

Occupational Hand Injuries Treated at a Tertiary Care Facility in Western Turkey

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Abstract: The study was designed to investigate characteristics of work-related hand injuries (WRHI) referred to a University hospital emergency department (ED) in an industrialized region as well as to supply data for preventive strategies. All patients with WRHI referred to the University-based ED in the two-year period were investigated. Sociodemographic and injury-related clinical information were analyzed. Out of 746 patients who were admitted to the ED due to occupational injuries within the two-year study period, 244 (32.7%) with isolated wrist, hand and finger injuries were included in the study. Male patients constituted the majority 87.2% (n=213) and 57.0% (n=139) of the patients were between 25 and 34 yr of age. WRHI recorded in industries involving metal and machinery constituted 41.4% (n=101) of all injuries. The sites of injuries were not significantly affected by differences in age, social security status and sectors. The most common types of injury were lacerations, punctures, and abrasions (40.2%, n=98). There was a statistically insignificant rise in amputation injuries with increasing age. Incidences, etiologies and characteristics of WRHI should be highlighted and preventive strategies based on these facts be implemented due to higher level of suffering and more serious consequences attributed to this specific injury.

Key words: Occupational injuries, Hand injuries, Hand, Fingers, Wrist, Emergency department

Introduction

Hands and digits of the human being occupy a major role in our professional life. Thus, not surprisingly, hand injuries are the most frequent bodily traumas sustained at work¹. Hand injuries due to occupational accidents or work-related hand injuries (WRHI) lead to more serious consequences than any other organs in terms of both clinical courses and economic losses². These injuries are as preventable as the other bodily traumas³.

At least a million people are admitted to the emergency departments (ED) due to acute WRHI in USA each year⁴. The incidence is particularly high in industries and jobs in which hand intensive work is necessary³. Lacerations of fingers or hands are reported as the most common occupational injury treated in EDs (15% of all injuries)⁵.

Data related to acute WRHI in developing countries are scarce. Cross-sectional descriptive studies provide important clues to establish preventive policies. The present study aims to investigate characteristics of WRHI referred to a University hospital ED in an industrialized region as well as to supply data for preventive strategies.

Employment statistics for March 2007 put forth that the sectors with the most intensive employment figures in Turkey are services, agriculture, industry and construction.

A total of 53,194 died of occupational injuries and diseases between 1946 and 2005, while 143,012 were permanently disabled in Turkey. Of note, these numbers represent only the officially recorded deaths and events¹.

Social Security Institution (SSK) is the biggest or main state-run institution established to manage the social security issues of the Turkish workers. Unregistered workers constitute up to 46.2% of all working population accord-

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ing to Turkish statistics conducted in March 2007.

SSK databases cite that 73,923 occupational injuries occurred in 2005. Metal and machinery sector championed among others with 10,283 events (13.9%) followed by construction sector with 6,483 (8.7%) and coal mining with 6,011 (8%). Male-to-female ratio in occupational injuries in Turkey is 21.1 with the highest rate of women injured in the textile industry. SSK registries also show that the weighted average age of victims involved in occupational injuries is 29 for women and 31 for men⁶.

An average of 70 to 80 thousands of workers visit health facilities due to occupational accidents annually in Turkey. Seventeen to 18 thousands of these consist of injuries involving hands which rank first in the array of organs and systems injured annually. The second most commonly injured region is digits with 13 to 15 thousands a year. Wrist injuries are encountered much less commonly (1,300 to 1,500 a yr)¹.

Denizli is one of the outstanding industrialized middle-sized city of western Turkey of which the multi-faceted textile industry is the leader in international commerce. There are about 30,000 textile workshops which weave a total of 1,000 tons of rope a day. 14,600 employees work in textile factories, which are situated in organized industry zones. The total number of employees in the textile industry is 35,000 including those in 550 factories. Besides textile, other branches of industry in Denizli include leather, metal furniture and equipment, agricultural implements and spare parts, kitchen equipment with or without electricity, gadgets, cables, nails, bricks, tile, glass, cement and concrete, and concrete pipes. Because of this giant industry capacity there is a wide range of occupational accidents. More than three percent (2,500 / 73,923) of countrywide occupational accidents consisted of injuries registered in databases in this single city in 2005. Another interesting fact is that male-to-female ratio in occupational accidents is much lower in Denizli when compared to the country based figures due to predominance of textile sector in the city (7.7 vs. 21.1). Mining and metal-machinery are the other common areas of employment in the region¹.

