

# Evaluation and cost analysis of the patients, who applied to the emergency service with an open injury of hand and / or wrist

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## Abstract

**Aim:** This study was planned to determine the demographic, etiological and clinical characteristics and the treatment costs of the patients with open isolated hand and/or wrist injuries.

**Material and Methods:** In this study, the data of 127 patients who were admitted to the adult emergency department due to hand and / or wrist trauma between 01.01.2018 and 06.30.2018 were examined. Data on demographic data, shape and clinic of injury were summarized as number and percentage. Shapiro Wilk test was used to determine whether the numerical measurements were compatible with the normal distribution and Kruskal Wallis test was used for comparison of cost between groups.

**Results:** Of the patients, 81.1% were male and the most common injury was seen in the age group of 19-64 and workers. Fingers were the most frequently injured areas and the most common injured finger was the index finger. The first two reasons in the aetiology were home and occupational accidents. Penetrating/cutting was the most common injury mechanism. There was no significant difference between occupation groups in terms of cost ( $p>0.05$ ) but there was a significant difference between diverse treatment methods ( $p<0.0001$ ).

**Conclusion:** Hand and / or wrist open injuries not only represent a significant part of all injuries but also represent a significant economic burden with high health costs. Measures to prevent such injuries could contribute to lowering health expenditures.

**Keywords:** Emergency department; hand; wrist; cost; trauma.

## INTRODUCTION

Hand is the most important organ used in daily basis activities and is the most active part of the upper extremity and the most frequently injured part due to its anatomical structure. The incidence of hand and wrist injuries increased with the industrialization. These injuries account for approximately 10-20% of all emergency service applications and 6.6-28.6% of all injuries (1,2). Injuries are mostly seen in young working men and in the dominant hand (3). Hand injuries occur in a wide range from simple soft tissue trauma to amputation; it causes functional losses, loss of labor force, development of disability in life activities and increase in health expenditures (4). Hand and wrist injuries are injuries of the high morbidity,

although their mortality is low. The economic burden is quite high in such injuries due to the fact that a significant proportion of the patients are male population who are active in the production, the disabling effect of the results of the injuries, and the recovery and rehabilitation periods take a long time (5). It is very important to collect data on the interventions performed for this type of injury, which cause labor loss and the economic burden in the society, and to determine the factors affecting the etiological causes and costs (6).

According to the Turkish Statistical Institute (TSI)'s 2015 report, about 39% of all occupational accidents concern the upper extremities, and approximately 70% is composed of hand and wrist injury (7). Hand and wrist injuries can

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cause high health costs, but also cause long-term loss of labor due to their physical and mental effects (3). As a result, hand and wrist injuries bear a significant economic burden on the society, accordingly economic analyses made due to increasing health costs are getting more and more attention.

In the light of the literature, this study was planned to investigate the demographic and etiological characteristics of the patients with open isolated hand and / or wrist injuries, the treatment costs for the Social Security Institution (SSI) and the factors affecting the cost.

## MATERIAL and METHODS

### Research type and participants

In this descriptive study, patients who were admitted to the adult emergency department due to hand and / or wrist trauma between 01.01.2018 and 06.30.2018 were examined retrospectively from the hospital records. Age, sex, referral hours, occupation, dominant hand used, cause and mechanism of injury, injured side and region, injured structure, injured finger, applied treatment methods, tetanus immunization, prognosis and treatment costs were recorded in the forms prepared for the study.

### Inclusion and exclusion criteria

The data of patients who exclusively had open hand and / or wrist trauma of all ages were included in the study.

Patients with isolated hand and / or wrist trauma with intact closed skin injury and patients with other systemic or extremity injuries were excluded from the study.

### Statistical analysis

Data on demographic data, shape and clinic of injury were summarized as number and percentage. Shapiro Wilk test was used to determine whether the numerical measurements were compatible with the normal distribution. As a result of this evaluation, numerical measurements were presented as mean, standard deviation, median and minimum-maximum and Kruskal Wallis test was used for comparison of cost between groups. United States Dollar (USD) / Turkish Liras (₺) was accepted as 4.08 based on the average exchange rate during the study period. The SPSS 16.0 package program was used for the analysis.  $p < 0.05$  was considered statistically significant.

### Ethics committee

The study was approved by the local ethics committee (Date: 25.07.2018- Decision No: 18).

