

NON-FATAL OCCUPATIONAL INJURIES IN SUEZ GOVERNORATE, EGYPT: CAUSES AND CONSEQUENCES ANALYSIS.

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Abstract:

Background: The collection and analysis of accurate injury statistics is essential for workers' health and safety and for future prevention and control of similar events. The Suez Governorate of Egypt is hosting one of the large and growing industrial areas of Egypt that contains many industries, old and recent, employing tens of thousands of workers.

Objective: The present study examines the insurance claims filed in the branch of Health insurance Organization (HIO) of Suez Governorate over the period of two years aiming at highlighting the problem of non-fatal accidents resulting in injuries, identifying the dangerous industries, searching for the hazardous acts and media of accidents, identifying the most frequently suffered body site and type of injury, and recommending measures to minimize accident rates and severity.

Methods: A record-based retrospective descriptive study was conducted and included 742 non-fatal occupational accidents/injuries notified and registered in the HIO Branch of Suez, over the years 2008 and 2009. An abbreviated sheet-form was constructed to collect data originally written in Arabic and in a paragraph-form. It included victims' demographic criteria, accident circumstances and outcomes. Statistical analysis was performed using the statistical package of SPSS version 10.

Results: The highest number of claims came from the metal and machinery industries (24%), mining, quarrying and glass industries (23%), then transport and storage industries (13%). Upper and lower extremities were the most frequently affected body sites. Fractures and bruises were the most frequently reported injury types. Amputations constituted 6% of total injuries. Slipping and tripping, being struck by objects and

road traffic accidents were the more frequently reported medium of injuries. Residual impairment and disability were observed in 13.3% of the total claims. Amputations and fractures significantly increased the risk of disability (OR=54.0 and OR=3.15). Eye injuries accounted for 2.42% of the grand total and tended to concentrate in Rock and Steel Industries.

Conclusion and recommendations: The metal and machinery industry yielded the largest number of claims of non-fatal injuries to HIO of Suez Governorate. Fractures and bruises ranked first as type of injuries. Amputations and residual impairment and disability were observed in significant proportion of injuries. An integrated Occupational Health and Safety Program should be launched in industries mentioned in the study specifically where the highest rates of injuries and residual disabilities were reported.

Key words: non-fatal injuries, industries, injuries medium, occupational injuries, victim's activities, disability.

Introduction

Occupational illnesses are a part of the human and social costs of industrial production primarily for affected workers and their families (USDOL,2003). Occupational injuries are a major contributor to the burden of occupational illness in all countries developing and developed. They are also a leading cause of disability and of health-related economic losses (Krug, 1999; Krug et al., 2000; Mock et al.,2004 and Peden et al., 2004).

Figures of occupational fatal and non-fatal injuries in developing countries were greatly underestimated (Ghaffar et al., 1999; Leigh et al.,1999; Loewenson,1999; Mock,1999 and Takala, 1999). Also in developed countries, a significant proportion of occupational injuries may

be missing from the registry of reported injuries (Leigh et al., 2004).

Takala reported a higher incidence of fatal work-related injuries in developing countries than in established market economies (11.0 – 23.0 versus 5.4 per 100,000 workers, respectively) with an overall annual incidence of 14.0 per 100,000 (Takala, 1999). The difference in injury rates between developed and developing countries is remarkable. While many enterprises in developed countries are taking zero accident policy for their goal, enterprises in developing countries are unable to identify their hazards (Larsson and Betts, 1996). Furthermore, poor countries and companies are accused of neglecting safety and health measures provision for their workers and this often makes accident hazards in these regions

high. Moreover, the predominance of the private market would lead to socially unacceptable levels of occupational injury, disease and death (ILO, 2003).

The rate of occupational injuries varies markedly depending on the type of industry. The construction, agriculture, manufacturing, transportation and fishing industries as well as mining sectors continue to experience higher rates of disabling injuries. Also, it has been reported that the type and site of injuries depend on the type of act and demographics of occupational group involved (HAS, 2011).

Modern occupational safety considers almost all occupational injuries as preventable. Occupational injury prevention requires the availability of consistent, accurate and comparable information on the intensity and incidence of occupational injuries as well as their mechanisms and risk factors. Unfortunately, in developing countries, the absence of such a systematic occupational injuries surveillance and analysis scheme makes the management of the problem difficult (Abas et al., 2011).