More than 2,500 admissions due to occupational injuries are recorded in the health facilities annually in Denizli. Severe injuries and multiple casualties generally tend to be transported using the state ambulance services (112), while other casualties are handled via the facilities' own resources. Three big hospitals operate in the city, including one University-based research hospital. This hospital receive approximately one third of all occupational injuries recorded to have occurred in the city. The University hospital has 24-h coverage regarding replantation, microsurgery and other advanced interventions for occupational injuries, contrary to the other

two hospitals. Therefore the patients are commonly transferred from other hospitals to the University hospital.

Materials and Methods

The study was conducted in an industrialized middle-sized city, Denizli, in a University-based hospital. All patients with occupational hand and wrist injuries referred to the University-based ED in the two-year period between 01.01.2005 and 31.12.2006 were investigated. Data recorded in the year 2005 were analyzed retrospectively, while injuries in 2006 were searched for prospectively. The data sheets comprised sociodemographic and injury-related clinical information. Institutional Review Board approval was obtained before beginning of the study. Patients with injuries proximal to wrist joint, accidents in the context of multiple trauma (severe injury in more than one body system) and patients younger than 15 yr of age were excluded from the analysis. Classifications regarding types of injury and age groups were based on previous studies on the similar subjects^{4, 7}. Fractures were not classified as open and closed.

Statistical analysis

All data obtained in the study were recorded in and analyzed using the Statistical Package for Social Sciences for Windows, Version 11. Numerical variables were given as mean and standard deviation (SD), while categorical variables were given as frequencies (n) and percentages. Categorical variables regarding NSI and sociodemographic variables were compared to each other using χ^2 test. *p* values below 0.05 were considered statistically significant.

Results

A total of 746 patients were admitted to the ED due to occupational injuries within the two-year study period. Of these, 244 (32.7%) with isolated wrist, hand and finger injuries were included in the study. Male patients constituted the majority 87.2% (n=213) and 57.0% (n=139) of the patients were between 25 and 34 yr of age. Twenty-one percent of the patients were younger than 24 and 22.1% were over 34. Mean age of the patients was 27.8 ± 6.1 (range 16 to 46) (28.2 ± 6.0 for males and 25.2 ± 5.8 for females).

WRHI recorded in industries involving metal and machinery constituted 41.4% (n=101) of all injuries (Table 1). The table also shows distribution of patients' admissions in the ED in terms of the hour and the day. 23.3% (n=57) were recorded in the first workday of the week.

ED treatment was sufficient for 159 (63.9%) patients

Table 1. Sociodemographic data relevant to the study sample

	n	%
Sex		
Male	213	87.3
Female	31	12.7
Social security		
Social Security Institution (SSK)	167	68.4
None	51	20.9
Other (Other state-run inst. or private insurance)	26	10.7
Sector		
Metal-machinery	101	41.4
Textile	41	16.8
Mining-construction	36	14.7
Wood-furniture	25	10.2
Service	21	8.6
Agriculture-cattle raising	7	2.8
Other	13	5.3
Time of admission (h)		
08:00–10:00	39	15.9
10:00–12:00	48	19.6
12:00–14:00	22	9.0
14:00–16:00	27	11.6
16:00–18:00	25	10.2
18:00–20:00	42	17.2
20:00–22:00	19	7.8
22:00–24:00	11	4.5
24:00–08:00	11	4.5
Day of the week		
Monday	57	23.3
Tuesday	41	16.8
Wednesday	37	15.2
Thursday	46	18.9
Friday	27	11.0
Saturday	28	11.4
Sunday	8	3.3
Disposition		
Discharge	156	63.9
Admission	68	27.8
Transfer to another hospital	14	5.7
Discharge against medical advice	6	2.5
Total	244	100.0

and they were discharged for follow-up while 68 (27.8%) were admitted to the hospital (Table 1). Of those, fifty-three patients (77.9%) were admitted to orthopedic ward, while the others were admitted to the plastic surgery ward. Mean length of stay in hospital was 4.2 ± 1.9 d.

Characteristics of injuries

Twenty-eight patients (11.5%) were found to have wrist injuries, while 40 (16.4%) had additional hand injuries

and 161 (66.6%) finger injuries. Injuries involving more than a single site were detected in 15 (6.1%) victims. No patient was identified to harbor injuries of both hands.

Table 2 demonstrates a comparison of injury sites with regard to demographic variables and sector involved. Injuries involving wrist joint was more common in women whereas trauma to fingers were more frequent in men, but the difference was not statistically significant.