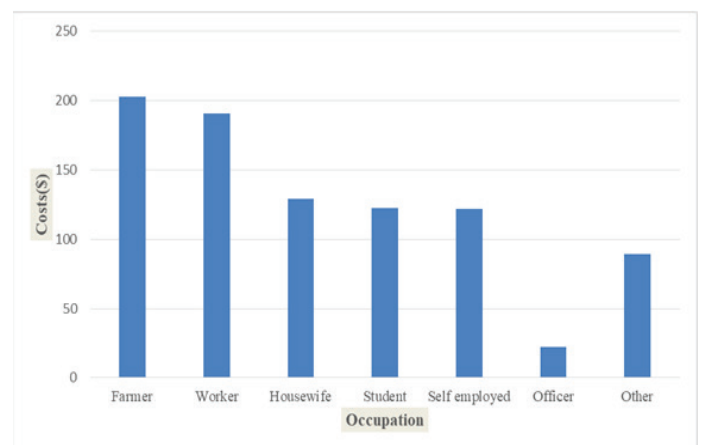
## RESULTS

Of the 127 patients included in the study, 81.1% were male and 18.9% were female. The mean age was  $38.7 \pm 17.2$  years SD (min = 2, max = 78) and the most common injury was in the age group of 19-64 (77.2%). According to the occupational group, the most common injury was seen in workers (44.1%). Demographic data of patients are summarized in Table 1.

**Table 1. Demographic characteristics of patients**

Demographic characteristics	Number	Percentage
<b>Age (years)</b>		
0-18	14	11.0
19-64	98	77.2
65 and above	15	11.8
<b>Sex</b>		
Male	103	81.1
Female	24	18.9
<b>Occupation</b>		
Worker	56	44.1
Housewife	18	14.2
Student	16	12.6
Farmers	11	8.7
Self employed	11	8.7
Officer	10	7.9
Other	5	3.8
<b>Dominant hand</b>		
Right	104	81.9
Left	23	18.1

Fingers (72.4%) were the most frequently injured areas and the most common injured finger was the index finger (15.7%). 7.9% of the patients had wrist injuries. The first two reasons in the etiology were home (43.3%) and occupational accidents (40.2%), and the least common cause was gunshot injury (0.8%). It was observed that penetrating/cutting injury (53.5%) was the most common injury mechanism, followed by crush and compression injury (27.6%) (Table 2).



**Figure 1.** Distribution of cost according to occupational groups

The most frequently injured structures were soft tissues (48.8%), multiple affected complex structures (15.8%) and amputations (14.2%), respectively. Primary sutures (38.6%) and multiple treatments (22.8%) were the most commonly used methods while graft / flap (5.5%) and fracture repair (3.9%) were the least applied methods. The clinical data of the patients are summarized in Table 3.

When the patients were examined in terms of cost, the

Table 2. Features related to injury		
Features	Number	Percentage
<b>Injured side</b>		
Right	57	44.9
Left	67	52.8
Bilateral	3	2.3
<b>Injured region</b>		
Finger	92	72.4
Hand volar side	15	11.8
Hand wrist	10	7.9
Hand dorsal side	9	7.1
Multiple	1	0.8
<b>Injured finger</b>		
1 <sup>st</sup> finger	17	13.4
2 <sup>nd</sup> finger	20	15.7
3 <sup>rd</sup> finger	12	9.4
4 <sup>th</sup> finger	9	7.1
5 <sup>th</sup> finger	16	12.6
Multiple fingers	19	15.0
Non finger	34	26.8
<b>Reason of injury</b>		
Home accidents	55	43.3
Occupational accidents	51	40.2
Self-mutilation	9	7.1
Traffic accidents	3	2.4
Assault	2	1.6
Crash of foreign bodies	2	1.6
Gunshot	1	0.8
Other	5	3.0
<b>Mechanism of injury</b>		
Penetrating / cutting injury	68	53.5
Crush / compression	35	27.6
Glass cut	17	13.4
Other	7	5.5

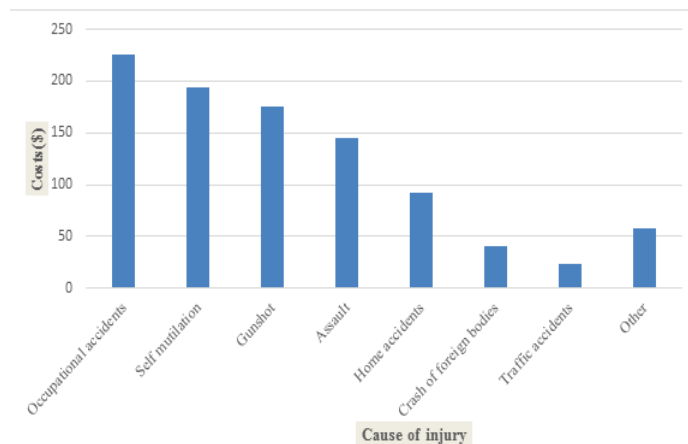


Figure 2. Cost distribution according to cause of injury

cost was 192,25.60 USD (\$) and the average cost was 151.38 \$. According to the cause of injury, the highest cost was related to occupational-accident related injuries and self-injuries, while according to the occupational groups, the highest cost was for workers and farmers; however, there was no statistically significant difference between the groups ( $p>0.05$ ). The cost distribution of the patients according to occupational groups and causes of injury is summarized in Figures 1 and 2.

