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Bicycle Related Injuries in Adults and Children in the Central Anatolian Region: Analysis of 4 Years

Orta Anadolu'da Çocuk ve Erişkin Bisiklet Yaralanmaları: 4 Yılın Analizi

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Abstract

Objective: We aimed to investigate and compare the features of child and adult injuries due to bicycle accidents admitted to our emergency department.

Material and Methods: The study was carried out retrospectively by searching the files of patients admitted to the emergency department due to bicycle accidents in the emergency department and archive records between the dates of January 2005-December 2008. The patients were divided into two groups as adults and children. Age and sex of the patients, season or month of injuries, place and mechanism of injury, site of the injury, diagnosis and treatment modalities, discharge and hospitalization rates were evaluated. Student t test was used for two group comparison.

Results: A total of 150 patients were included in the study. 79% of the patients were in the child age group, 21% were adults. It was determined that the number of accidents increased especially in the summer months. 71.4% of accidents concerning children and all adult accidents occurred in the streets. Falling off the bicycle was the most common cause of injury in children (91%) and adults (90%). The head and neck region was the most common body site subjected to injury in both children (32%) and adults (40%). There was a significant difference between the two groups with respect to injury severity.

Conclusion: Most of the injuries due to bicycle accidents in children happen, in the streets, in summer months and during school vacations. Although not statistically significant, it was seen that adult injuries were more serious. *(JAEM 2012; 11: 35-40)*

Key words: Bicycle, injuries, child, adult

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Özet

Amaç: Çalışmamızda bisiklet kazalarına bağlı yaralanmalarla acil servisimize başvuran çocuk ve erişkin hastaların yaralanma özelliklerinin araştırılması ve karşılaştırılması amaçlanmıştır.

Gereç ve Yöntemler: Çalışma Ocak 2005-Aralık 2008 tarihleri arasında acil servise bisiklet kazası ile gelen olguların dosyalarına acil servis ve arşiv kayıtlarından ulaşılarak geriye dönük olarak gerçekleştirildi. Hastalar erişkin ve çocuk yaş grubu olmak üzere iki gruba ayrıldı. Hastaların yaş, cinsiyet, kazaların oluştuğu aylar, yaralanmanın oluştuğu mekan, yaralanma mekanizması, yaralanan vücut bölgeleri, tanı ve tedaviler, taburculuk ve yatış oranları incelendi. İki grubun karşılaştırılmasında Student t testi kullanıldı.

Bulgular: Toplam olgu sayısı 150 bulundu. Olguların %79'unu çocuk, %21'ini erişkin yaş grubu oluşturdu. Kazaların sayısının özellikle yaz aylarında arttığı tespit edildi. Çocuklarda oluşan kazaların %71.4'ü erişkinlerin ise tamamı cadde ve sokakta meydana gelmiştir. Çocuklarda (%91) ve erişkinlerde (%90) bisikletten düşme en fazla görülen yaralanma mekanizmasıydı. Baş-boyun bölgesi çocuklarda %32, erişkinlerde ise %40 ile en fazla yaralanmaya maruz kalan vücut bölgesi tespit edildi. Çocuk olguların %78'i, erişkinlerin ise %84'ü acil serviste takip ve tedavi sonrası taburcu edildi. Yaralanma şiddeti açısından iki grup arasında anlamlı fark mevcuttu.

Sonuç: Bisiklet kazalarına bağlı yaralanmaların çoğu cadde-sokaklarda, okulun tatil olduğu yaz aylarında ve çocuklarda meydana gelmektedir. Ciddi yaralanmalar erişkinlerde daha fazla görülmektedir. *(JAEM 2012; 11: 35-40)*

Anahtar kelimeler: Bisiklet, yaralanma, çocuk, yetişkin

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Introduction

Traffic accidents are one of the most common causes of multiple trauma injuries worldwide. In our country, traffic accidents are still among the causes of fatality and permanent disabilities, and continue to remain an important factor (1). In 2007, 749.456 traffic accidents took place in Turkey. While the number of deaths in those accidents was 3459, 149.140 casualties have been reported (2). The most preferred vehicles in road transportation are the automobile, motorcycle, electric bike, and bicycle; which are also the most com-

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mon vehicles reported to be involved in the accidents (3). The number of bicycle related accidents in 2007 was 3.195, which constituted 0.43% of all accidents (2).

The bicycle is the most commonly used non-motor vehicle involved in accidents, while it is preferred for its environment-friendly, practical, and cheap features (4). Bicycle use is particularly popular among small children and teenagers. While small children ride bicycles to play games, it is preferred for recreation and transportation purposes in the older ages (5). Bicycle accidents are frequently encountered especially during summertime and among teenagers. Serious injuries have been reported to be associated with those accidents (5, 6).