The sites of injuries were not significantly affected by

Table 2. Comparison of injury sites with regard to demographic variables and sector involved

Variable	Injury site				<i>p</i> value
	Wrist n=28 n (%)	Hand n=40 n (%)	Finger n=161 n (%)	Multiple n=15 n (%)	
Sex					
Male	23 (10.8)	34 (16.0)	143 (67.1)	13 (6.1)	0.752
Female	5 (16.1)	6 (19.4)	18 (58.1)	2 (6.4)	
Age					
15–24	4 (7.8)	6 (11.8)	38 (74.5)	3 (5.9)	0.382
25–34	14 (10.1)	23 (16.5)	94 (67.6)	8 (5.8)	
34>	10 (18.5)	11 (20.4)	29 (53.7)	4 (7.4)	
Social security					
Social Security Institution (SSK)	15 (9.0)	23 (13.8)	119 (71.2)	10 (6.0)	0.258
None	8 (15.7)	11 (21.6)	28 (54.9)	4 (7.8)	
Other (Other state-run inst. or private insurance)	5 (19.2)	6 (23.1)	14 (53.8)	1 (3.8)	
Sector					
Metal-machinery	8 (7.9)	13 (12.9)	75 (74.2)	5 (5.0)	0.693
Textile	4 (9.8)	8 (19.5)	27 (65.8)	2 (4.9)	
Mining-construction	5 (13.9)	8 (22.2)	20 (55.6)	3 (8.3)	
Wood-furniture	3 (12.0)	4 (16.0)	16 (64.0)	2 (8.0)	
Service	5 (23.8)	2 (9.5)	13 (61.9)	1 (4.8)	

differences in age, social security institution belonged and industrial sectors involved. Incidences of injuries of the hand and the wrist were found to have increased while finger injuries have diminished with increasing age, but the difference was not statistically significant (Table 2).

The most common types of injury were lacerations, punctures, and abrasions (40.2%, n=98) (Table 3). Three most common types of injury were not found to differ significantly with regard to sex, when compared to each other ($p=0.497$). The injury patterns were not related to age differences, either, except a statistically insignificant rise in amputation injuries with increasing age. Lacerations, punctures, and abrasions were the least common in the textile sector while amputation injuries were recorded lesser in textile and services areas ($p=0.001$) (Table 4).

There were 67 fractures and 49 amputations recorded in the study sample. Fractures were most commonly recorded in proximal phalanges (23.9% n=16) followed by metacarpal bones (22.4% n=15) distal phalanx (17.8% n=12), distal tip of radius (13.4% n=9), while third finger were the most common location of amputations (38.8% n=17) followed by fourth finger (32.6% n=16), index finger (14.3% n=7), thumb (8.1% n=4).

Discussion

The most common types of occupational injuries referred to the EDs are trauma to the upper extremities,

especially to the fingers and hand⁵. Hand and finger injuries constitute up to 30% of all occupational injuries and 44% in Turkey^{1, 8}.

Demographics in WRHI

Researchers pointed out that WRHI was reported most commonly in patients between 25 and 34 (30% to 32%), while 12% in those younger than 25 yr of age^{4, 7}. The present findings are similar to literature data in that most cases were in between 25 and 34 yr of age and in metal and machinery sector, followed by construction and services sectors. However, the mean age of our sample was 27.8 ± 6.1 due to traditionally younger inaugural age for working life in Turkey and 22 percent of the patients were younger than 25 yr of age.

A sex difference in injury patterns was reported in the literature. Injury to the hands and fingers were more common in men, while wrist injuries were more common in women⁹. Similarly, injuries of the wrist which was not statistically significant, were found to be more common in women.

Injury Types in WRHI

In the present study, one third of cases referred to the ED due to occupational injuries were consisted of injuries of hand, fingers and wrist. Among these, fingers were found to be injured more commonly than the other regions (66%). In 1998, 3.6 million patients were admitted to the EDs in USA and 30% harbored injuries of hands and dig-

Table 3. Distribution of injury types with respect to sites of injury

Nature of injury	n (%)	Part injured	n (%)
Cut, laceration, puncture, abrasion	98 (40.1)	wrist	6 (2.5)
		hand	18 (7.4)
		fingers	70 (28.7)
		multiple	4 (1.6)
Amputation	44 (18.0)	hand	1 (0.4)
		fingers	43 (17.6)
Contusion, bruise	13 (5.3)	wrist	1 (0.4)
		hand	2 (0.8)
		fingers	10 (4.1)
Crushing injury	4 (1.6)	fingers	3 (1.2)
		multiple	1 (0.4)
Sprain, strain	18 (7.4)	wrist	13 (5.3)
		fingers	5 (2.0)
Dislocation	2 (0.8)	hand	1 (0.4)
		fingers	1 (0.4)
Fracture	61 (25.0)	wrist	8 (3.3)
		hand	18 (7.4)
		fingers	29 (11.9)
		multiple	6 (2.5)
Burn	4 (1.6)	multiple	4 (1.6)
Total	244 (100.0)		244 (100.0)