Table 3. Clinical features of patients		
Clinical features	Number	Percentage
<b>Time of admission</b>		
00:00-07:59	6	4.7
08:00-11:59	34	26.8
12:00-15:59	43	33.9
16:00-23:59	44	34.6
<b>Tetanus immunization</b>		
Yes	67	52.8
No	60	47.2
<b>Treatment methods</b>		
Primary suture	49	38.6
Tendon repair	13	10.2
Dressing	13	10.2
Stump repair	11	8.7
Graft / flap	7	5.5
Fracture repair	5	3.9
Multiple treatments	29	22.8
<b>Prognosis</b>		
Hospitalization	64	50.4
Discharge	60	47.2
Transfer	3	2.4
<b>The clinic in which the patient was managed</b>		
Emergency department	63	49.6
Orthopedic clinic	58	45.7
Plastic and reconstructive surgery	6	4.7

Table 4. Cost analysis according to treatment methods (\$)		
Treatment methods	Mean ± SD	Median (Min - Max)
Multiple treatments	401.6 ± 334.0	233.3 (6.7 – 1224.5)
Tendon repair	183.4 ± 195.4	140.3 (25.0 – 802.6)
Fracture repair	182.4 ± 51.4	176.1 (140.3 – 266.0)
Graft /flap	159.0 ± 53.1	135.5 (106.7 – 235.4)
Stump repair	94.5 ± 48.2	92.9 (19.5 – 189.2)
Primary suture	41.3 ± 75.4	24.2 (4.8 – 523.5)
Dressing	7.6 ± 4.1	6.7 (4.5 – 19.9)

<sup>a</sup>Kruskal Wallis

When the cost analysis is examined according to the treatment methods; it was determined that the highest

cost was in multiple treatments of multiple structures (the mean 401.6 \$; median 233.3 \$), and the least cost was in dressing treatments (mean 7.6 \$; median 6.7 \$). There was a significant difference between the treatment methods and cost ( $p < 0.0001$ ) (Table 4).

## DISCUSSION

We investigated the demographic and etiological characteristics of the patients with open isolated hand and / or wrist injuries, the treatment costs for the Social Security Institution (SSI) and the factors affecting the cost in this study.

According to women's participation in social and work life, injuries show regional differences in terms of gender. In our country, it is reported that 61.8-87.3% of the hand and wrist injury patients are male, 12.7-38.2% are female and the most frequent injury is seen in 20-30 age group (2,5,6,8). In a study conducted in the Netherlands, 57% of the patients were male and 43% were female (9). Similar to the literature, most of the cases were males and the majority of injuries were in the 19-64 age group. In our region, women are not taking much part in working life and avoiding physical force, and also injuries are seen especially in occupational environment and active working individuals; we believe that these have effect in this result.

The most common etiological factors in the studies about hand and wrist injuries were work accidents (32.8-72.1%) and home accidents (19-25%) (2,5,6). Şakrak et al. (6) reported that 32.6% of injuries were caused by penetrating-cutting tools, while Oğuz et al. (5) reported that 25% of injuries were a result of penetrating injury mechanism. In these studies, open hand and / or wrist injuries were not separated from closed hand and / or wrist injuries. In this study, open isolated hand and / or wrist injuries were examined, and the most common etiological cause was found to be home accidents, with occupational injuries in the second place. In terms of injury mechanism, it is seen that more than half of the cases were injured by penetrating-cutting tools and less frequently they were subjected to crush-compression injuries. As glass cuts constitute an important place in open injuries, this injury mechanism was not evaluated in cutting / penetrating injuries and was investigated separately.

In the literature studies, it is observed that there are differences between the affected structures in hand and wrist injuries. While Ferree et al. (10) reported that metacarpal bones (48%) and phalanxes (24%) were the most commonly affected structure, Oğuz et al. (5) reported that the most affected structures were soft tissue components (65.9%), but did not make a regional distinction. In this study, it was found that the most affected area was the fingers and the index finger was the most affected finger. As the basic function of the hand is grasping and it is carried out by fingers, it is explained why fingers are most frequently affected in injuries. It was thought that the reason why the index finger to be affected

frequently was that it was the most important actor of the hand in lateral grasping.

