Cost factors in pediatric trauma

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Introduction: There is a lack of information on the cost of treating trauma in children in developing countries. Therefore, in the pediatric emergency unit of a university hospital in Turkey, we prospectively investigated the cost factors of pediatric trauma and attempted to identify cost predictors. **Methods:** We prepared questionnaires and charts for 91 children (50 boys, 41 girls) admitted with multiple trauma to obtain data on age, gender, date and mechanism of injury, site of injury, type of the treatment and length of hospital stay. We studied the physical findings, Pediatric Trauma Score (PTS), Revised Trauma Score (RETS) and pediatric Glasgow Coma Scale (GCS) score, and we totalled all hospital-based costs according to Ministry of Health guidelines. **Results:** The mean (and standard deviation [SD]) age of the children was 79.4 (52.3) months. Motor vehicle crashes accounted for 45% of the injuries, followed by falls (41%) and bicycle accidents (14%). The mean (and SD) total cost of care was US$376.60 ($428.20) (range from $20–$1995). The cost associated with motor vehicle crashes was higher than that for the other injury types ($p < 0.05$). Seventeen patients required major and 27 patients required minor surgical treatment, whereas 44 patients were treated conservatively; 3 died. Forty-eight percent of patients were referred from another hospital, and the cost of care of referred patients was significantly higher than for those admitted directly ($p < 0.001$). The mean (and SD) duration of hospital stay was 98 (150) hours. Total cost correlated directly with the duration of hospital stay and distance of the referred hospital or accident scene from our hospital ($p < 0.001$, $r = 0.827$ and 0.374 respectively), but the cost correlated inversely with the PTS, the RETS and the pediatric GCS score ($p < 0.001$, $r = –0.339$, –0.301 and –0.453 respectively). **Conclusion:** Our findings indicate that the cost of pediatric trauma is high and may be predicted from admission data and trauma scores.

Introduction : On manque d'information sur le coût de traitement des traumatismes chez les enfants dans les pays en développement. C'est pourquoi nous avons étudié de façon prospective, au service d'urgence en pédiatrie d'un hôpital universitaire de Turquie, les facteurs de coût des traumatismes pédiatriques et tenté de définir les prédicteurs des coûts. **Méthodes :** Nous avons préparé des questionnaires et des dossiers sur 91 enfants (50 garçons, 41 filles) polytraumatisés pour en tirer des données sur l'âge, le sexe, la date et le mécanisme traumatisant, le site du traumatisme, le type de traitement et la durée de l'hospitalisation. Nous avons étudié les résultats physiques, les résultats selon l'échelle des traumatismes pédiatriques (ETP), l'indice révisé du traumatisme (IRT) et le score sur l'échelle de Glasgow en pédiatrie et nous avons totalisé tous les coûts hospitaliers conformément aux lignes directrices du ministère de la Santé. **Résultats :** La moyenne d'âge (et l'écart type [ET]) des enfants s'établissait à 79,4 (52,3) mois. Les collisions mettant en cause un véhicule à moteur ont causé 45 % des traumatismes, suivies des chutes (41 %) et des accidents de bicyclette (14 %). Le coût total moyen (et l'ET) des soins s'est établi à 376,60 $US (428,20 $) (intervalle de 20 $ à 1995 $). Les coûts associés aux collisions mettant en cause un véhicule à moteur ont été plus élevés que dans le cas des autres types de traumatisme ($p < 0,05$). Dix-sept patients ont eu besoin d'une intervention chirurgicale majeure et 27, d'une intervention mineure, tandis que 44 patients ont reçu un traitement conservateur; 3 sont morts. Quarante-huit pour cent des patients provenaient d'un autre hôpital et le soin des patients référés a coûté beaucoup plus cher que celui des patients admis directement ($p < 0,001$). La durée moyenne (et l'ET) de l'hospitalisation s'est établie à 98 (150) heures. Il y avait un lien direct entre, d'une part, le coût total et, d'autre part, la durée de l'hospitalisation et la distance entre l'hôpital de référence ou les lieux de l'accident et notre hôpital ($p < 0,001$, $r = 0,827$ et 0,374 respectivement), mais il y avait un lien inverse entre le coût et l'ETP, l'IRT et le score sur l'échelle de Glasgow en pédiatrie ($p < 0,001$, $r = –0,339$, –0,301 et –0,453 respectivement). **Conclusion :** Nos constatations indiquent que les traumatismes en pédiatrie coûtent cher et qu'il est possible de prédire ces coûts à partir des données d'admission et de la classification des traumatismes.