Table 4. Comparison of injury types regarding sex, age groups and sectors involved

Variable	Injury type				p value
	Laceration Puncture Abrasion n=98 n (%)	Fracture n=61 n (%)	Amputation n=44 n (%)	Other n=41 n (%)	
Sex					
Male	84 (39.4)	54 (25.4)	41 (19.2)	34 (15.9)	0.497
Female	14 (45.1)	7 (22.6)	3 (9.7)	7 (22.6)	
Age					
15–24	19 (37.2)	12 (23.5)	14 (27.5)	6 (11.7)	0.065
25–34	58 (41.7)	38 (27.3)	24 (17.3)	19 (13.7)	
>34	21 (38.8)	11 (20.4)	6 (11.1)	16 (29.6)	
Sector					
Metal-machinery	49 (48.5)	21 (20.8)	25 (24.7)	6 (5.9)	0.001
Textile	9 (21.9)	12 (29.3)	1 (2.5)	19 (46.3)	
Mining-construction	14 (38.9)	11 (30.5)	6 (16.7)	5 (13.9)	
Wood-furniture	11 (44.0)	4 (16.0)	7 (28.0)	3 (12.0)	
Services	8 (38.1)	5 (23.8)	1 (4.8)	7 (33.3)	

its. Among these, penetrating injuries, amputations and avulsions constituted the lion’s share (63%) while contusion, abrasion, and crush injuries composed 17%, dislo-

cations and fractures 7%, sprain and strains 4%¹⁰).

Literature data cite that laceration-type injuries rank first in hands with a ratio of 57% to 62%. It is followed

by crush injuries with 12%, fractures with 4% to 8%, and amputations with 1%^{4, 5, 7}). Relatively higher percentage of fractures and amputations in the present study can be attributed to that the hospital hosting the study is reference (tertiary care) hospital. On the other hand, injuries such that cuts, lacerations, punctures, and abrasions which generally represent a deficiency in protective measures in the workplace were the most common type of injuries similar to the literature data¹¹).

The most common type of work-related amputations was found to be single-digit amputations in the upper extremity (71%) with a high incidence in agriculture and manufacturing¹²). The rate of the amputations of the hand was 1.2% among all WRHI. In the presented study this rate was slightly higher than 2%, which may be attributed to that the institution is a reference hospital in the region.

An interesting result of the study is that amputations tended to decline with increasing age. This finding can be attributed to experience in manufacturing with resultant caution exercised in the high-risk work field. Stanbury *et al.*¹²) reported incidence of work-related amputations as 16% between 18 and 24 yr of age, 28% between 25 and 34, and 25% between 34 and 45. The corresponding figures in the present study were 27%, 17% and 11%, respectively.

Work-related fractures were shown to occur most commonly in phalanges (15%), followed by foot bone (9%) and carpal bone (8%)¹³). In an Australian study on miners phalanges were demonstrated to be the most common site of fractures¹⁴). Fractures were noted in men twice as women¹⁵). The incidences were found higher in men in another study¹⁶). The presented results indicate that the incidence of fractures did not change in respect to sex, age and sector.

Working hours in WRHI

Statistical data cite that 18.5% of all occupational injuries occurred within the first working hour in Turkey in 2005, while 31.8% were noted in the first three hours¹). Lombardi *et al.* reported that the highest frequency of injury was observed from 08:00 AM to 12:00 PM (54.6%), with a peak from 10:00 to 11:00 AM (14.9%). The median time into the work shift for injury was 3.5 h⁷). Justis *et al.* pointed out that 24% of WRHI occurred within the first working hour¹⁷). Similarly, there were two peak periods in admission to the ED. 35.5% of the patients in the present study were admitted to the ED between 08:00 and 12:00 and 17% between 18:00 and 20:00. The latter can be explained by extensive employment in double-shift schedules in especially textile factories. These injuries coincide with the first working hours of the second or 'nightshift'.

Industry types in WRHI

Incidences of fractures were found to be comparable in different sectors while penetrating injuries were more common in metal-machinery, the least common in textile sector. On the other hand, amputations were the least frequent in services and textile sectors.