Our university hospital is located in Kayseri, a large city in the Central Anatolian region. It serves patients from Kayseri and six neighbouring cities, with a total population of approximately 7 million people.

Since children and adults use bicycles for different purposes, the severity of the resulting injuries also change. In the current study, we aimed to investigate the characteristics of bicycle-related adult and pediatric injuries presenting to our Emergency Department, reveal any differences between these two groups, evaluate the efficiency of safety and preventive measures against accidents, and present solutions for the reduction of injuries.

Materials and Methods

The current retrospective study was conducted based on the reviewal of Emergency Department records belonging to the cases involving a bicycle-related injury who had been admitted to the Emergency Department of University Hospital between January 2005-December 2008. As the patients ≥16 age were included in the adult group, cases between 0-15 age were enrolled in the pediatric group. The following characteristics of the patients were analyzed; age, gender, month of the accident, accident site, mechanism of injury, injury site, diagnoses and treatments, discharge and hospitalization rates. Injury Severity Score (ISS) was calculated for determination of the severity of injuries among adults, whereas pediatric trauma score (PTS) was used for the same purpose in pediatric patients. Glasgow Coma Scale Score (GCS) was applied for assessment of the consciousness status of patients with head trauma. The collected data were evaluated by SPSS 11.0 (Statistical Package for Social Sciences for Windows, Chicago, Illinois) package program. Student t-test was used for comparison of the two groups. A p value of <0.05 was recognized as statistically significant.

Results

Demographic Characteristics

The number of bicycle-related injuries which presented to the Emergency Department during the aforementioned 4-year period was found to be 150. As 79% (n=119) of the cases were children, 21% (n=31) were adults. 81.5% (n=97) of patients in the pediatric group were male and 18.5% (n=22) were female. Mean age was 9.2±3.3 years. 97% (n=30) of the adult group was male and 3% (n=1) was female. Mean age for the adult group was 28.7±17 years. A significant difference was determined between the groups with regard to gender ($p<0.05$) (Table 1).

13% (n=15) of the cases in the pediatric age group were between 0-5 years, whereas 52% (n=62) were between 6-10 years and 35% (n=42) were between 11-15 years. 68% (n=21) of adults were between 16-29 years, 16% (n=5) were between 30-44 years, 10% (n=3) between 45-59 years, and 6% (n=2) ≥60 years. Transport means of the cases to the emergency department were shown on Table 1. In both groups, the required time for arrival to the Emergency Department was between 1-3 hours (Table 1).

Only one injury was determined during the December-January-February period. That single case was due to an accident within the confines of the house. The rate of accidents was found to show an increase particularly during the June-July-August period. The distribution of cases over the months is shown in the graph below (Figure 1).

The median of injury severity scores among adult cases was 4 (range: 1-25). The number of patients with an injury severity score (ISS) ≥15 was 4 (13%), the number of cases with an ISS <15, was 27 (87%) (Table 1). In children, we employed the pediatric trauma score (PTS). The median PTS of the cases was determined as 11 (range: 4-12). The number of patients with a PTS ≤8 was 4 (4%), whereas it was 114 (96%) for patients with a PTS >8 (Table 1). Both groups were compared with each other with regard to injury severity, and no significant difference was found ($p>0.05$).

The accident sites and mechanisms of injuries

In children, 71.4% of accidents took place on the street. However, in adults, almost all of the accidents were observed to take place on the streets. The difference between the two groups in terms of accident sites, was statistically significant ($p<0.05$) (Table 2).

There was no difference between the two groups regarding the injury mechanisms. A bicycle fall was the most common injury mechanism both in children (91%) and adults (90%) (Table 3).

Injury sites

The head-neck region was the most frequent injury site in children with a rate of 32% (n=57) and in adults with a rate of 40% (n=20). Facial injuries took second place in both of the groups (Table 4).

Diagnoses and treatments

The most frequent injury among children was head trauma (30%, n=36) followed by lacerations (26%, n=31). Among adults, laceration was the most common injury (32%, n=10) followed by soft tissue injuries (29%, n=9). Head trauma was the third most common injury. The comparison of the 2 groups in terms of diagnosis revealed a significant difference ($p<0.05$) (Table 5).

The head traumas among children were classified based on GCS, and the following results were obtained: 91% (n=33) minor head trauma, 6% (n=2) moderate head trauma, and 3% (n=1) severe head trauma. In the adult group, head trauma was determined in 7 cases. While 5 (71%) of those cases were minor head traumas, 2 (29%) were severe head traumas.