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Although the costs of trauma, which is well recognized as a significant cause of mortality and morbidity in children,[1,2] are high in all age groups, pediatric trauma care is accepted to be profitable.[3]

Several studies reported from the United States and Canada examine the cost factors of pediatric trauma, including pediatric trauma scores.[4–6] Equivalent studies in Turkey are lacking. We carried out this study to estimate the cost factors of trauma in children and to identify predictors of the cost of managing such trauma in a developing country.

Patients and methods

Children under 16 years of age consecutively admitted to our pediatric emergency unit with multiple trauma between Oct. 15, 1998, and Sept. 31, 1999, were prospectively evaluated.

A questionnaire was prepared to include the following information: date of birth, gender, date and mechanism of injury, site of injury, type of the treatment and length of hospital stay. The physical findings, Pediatric Trauma Score (PTS), Revised Trauma Score (RETS) and pediatric Glasgow Coma Scale (GCS) score for all children were prospectively studied.[7] The cost factors of pediatric trauma were determined.

The cost of surgical procedures, laboratory tests, physicians' fees, nursing, anesthesia and bed fees (in ward and intensive care units) used in this study were those determined by the ministry of health and used in all government and university hospitals in Turkey rather than real costs.

Other costs were those for materials used in surgery, drug costs and miscellaneous costs (e.g., materials purchased by the hospital management through tender). The final costs were totalled and charged to the patient or the social insurance authorities of the referring hospital. Because of variation in payment by insurance authorities, we excluded these costs.

The cost of trauma was determined in Turkish lira and converted into US dollars according to daily exchange rates to enable comparison and a better understanding of the results of our study.

The t test, χ^2 test, one-way ANOVA, Pearson's correlation and linear regression were used for data analyses. A probability value of less than 0.05 was considered significant. All data are presented as the mean (and standard deviation).

Results

Ninety-one children (50 boys, 41 girls) with multiple trauma were investigated in our study. They ranged in age from 2 to 180 months (mean [SD] 79.4 [52.3] mo). The mean monthly income of the children's families was US$437 ($345) (range from $50–$1650) and the mean total cost of care was $377 ($428) (range from $20–$1995).

The mean (and SD) trauma scores for the children were: PTS 9.7 (1.8) (range from 2–12), RETS 11.4 (1.3) (range from 4–12) and pediatric GCS score 13.7 (2.8) (range from 3–15).

Motor vehicle crashes accounted for 45% of the injuries, followed by falls (41%) and bicycle accidents (14%). The costs for these were US$500 ($538) (range from $20–$1995), $267 ($275) (range from $30–$1045) and $291 ($281) (range $16–$980), respectively ($p < 0.05$). Table 1 shows the relationship between type of accident and pediatric GCS score, PTS, RETS, hospital stay and costs.

Seventeen children (19%) required major surgical treatment, and 27 (30%) required minor procedures (application of splint, cast, sutures, tube thoracostomy or thoracentesis); 44 (48%) were managed conservatively and 3 died (3%). The costs were US$929 ($567) (range from $63–$1995), $355 ($390) (range from $41–$1550), $181 ($139) (range from $20–$570) and $496 ($218) (range from $271–$706), respectively, for children who required major and minor surgical treatment, in conservatively treated children and in those who died. When the children who required major and minor surgical treatment and conservative treatment were compared, the cost was found to be higher among those who required major surgical treatment ($p < 0.001$). Table 2 shows the relationship between type of treatment and pediatric GCS score, PTS, RETS, hospital stay and cost.