To the best of our knowledge, limited attempts were done to assess the epidemiology of occupational injuries in the industrial zones of peripheral

administrative regions of Egypt as the Suez Governorate. This research work was an effort intending to fill the current existent gap of knowledge.

Aim of the study

1. Assess the pattern of distribution of reported non-fatal injuries in Suez Governorate.
2. Identify types and determinants of reported non-fatal injuries.
3. Recommend measures to minimize injury rates and severity.

Subjects and methods

1. Type of the study:

A record-based retrospective descriptive epidemiologic study was conducted and included 742 reportable and serious occupational accidents notified and registered to the Health Insurance Organization (HIO) - the Branch of Suez during the years 2008 and 2009. The study was approved by the Mansoura Faculty of Medicine Ethical Committee. Approval was obtained from the authorities of HIO to conduct the study.

2. Population and industries:

The industries present were classified into major categories of industrial economic

activities which included 9 main sectors namely: petroleum industries, metal and machinery industries, mining, quarrying and glass industries, construction and plant industries, food industries, wood and textile industries, transport and storage industries, communication and energy industries and lastly services industries.

3. Accidents and injuries

In this study an occupational accident was defined as an occurrence arising out of or in the course of work which results in fatal or non-fatal occupational injury. Occupational injury means death, any personal injury or disease resulting from an occupational accident (Egyptian Social Insurance Law 79/1975 and ILO, 1996).

The occupational injuries were classified according to severity into: (a) First-aid injuries which result in the enforced absence of the injured person from work for a period not exceeding 24 h, and the treatment given is a routine first-aid treatment; (b) Minor injuries which results in the enforced absence of the injured person from work for a period exceeding 24 h, but less than 72 h; (c) Reportable injuries other than a serious bodily injury which involves the enforced absence of the injured person from work for a period

of 72 h or more; (d) Serious injury which involves the permanent loss of any part of the body or the permanent loss of or injury to the sight or hearing or any permanent physical incapacity or the fracture of any bone or joint; (e) Fatal injuries which result in death of the injured person (Khanzode et al.,2010). Only reportable and serious injuries were included in the present study. For each injury, data were collected about:

- a. Age and gender of the victims
- b. Title and type of industry involved.
- c. Part of body affected (site of injury) according to US Department of Labor (USDOL) (1992) grouped into: (a) injury to head region (head, eye, , nose, cheek, mouth, multiple face sites); (b) neck including throat; (c) Trunk including (chest, shoulder, back, abdomen and pelvis); (d) upper extremities including arm parts (upper arm, elbow, forearm), wrists, hand and fingers; (e) lower extremities including; leg parts (thigh, knee, lower leg), ankle, feet and toes.
- d. The nature of injuries grouped into one of the following categories: amputation, fracture, bruising, foreign body, sprain/ligament tear, open wound, burn, and inflammation.

- e. Victim's activity when the accident happened : (a) baling/lifting/loading; (b) climbing stairs; (C) handling objects; (d) movements; (e) operating equipment; (f) riding/operating vehicle; (g) violence
- f. The event (medium) leading to injury: (a) falling from height; (b) fire/explosion; (c) leakage; (d) lifting; (e) loss of machine control; (f) striking against an object; (g) traffic accident; (h) Tripping / slipping.
- g. Outcome of the injury either residual impairment with or without disability or complete cure. Impairment was defined as loss, loss of use, or derangement of any body part, organ system, or organ function. Disability was defined as an alteration of an individual's capacity to meet personal, social, or occupational demands because of impairment (AMA, 2001).

Results

A- Pattern of distribution of reported injuries as evident in figure 1 and table 1:

Studying the relative frequencies of 742 occupational non-fatal injuries reported to HIO Suez branch during the years 2008 and 2009 revealed that the largest number of

non-fatal injuries originated from the metal and machinery industries (24% of claims), followed by mining, quarrying and glass industries (23% of claims), then transport and storage industries ranked third (13% of claims). Meanwhile, chemicals and paper industries constituted only 1% of the total injuries reported.

Victim's age distribution revealed that, young age groups (less than 30 years and 30-to-39 years) peaked in different industries (38.6% and 35.3% , respectively) while age group >50 years has a minority of accidents (10.3%). Men were noted to have about eight-fold the rate of claims compared to women.

Of the total number of reported injuries, victim's upper extremities ranked first as a site of injury in 38.2% of instances out of which fingers and hands constituted the most frequently affected sites (23%). The lower extremities ranked second giving rise to 33.2% of total injuries out of which toes and feet were the most frequently affected sites (19.9%). Head, face and neck constituted only 8.7% and the eyes were affected in 2.4% of total reported injuries.