In a study, it was reported that the most frequent injuries were observed between 08:00 and 16:00 and the least frequent injuries were between 00:00-08:00 (5). We have found similar results in terms of injury times to support this study. We believe that people are most likely to be injured during the most active hours of life, and they are exposed to the least injuries during their passive resting hours in line with the natural flow of life.

Putter et al. studied hand and wrist injuries that were admitted to the emergency department, and they reported that the annual treatment costs of patients were \$ 740 million (\$) and this cost was higher than other region injuries (11). In the same study, it was stated that the cost of hand and finger fractures and the ages between 20-64 years of age were the highest. When the health data in the Netherlands were examined, the costs per capita in wrist and hand wrist injuries were \$ 90 in men and \$ 108 in women (12). In the same study, it was stated that 44% of the costs associated with hand and wrist injuries were the cost of treatment and the remaining 56% were productivity costs. Oğuz et al. (5) reported that the average cost per patient was 45545.5 ₺; and that the cost was higher in male gender, occupational injuries, penetrating injuries, surgical treatments and 60-69 age group. In that study, the most commonly applied treatments were; non-steroidal anti-inflammatory drugs (35.8%), plaster cast / splint immobilization (17.1%), suturing (16.7%), elastic bandage (15.7%), surgical treatment (14.6%), respectively; and the highest cost of treatment belonged to patients who underwent surgical treatment. In this study, the most common treatments were observed as; primary suturing, multiple repairs in affected multiple structures, tendon repair and dressing. While the average cost per capita was found to be much higher in this study (151.38 \$ or 617.64 in ₺), the highest cost was observed in the group of patients who underwent multiple repairs. In addition, the highest cost according to the occupational group was observed in farmers and workers. In open hand and / or wrist injuries, the cost of treatment of the most complex injury was found to be 52 times more than the cost of the simplest injury. It is seen that open injuries of the hand and / or wrist are more costly, more complicated and more are in need of surgical interventions, unlike closed hand and / or wrist injuries. We think that the possibility of injury of more prominent tissues in open injuries and the use of more expensive medical materials and procedures in the repair of these tissues cause this condition.

In cases where skin integrity is impaired, tetanus prophylaxis is questioned and vaccinations are performed. In this study, more than half of the patients already had tetanus prophylaxis. This situation may be the result of previous exposure to similar open injuries and the vaccination of the same patients at that time, or the result of the large number of young males in this study who had their routine vaccination in the military service.

When the related literature is examined, the lack of another study examining isolated open hand and / or wrist injuries in which skin integrity is impaired, gives our study the first feature in this field. Furthermore, the fact that the cost of the study was addressed was strength of our study. However, there were some limitations of our study. One of them was the relatively small number of samples. Another limitation was that only the direct hospital costs of injuries could be assessed, because our study was based on patient records.

## RECOMMENDATIONS

Isolated open hand and / or wrist injuries are caused mainly by occupational and home accidents, both of which are preventable by the application of certain public health measures. For the prevention of occupational accidents, elimination of risks from the hazardous sources, engineering controls, administrative controls and usage of personal protective clothes and equipment is suggested, and as for the home accidents, education of public in order to raise awareness is necessary. We suggest that further intervention studies should focus on these issues.

## LIMITATIONS OF THE STUDY

This study outlines a major trauma type which is associated with a serious morbidity as well as an economic burden. However, many limitations of the study can be addressed. As this study was planned in a descriptive design, it is poor in terms of analytical respects. In addition the study period was short which obstructs temporal assessments. Also, the sample size was small; this is because of two reasons: first is that; during the study time admission numbers of trauma cases were in low numbers and the second reason is that a specific subgroup of trauma patients were exclusively selected for the study

## CONCLUSION

In conclusion, isolated open hand and / or wrist injuries are most common in the 19-64 age groups, in men and workers. While fingers are the most frequently injured area, especially the index finger is the most frequently injured finger. Hand and / or wrist open injuries are not only a significant part of all injuries, but also represent a significant economic burden with high health costs. We believe that the emergence of such injuries may decrease as a result of training activities aimed at increasing personal and institutional security awareness, ensuring occupational safety in all areas, security elements in the design of social life areas and public information. In addition, we believe that taking these preventive measures may lead to a decrease in health expenditures, labor force loss and disability, which would also be a significant contribution to the country's economy.

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