Forty-four children (48%) were referred to our hospital from another

Table 1

The Relationship Between Type of Accident and Trauma Scale Scores, Hospital Stay and Costs in Children With Traumatic Injuries

	Variable, mean (and SD)*					
Type of accident	Age, mo	PTS	RETS	GCS score	Hospital stay, h	Cost, US$
Motor vehicle crashes	77 (56)	9.6 (2)	11.3 (1.4)	13.3 (3.1)	133 (187)	500 (538)
Falls	74 (52)	9.7 (1.7)	11.3 (1.5)	13.8 (2.9)	62 (97)	267 (275)
Bicycle accidents	102 (37)	10 (1.3)	11.8 (0.4)	14.5 (1.2)	84 (124)	291 (281)
p value	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	< 0.05

*Unless otherwise indicated.
PTS = Pediatric Trauma Score, RETS = Revised Trauma Score, GCS = Glasgow Coma Scale.

hospital, and the mean cost of their care was US$608 ($568) in our hospital compared with $155 ($125) for the 47 (52%) children who were admitted directly to our hospital ($p < 0.001$) (Table 3).

The site of injury was as follows: head injury, 74%; abdominal injury, 57%; extremity injury, 37%; and trunk injury, 4%. There were 3 trauma-related deaths, for a mortality of 3%.

The mean (and SD) duration of hospital stay was 98 (150) hours (range from 1–720 h). Total cost correlated directly with the duration of hospital stay (Fig. 1) and with the distance of the referred hospital or accident scene from our hospital ($p < 0.001$, $r = 0.827$ and 0.374 respectively), but it was inversely proportional to the PTS (Fig. 2), RETS and pediatric GCS score ($p < 0.001$, $r = –0.339$, –0.301 and –0.453 respectively).

Discussion

In our study, 55% of children were male and 45% were female. This is in keeping with the gender distribution in other studies, which suggest a preponderance of boys, ranging from 58.8% to 78.4%.[4,6,8–11] The mean age of patients was 79.4 months, slightly lower than that reported in other studies.[4,6,12] Motor vehicle crashes were the leading cause of trauma (45%), followed by falls (41%). Although some studies identified falls as the most frequent cause,[11,13] our results were similar to those of some other reports.[4,12,14] Dueck and associates[4] reported a death rate of 8.6%. In our study, the death rate was 3.3%, similar to or slightly lower than that reported by others.[11,14]

The cost of trauma has reportedly ranged between US$1900 to $5800 per hospital stay.[3,6] Dueck and associates[4] reported a mean cost per patient of Can$7582 (approx. US$5300), compared with US$377 in our study. This striking difference is a reflection of the significantly lower health care costs in Turkey. To the best of our knowledge there is no report in the English literature on financial aspects of trauma in developing countries, and there are only few reports from developed countries, mainly the US and Canada.[4–6]

Similarly, studies on the correlation between the trauma scores and cost of trauma are limited in the literature.[4,5,10] Harris and associates[5] reported increasing costs with higher Injury Severity Scores. Dueck and associates[4] also reported a positive correlation between the cost of trauma and injury severity score and age, and a negative correlation between cost of trauma and the PTS. We investigated the relation between the cost of trauma and the RETS and pediatric GCS score in addition to the PTS. We found a significantly negative correlation between the cost of trauma and the PTS, RETS and pediatric GCS score. A positive correlation between the cost of trauma and age has been described.[4,9] The authors argued that this may reflect the higher frequency of motor vehicle

Table 2

Relationship Between Type of Treatment and Trauma Scale Scores, Hospital Stay and Costs in Children With Traumatic Injuries