Fractures and bruises constituted the highest percentage of reported occupational injuries type (39% and 25%, respectively),

sprain and strain ranked third (13%) and amputations constituted 6% of the total injuries.

Movements through the workplace, handling objects, operating machines and riding vehicles were the most frequently reported workers' activities when injuries occurred (30%, 24%, 19% and 14% , respectively).

Slipping and tripping and struck by objects were reported as a medium of injuries in 30% and 26%, respectively of total reported injuries. These were followed by loss of machinery control (17%) and traffic accidents both inside and outside the factories (14%) while falling from height constituted 7% out of the total.

B- Pattern of distribution of reported injuries across industries as evident in table 2:

Food Industries

Occupational non-fatal injuries in food industries represented 7% of total injuries. Most of the injuries happened while the victims moved (38.9%) or handled objects (16.7%). Most frequent media of injuries were tripping /slipping (35.2%) and being struck by objects (24.1%). Knees and legs, and fingers were the most suffered body

parts (33.3% and 20.4%, respectively). The most predominant injuries were bruises (42.6%) and fractures (31.5%).

Petroleum industries

Occupational non-fatal injuries in petroleum industries represented 5% of the total reported injuries. Riding and/or operating vehicles predominated the other working activities causing injuries (32.5%) followed by objects handling (30.0%). Most of the injuries were mediated by traffic accidents (40.0%), struck by objects and tripping and slipping (20.0% each). Knee and legs were the most affected body sites (20.0%) followed by shoulder, chest and ribs (12.5%). Fractures and bruises were the most predominant injuries (47.5% and 30.0% , respectively).

Metal and machinery industries

Occupational non-fatal injuries in metal and machinery industries represented 24% of the total reported injuries. Handling objects and operating machines were the most prevalent working activities preceding injuries (28.9% and 23.9% , respectively). Struck by objects and loss of machine control were the predominant media for injuries (30.6% and 21.1% , respectively). Fingers were the most affected body parts (26.1%) followed by feet and toes (16.7%).

Fractures, bruises and cut wounds were the most prevalent injuries (33.9%, 28.3% and 15.6% , respectively).

Mining, quarrying and glass industries

Occupational non-fatal injuries in mining, quarrying and glass industries represented 23% of the total reported injuries. Movements and objects handling predominated the other working activities causing injuries (32.3% and 30.5% , respectively). Struck by objects and tripping and slipping (31.1% and 27.5%, respectively) were the most frequent media of injuries. Fingers were the most suffered body parts (33.5%) followed by other parts of the upper limbs (19.8%). Fractures and bruises were the predominant injuries (43.1% and 19.2% , respectively) and amputation presented in 8.4% of casualties.

Construction and plant industries

Occupational non-fatal injuries in construction and plant industries represented 6% of the total reported injuries. Operating machines and equipment and movements were the most frequently reported activities causing injuries (30.2% and 25.6% , respectively). Tripping and slipping, being struck by objects and loss of machine control were the most prevalent causes of injuries (32.6%, 27.9% and 18.6%

, respectively). Fingers and toes and feet were the most-affected body parts (27.9% and 20.9%, respectively). Fractures and bruises were the predominant injuries (37.2% and 25.6% , respectively) and amputation and ligament sprains and strains were presented by 11.6% of casualties for each category.

Wood and textile industries

Occupational non-fatal injuries in wood and textile industries constituted 6% of the total reported injuries. Movements and operating machines and equipment were the most frequently reported activities resulting in injuries (36.4% and 34.1% , respectively). Tripping and slipping and loss of machine control were the most prevalent causes of injuries (34.1% and 25% , respectively). Arm, elbow and forearm were the most affected body parts (29.5%) followed by fingers and toes and feet (13.6% for each). Bruises, cut wounds and ligament sprains and strains were the most predominant injuries (29.5%, 25% and 13.6% , respectively).

Transport and storage industries

Occupational non-fatal injuries in transport and storage industries contributed to 13% of the total reported injuries. Movements and objects handling

predominate the other working activities causing injuries (38.1% and 24.7% , respectively). Struck by objects and tripping and slipping (29.9% and 27.8% , respectively) were the most frequent media of injuries. Fingers and feet and toes were the most affected body parts (21.6% and 18.6%, respectively). Fractures and bruises were the predominant injuries (34.0% each) and ligament sprains and strains were present in 17.5% of casualties.

