accidents and falls are the major trauma types encountered in our region. A few simple measures such as appropriate intervention and referrals, education of physicians and medical personnel, and increasing public awareness in these types of trauma causes can significantly reduce injury-related burden, suffering, and mortality.

This study has also revealed the importance of keeping medical records of trauma patients. We know that this study would have been much better if we had had all the information pertaining to the trauma patients in their trauma charts. Trauma registry should be taken more seriously in our institution and in our country as well as in other developing countries.

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CLINICAL ISSUES

Uncontrolled Hemorrhage in a Patient with Pelvic Fracture: A Case Report

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Learning Objectives: 1) To be aware of the potential influence of episodic rebleeding on hemodynamic stability in patients with traumatic pelvic fracture, and 2) to be aware that animal experiments demonstrate a better outcome if fluid resuscitation does not completely restore the arterial blood pressure in the presence of major vascular injury.

Neither author has any conflicts of interest to disclose.

Abstract

A 73-year-old woman arrived at hospital with multitrauma, including a nonoperative pelvic fracture. Fluid resuscitation aimed at restoring normal hemodynamics was started, but hypotensive events developed on four occasions when intensive fluid resuscitation had raised the systolic pressure to just above 100 mm Hg. The blood volume expansion resulting from transfusion of erythrocytes and plasma and the infusion of clear fluid corresponded to six times her blood volume during the first 21 hours in hospital. The clinical course suggests the presence of episodic rebleeding from the pelvic fracture.

Pelvic fractures are often accompanied by major bleeding, which is potentially life-threatening.^{1,2} Current recommendations for treatment are to stabilize the bony pelvis (if anatomically possible) while restoring normal tissue perfusion through administration of fluids and blood products.^{3,4} In recent years, however, animal experiments have raised concerns as to