The comparison of cases with regard to the applied treatments showed no significant difference. The treatments that our cases were administered are shown in Table 5.

Admitting departments and outcomes

78% (n=93) of children and 87% (87%) of adults were not hospitalized at all. The department admitting the most cases among children was the Pediatric Surgery Department (6%), followed by the Neurosurgery Department (4%). Adult patients were most commonly hospitalized in the Neurosurgery Department (7%).

Table 1. Demographic features of the cases

	Children n (%)	Adults n (%)	t	p
Gender			3.17	p<0.05
Male	97 (81.5)	30 (96.8)		
Female	22 (18.5)	1 (3.2)		
Mean age	9.2±3.3 (min: 2-max: 15)	28.7±17 (min: 16-max: 79)		
Transport via			0.10	p>0.05
Ambulance	44 (37)	14 (45)		
Private vehicle	56 (47)	10 (32)		
Not known	19 (16)	7 (23)		
Referred from another health center			-0.16	p>0.05
Yes	90 (76)	23 (74)		
No	29 (24)	8 (26)		
Social Security			0.40	p>0.05
Available	96 (81)	24 (77)		
Nonavailable	23 (19)	7 (23)		
Required time for arrival at the Emergency Department			-1.13	p>0.05
0-1 hour	31 (26)	3 (10)		
1-3 hours	60 (50)	19 (61)		
3-6 hours	21 (17)	8 (26)		
6-12 hours	3 (3)	-		
12-24 hours	3 (3)	-		
24 hours or above	1 (1)	1 (3)		
Severity of injury			-1.36	p>0.05
Minor injury	114 (%96)	27 (%87)		
Major injury	5 (%4)	4 (%13)		
p<0.05 was recognized as statistically significant				

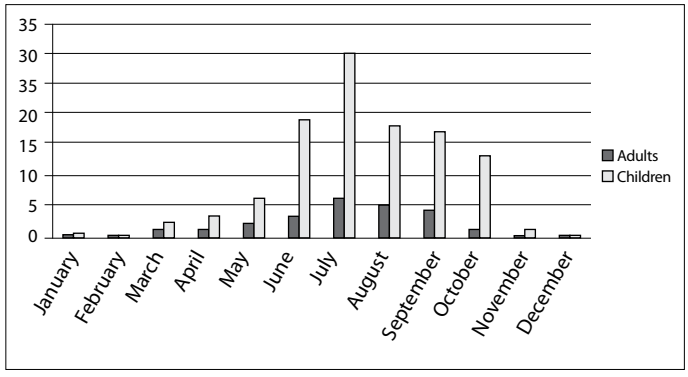

Figure 1. The distribution of cases over the months

78% (n=93) of children and 84% (n=26) of adults were monitored in the Emergency Department and discharged following the treatment and follow up in the emergency department. No fatality was reported among the children. However, in adults, 2 (6%) cases died, one in the Emergency Department and the other in the ICU of Neurosurgery Department. The cause of those 2 deaths was severe head trauma.

Discussion

Bicycle is the most common non-motor vehicle involved in traffic accidents. It is a vehicle capable of reaching high speed while having no protection in traffic, which leads to high rates of accidents and injuries (7). While children use bicycles during playing, adults prefer it for transportational and recreational purposes (5). In Turkey, although bicycle use for transportation is common in provinces such as Konya, Iskenderun, Adana, and Izmit, it has a low rate of use in general (8). Bicycle use among children is greater than in adults and they prefer bicycles to have fun and play games. Therefore, bicycle-related accidents are seen more commonly in children below 16 age compared with adults (5, 6). In the present study, 79% of the injuries occurred in children.

Bicycle-related injuries have been reported to take place 2-4 fold more frequently in males compared with females (5, 6, 9). Also in our study, 81% of children and 97% of adults were male. The low number of females, particularly in the adult group, was remarkable.