Fractures were reportedly recorded most commonly in construction and manufacturing sectors^{13, 18}). In an USA study, incidences of fractures were shown to be the highest in agriculture, followed by mining, construction and manufacturing sectors¹⁵). Lacerations and amputations ranked first (45%) followed by fractures in agriculture¹⁹).

Data from the national occupational health authorities reveal that coal mining followed by metal-machinery were the areas with the highest rates of work-related morbidities⁶). The results relevant to the region in this study are in accord with the national trends.

Bell *et al.* reported an inverse relationship between the level of job routinization and hand lacerations, and most lacerations occurred among workers assigned to less routine (more variable) work patterns²⁰). The level of job routinization is lower in the metal-machinery sector when compared to textile and mining sectors and the worker intervenes in the raw material, tools, system and the products with a resultant high level of hand-tool interaction. Higher frequency of lacerations in this sector is supportive of findings in the study by Bell *et al.*

Risk factors in WRHI

Although fractures constitute 25% among whole toll of WRHI, they have important impact in the total medical costs¹⁵). Expedient development of preventive strategies will not only diminish the resultant suffering and toll, but also alleviate tremendous costs relevant to occupational injuries. Three major risk factors in WRHI were described as deficient use of protective measures (glove etc.), lack of work experience and worker-related factors (drowsiness, inattention etc.)⁵).

Hertz *et al.*, put forth that age younger than 25 was also a risk factor itself. They emphasized the importance of the use of protective equipment and involvement in non-typical tasks in the occurrence of WRHI²¹). Chow *et al.* defined seven significant transient risk factors for acute WRHI, using malfunctioning equipment/materials using a different work method, performing an unusual work task, working overtime, feeling ill, being distracted and rushing²²). Nowadays, labor-intensive work areas are subject to a significant shift towards developing countries due to costs of manufacturing. In countries with a great proportion of young population like Turkey, a prerequisite of improvement of working conditions is training related to the work environment and the work itself.

In a study investigating crushing-type WRHI among

workers in Turkey, voluntary poking hand into an operating machine in 25% and unfamiliarity to the work engaged in 8% was the accused factor in injury mechanism²³). Following injuries, mean period passed until restart to work was found to be 80.4 ± 52.9 h in WRHI in Turkey²⁴). Effective organization and communication of knowledge and technology related to occupational risks and prevention are the principal factors affecting the reduction of occupational injuries. Labor-intensive manufacturing mandates a more thorough investigation of analysis and prevention of occupational injuries which employs a multidimensional approach including education, engineering, and enforcement efforts. Incidences, etiologies and characteristics of WRHI should be highlighted and preventive strategies based on these facts be implemented due to higher level of suffering and more serious consequences attributed to this specific injury in Turkey.

Effective occupational safety efforts involve the control and elimination of recognized workplace hazards to attain an acceptable level of risk and promote the well-being of workers. Optimal occupational safety results from a continuous proactive process of anticipating, identifying, designing, implementing, and evaluating risk-reduction practices. A safety management system is an organized and structured means of ensuring that an organization (or a defined part of it) is capable of achieving and maintaining high standards of safety performance. The management system should be based on the principles of continuous improvement.

In 2001, measures to encourage improvements in the safety and health of workers at work, recommended by council directives of the commission of the European Parliament, the Economic and Social Committee and the Advisory Committee on Safety, Hygiene and Health Protection at Work were implemented and administered by Turkish Ministry of Health and Ministry of Labour and Social Security. This directive, applied to all sectors of activity, both public and private (industrial, agricultural, commercial, administrative, service, educational, cultural, leisure, etc.) contains general principles concerning the prevention of occupational risks, the protection of safety and health, the elimination of risk and accident factors, the informing, consultation, balanced participation in accordance with national laws and/or practices and training of workers and their representatives, as well as general guidelines for the implementation of the said principles²⁵).

The present study has a number of limitations. First, the study enrolled only the solitary injuries in the wrist and in regions distal to it. This may have resulted in exclusion of some patients with WRHI. Second, inadequate filing of necessary data related to occupational

injuries in hospital charts, therefore, limited information respecting education level, experiences, work- and event-related histories, overtime status, work load might have resulted in limitation in terms of analysis and interpretation. Since there are not enough WRHI studies that were carried out in the emergency department patients, we had to compare and discuss some databases in other countries usually include non-traumatic hand injuries such as carpal tunnel syndrome which presumably were not common in the Emergency Department referrals. Nonetheless, the presented findings in this cross-sectional study provide important clues with regard to characteristics and high-risk areas of and due measures against WRHI in a region employing labor-intensive manufacturing practices.

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