	Variable, mean (and SD)*					
Type of treatment	Age, mo	PTS	RETS	GCS score	Hospital stay, h	Cost, US$
Major	107 (56)	8.4 (1.7)	10.9 (1.4)	11.4 (3.8)	279 (217)	929 (567)
Minor	84 (50)	10.2 (1.4)	11.8 (0.7)	14.5 (1.7)	85 (125)	355 (390)
Conservative	66 (47)	10.2 (1.2)	11.7 (0.6)	14.7 (0.7)	39 (63)	181 (139)
Died	85 (90)	5 (3)	6.3 (2.5)	4.7 (2)	96 (0)	496 (218)
p value	> 0.05	0.000	0.000	0.000	0.000	0.000

*Unless otherwise indicated.
PTS = Pediatric Trauma Score, RETS = Revised Trauma Score, GCS = Glasgow Coma Scale.

Table 3

The Relationship Between Referred and Directly Admitted Patients and Trauma Scale Scores, Hospital Stay and Costs in Children With Traumatic Injuries

	Variable, mean (and SD)*					
Admission	Age, mo	PTS	RETS	GCS score	Hospital stay, h	Cost, US$
Referred	85 (57)	9 (2)	11 (1.7)	12.9 (3.5)	167 (180)	608 (506)
Directly admitted	74 (48)	10.3 (1.3)	11.7 (0.6)	14.4 (1.7)	32 (65)	155 (125)
p value	> 0.05	= 0.001	< 0.05	< 0. 05	0.000	0.000

*Unless otherwise indicated.
PTS = Pediatric Trauma Score, RETS = Revised Trauma Score, GCS = Glasgow Coma Scale.

crashes in the older age group, and the costs of motor vehicle crashes were higher than the costs for other types of accident. We did not find a correlation between the cost of trauma and age. This may be expected since we did not show any difference between the cost of trauma and the type of accident.

Dueck and associates[4] reported a significantly higher cost and duration of hospital stay associated with motor vehicle crashes. The findings in our study were similar. In addition, we found longer duration of hospital stay without statistical significance in terms of the cost of trauma in motor vehicle crashes. In our study, the cost of trauma was higher in motor vehicle crashes, a finding that is independent of the duration of hospital stay. The cost of trauma in motor vehicle crashes found in our study can be explained by the fact that this type of injury is associated with more expensive, invasive and noninvasive diagnostic and therapeutic procedures.

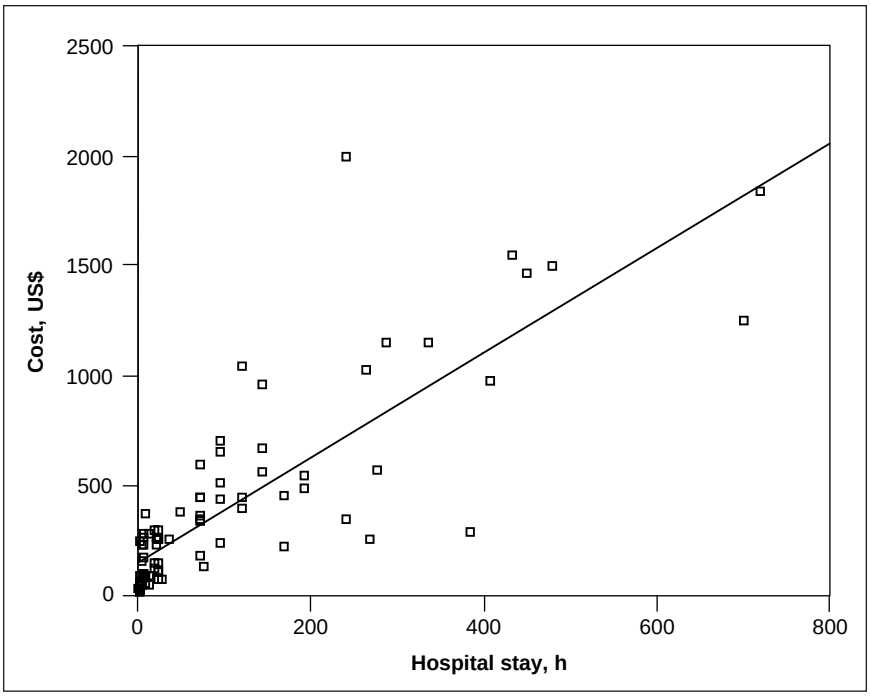

FIG. 1. Correlation between the cost of trauma care for children in the study and the duration of hospital stay ($p < 0.001$, $r = 0.827$). y = 2.4x + 148.6.