In the present study, 52% of injuries in the pediatric group occurred among children aged 6-10 years. In studies on children, bicycle accidents have been shown to occur mostly during school

Table 2. Accident site

	Children n (%)	Adults n (%)	t	p
Accident site			-6.45	p<0.05
Streets	85 (71)	31 (100)		
Home	20 (17)	-		
Outdoor Playground	14 (12)	-		
p<0.05 was recognized as statistically significant				

Table 3. Injury mechanism

	Children n (%)	Adults n (%)	t	p
Injury Mechanism			1.54	p>0.05
Bicycle falls	109 (91)	28 (90)		
Bicycle-automobile collision	2 (2)	1 (3)		
Bicycle-pedestrian collision	5 (4)			
Bicycle-object collision	3 (3)	2 (7)		
p<0.05 was recognized as statistically significant				

Table 4. Injury site

	Children n (%)	Adults n (%)	t	p
Injury site			1.76	>0.05
Head-neck	57 (32)	20 (40)		
Face	45 (25)	15 (30)		
Thorax	4 (2)	1 (2)		
Abdomen	20 (11)	5 (10)		
Spine	1 (1)	0 (0)		
Pelvis	8 (5)	2 (4)		
Upper extremity	26 (15)	4 (8)		
Lower extremity	16 (9)	3 (6)		

age and in males. Serious injuries and fatalities have been found to have a higher incidence in children aged 5-15 years (6, 7, 10). Cases of lower age groups are known to display lower injury rates due to the use of kids tricycles (6). In the adult group, 68% of injuries were determined to take place in the 16-29 age group.

A bicycle fall was the most common injury cause for both the groups. Eid et al. (11) conducted a study and also found bicycle falls as the most common injury mechanism.. Abuzidan et al. (12) performed a study on the same subject and found the following rates for injury mechanisms; bicycle falls 55% and car crash 32%. Brown et al. (13) found bicycle falls as the most common (59%) injury mechanism below 16 years of age.

In our study, 71% of accidents involving children were determined to take place on the streets. Other studies in the literature report that 80% of bicycle-related injuries involving people between 5-14 ages occur on the streets (14). In adults, all the accidents were determined to take place on the streets. In another study performed on all the age groups, 85% of all accidents were found to occur on the streets (12). The accidents taking place on the streets particularly, lead to more serious injuries and consequences. The traffic flow with motor vehicles increases the risk of injury for bicycle accidents. Because children do not know how to behave properly regarding motor vehicles moving in traffic, they constitute a higher risk group. In contrst to adults, children were also observed to experience accidents in places such as the playground, home, yard, and roof. In those instances, factors such as lack of experience, carelessness, and failure to balance themselves due to incomplete psychomotor abilities, have a greater influence. Therefore, in order to minimalize the accident risk in children, the legal age for being allowed to ride a bicycle should be increased (5).

The study conducted by Rozenkraz et al. (15) in adults demonstrated that 69% of accidents took place between the months of June and September. Brown et al. (13) showed that bicycle accidents frequently occurred between April and September. In the current study, we also determined Summertime as the period demonstrating the highest number of accidents in all age groups. During the Winter season, fewer accidents occur compared with the other seasons. In the present study, only a single case was found to occur as a result of riding a bicycle at home. Adults also showed a smaller rate of bicycle accidents in Winter. This finding was associated with the

Table 5. Diagnosis and Treatment of cases

	Children n (%)	Adults n (%)	t	p
Diagnosis			2.71	p<0.05
STI	17 (14)	9 (29)		
Lacerations	31 (26)	10 (32)		
Head trauma	36 (30)	7 (23)		
Maxillofacial fracture	4 (3)	3 (10)		
Upper extremity fracture	17 (14)	1 (3)		
Lower extremity fracture	4 (3)	1 (3)		
Intraabdominal organ injury	7 (6)	-		
MOI	1 (1)	-		
Vascular injury	2 (2)	-		
Treatment			1.50	p>0.05
Medical	37 (31)	9 (29)		
Primary suture	34 (29)	11 (36)		
Wound dressing	3 (3)	5 (16)		
Surgery	18 (15)	2 (7)		
Splint	2 (2)	-		
Casting	10 (8)	1 (3)		
Cervical collar	1 (1)	3 (10)		
Conservative	7 (6)	-		
Bandage	6 (5)	-		
Extremity revision	1 (1)	-		

STI: Soft tissue injury, MOI: Multiple organ injury, p<0.05 was recognized as statistically significant

reduced rate of cycling during the Winter season due to weather conditions.

Earlier studies demonstrated the head-neck as the most common injury site (5-7, 9, 10, 16, 17). Facial injuries are reported to be the second most common injury site (23-25%) (6). Facial injuries occur more frequently in the preschool period (6).

In the current study, in accordance with the literature, we also found the head-neck as the most common injury site in both of the groups followed by the face. We determined a head-neck injury in 32% of children and 40% of adults. Another previous study revealed the following facial injury rates: 46% in the 0-5 age group, 25% in the 5-9 age group, and 8% in the 11-16 age group (6). Other studies reported a facial injury rate of 23-25% among children below 15years of age (18). In the current study, facial injury rate in children and adults were 25% and 30%, respectively. We believe that the reason behind th eoccurrence of facial injuries particularly among young children, is the failure to protect their face due to incomplete psychomotor development.

The head trauma rate in the study by Guzel et al. (3) performed on children, was 42%. In another study, head trauma rate was reported to be 47% (19). Rozenkraz et al. (15) reported a head trauma rate of 28% in their study. Approximately 2/3 of fatalities associated with bicycle accidents occur due to head trauma (11, 14, 20, 21). We found head trauma in 30% of our cases. In the current study, parallel with the results of the literature, the rate of head trauma was found to be 23%. The two deceased cases were adults as well and had severe head trauma.

Riding a mountain bike is a popular activity among adults and associated injuries particularly cause facial bone fractures (4). In the current study, the maxillofacial bone fracture incidence in children was found to be 3%, whereas it was 10% in adults. The comparison of children and adults revealed adult cases as having a more severe nature.

Helmet use has been reported to reduce head injury risk by 85% and facial injury risk by 73% (6). A study conducted by Thompson et al. (22) reported that 13 of 14 deaths associated with bicycle accidents had no helmet, while the cause of mortality was head trauma in 11 cases. None of the cases in our study had a history of helmet use. The common belief which regards the bicycle as a slower and a safer way of transportation, plays a role in that consequence. In our country, education towards raising awareness of the importance of helmet use while riding bicycles, is necessary.

Countries such as Australia, Canada, and New Zealand have issued laws that require helmet use for children while riding bicycles and those jurisdictions have reduced the mortality and injury rates associated with bicycles (11). By helmet use, serious head injuries have been reported to be reduced by 60% (23). Although the helmet is a protective gear, the rate of helmet use varies between 0.5-80% depending on the laws (12). Brown et al. (13) reported the rate of helmet use in their study as 8%. There is strong evidence which suggests that helmet use reduces certain head traumas (12, 24, 25).

There are also studies that recommend its modification in order to provide a more effective protection against facial injuries. Thompson et al. (22) reported helmets as protective against upper and mid facial injuries, but showed its ineffectiveness against lower facial injuries. Similarly, Acton et al. (26) showed that helmets did not prevent maxillofacial injuries among children, and suggested t that the design of the helmets be modified.

Abdominal and urogenital injuries associated with bicycle accidents have been reported to occur less frequently in the literature (14). In the present study, we determined intraabdominal organ injury in 6% of children. Urogenital injuries were found to be present, particularly in female children. Guzel et al. (3) found abdominal injuries in 3% and urogenital injuries in 2% of their cases. In adults, no intraabdominal injury was detected.

We have less knowledge about accidents and injuries associated with the use of tricycles. In tricycle accidents, the head trauma rate is reported to be 2/3 (14). The role of helmet use in prevention of head injury in these accidents is not clear.

Despite the high incidence of accidents among children, the severity of the accidents was found to be low. While the rate of serious injuries in children was 4%, it was 13% in adults. The difference was not found to be significant. Brown et al. (13) reported the rate of serious injuries as 6%. In adults, the occurrence of accidents on the streets where other motor vehicles are present, and the high speeds, increase the severity of the injuries.

Generally, injuries associated with bicycles have a mild nature. In some, serious bone fractures or soft tissue lesions may be seen. Puranik et al. (19) conducted a study and reported that 94% of cases visiting the Emergency Department due to bicycle-related injuries, were discharged again from the Emergency Department. They found the fatality rate as 3%. In another study, the fatality rate among children was found to be 0.7% (13). In the present study, there was no fatality in the pedatric group, whereas the fatality rate in the adult group was 6%. Eid et al. (11) reported a fatality rate of 1.5% for the entire age groups. Presence or absence of head trauma determines the prognosis of bicycle accidents.

Limitations: The low patient number was the first limitation of our study. The second limitation was that our hospital is a third level hospital, therefore more severe patients were admitted or referred from other hospital.

Conclusion

The majority of injuries associated with bicycles take place among children on the streets during the Summertime when schools are closed. Generally, bicycle accidents occur as a result of carelessness, lack of experience, failure to achieve balance, and lack of knowledge on how to behave in places where traffic is intense. The most common accident mechanism is bicycle falls due to losing one's balance. Injuries appear to be more severe among adults. In order to reduce the injuries associated with bicycle accidents, the following precautionary steps should be considered; building bicycle paths, issuing laws for the requirement of helmet use, providing education on cycling, increasing the starting age of bicycle riding in children, and increasing the required age allowed for riding a bike in traffic.

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

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