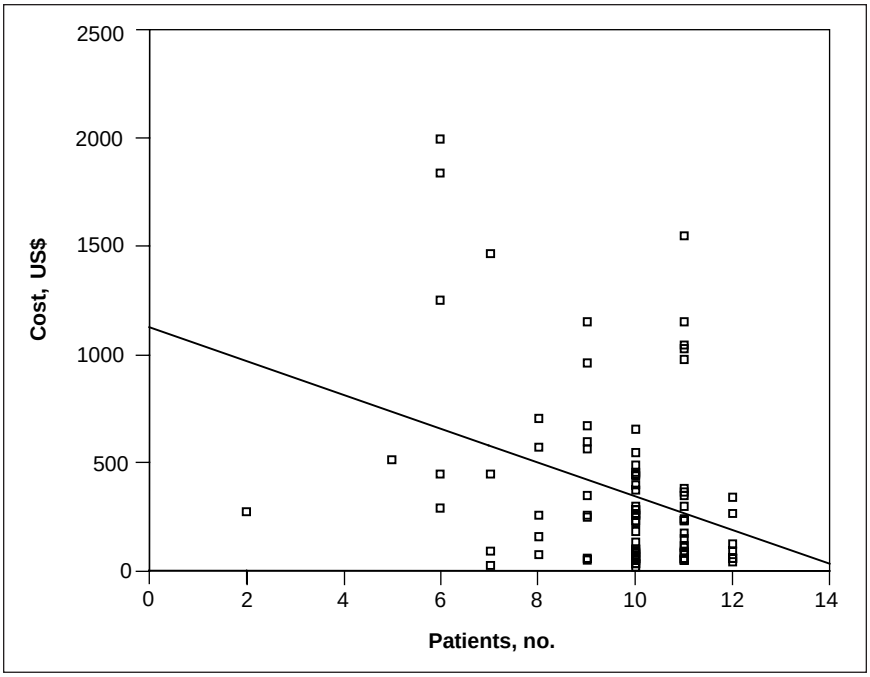

FIG. 2. Correlation between the cost of trauma care for children in the study and the Pediatric Trauma Score ($p < 0.001$, $r = -0.339$). y = −77.9x + 1126.1.

Our findings of head injuries in 74% of children, abdominal injuries in 57%, extremity injuries in 37% and trunk injuries in 4% are similar to those reported by Dueck and associates;[4] however, they did not report a percentage of abdominal injury. In their study, 86% of patients underwent surgical treatment, and their cost of care was nearly 3 times greater than those who did not require surgery. In our study, 19% of children required major surgical treatment and 30% of children required minor procedures. We found that the cost of care was 5 times greater in the major surgically treated patients than the conservatively treated patients, and 2 times greater in the minor surgically treated patients than the conservatively treated patients. The trauma scores were lower in the major surgically treated patients. The higher cost of trauma in these patients also may be due to the higher cost of operation. Forty-eight percent of patients were referred from another hospital. The duration of hospital stay of the referred patients was longer, and cost of trauma was higher due to their low trauma scores.

Studies on the cost of care, especially when presented from countries in different geographic and socioeconomic settings, have several limitations. Nevertheless, these studies are required to establish a worldwide policy on the prevention of trauma and standardization of health care.

Turkish pediatric trauma carries a significant cost, which correlates with trauma scores, type of treatment and type of accident. We suggest that trauma scores may be a predictor of cost of care in trauma. Further studies are required to explore the cost of care after pediatric trauma.

Competing interests: None declared.

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