Communication and energy industries

Communication and energy industries contributed to 5.0% of reported non-fatal injuries. Movements followed by riding and/or operating vehicles were accused in 43.2% and 32.4% of instances , respectively . Traffic accidents and movements were the predominant media of injuries (37.8% and 29.7%, respectively). Feet and toes followed by shoulder, chest and ribs were the frequently affected body sites (27.0% and 21.6% , respectively) . Fractures was the most prevalent injuries (56.8%) followed by bruises (21.6%).

Services Industries

Services Industries contributed to 10% of reported non-fatal injuries. As shown in table 2, climbing/descending stairs was the predominant type of activities resulting in

injuries (40.3%) followed by movements (26.4%). Tripping and slipping were the most important media of injuries (65.3%) followed by being struck by objects (19.4%). Feet and toes followed by knees and legs were the most affected body sites (52.8% and 9.7% , respectively). Fractures were the most prevalent injuries (52.8%) followed by ligaments sprain and or tear which was present in 22.2% of casualties.

C- Pattern of distribution of residual impairment and disability

Residual impairment and disability were observed in 13.34% of the total reported injuries. Analyses of risk factors contributing to development of residual impairment and disability from reported accidents were shown in table 3. Risk of developing residual disability was significantly higher in the age group 30-40 years (OR=1.65, 95%CI: 1.02-2.67) when taking the age group <30 years as a reference group. The risk of disability was not significantly higher in construction and plant industries (OR=1.52, 95%CI: 0.53-4.35) when taking services industries as a reference group. On studying the work activities carrying higher risk of developing disability operating equipment, tools and machines ranked first as compared to

movements (OR=9.56, 95%CI: 4.74-19.25) followed by objects handling (OR=3.03, 95%CI: 1.45-6.34) and lastly riding/operating vehicles (OR=2.52, 95%CI: 1.07-5.93). Loss of machine control, falling from height, traffic accidents and being struck by objects respectively were the most risky media for injuries ending in disability when taking slipping and tripping as a reference group (OR=24.2, 95% CI: 9.72-63.19; OR=7.59, 95% CI: 2.50-23.06 ; OR=6.70, 95% CI: 2.34-19.13 and OR=6.18, 95% CI: 2.31-16.52 , respectively). Probability of disability was observed to be significantly higher with injury of the fingers compared to other parts of the upper limb (OR=2.06, 95%CI: 1.13-3.77) and significantly lower with trunk and lower limb injuries

(OR=0.21, 95%CI: 0.05-0.95 and OR=0.41, 95%CI: 0.20-0.82 , respectively). Amputations and fractures significantly increase the risk of disability (OR=54.0, 95%CI: 23.16-126.7 and OR=3.15, 95%CI: 1.73-5.75 , respectively) when taking burn, foreign body, inflammation and wounds as reference group.

Proportions of more than 30 working days lost were higher in mining, quarrying and glass industries and communication and energy industries (54% each). Injuries involving arm, elbow and forearm, head, pelvis and thigh were associated with higher proportions of more than 30 working days lost (59%, 58% and 58% , respectively) as evident in table 4.

Table (1): Pattern of distribution of reported non-fatal injuries

Pattern	Reported non-fatal injuries(n=742) No (%)
Male/Female	664/78
Age : years	
<30	286(38.6)
30-39	261(35.3)
40-49	117(15.8)
50-60	76(10.3)
Anatomical body site injured.	
1-Head, face & neck	65(8.7)
-head	24(3.2)
-eye	18(2.4)
-face and neck	23(3.1)
2-Chest, back and pelvis	126(17.0)
-chest and shoulder	48(6.5)
-back	52(7.0)
-pelvis and thigh	26(3.5)
3-Upper extremities	284(38.2)
-arm, forearm and wrist	113(15.2)
-hand and fingers	171(23.0)
4-Lower extremities	250(33.6)
-knee and leg	102(13.7)
-feet &toes	148(19.9)
Types of injuries	
Amputation	43(6.0)
Fracture	290(39.1)
Bruising, contusions	186(25.1)
Foreign body	11(1.5)
Sprain/ligament tear	93(12.5)
Cuts, lacerations, punctures	91(12.3)
Burn	14(1.9)
Inflammation	4(0.5)
Hepatitis C virus (HCV) Infection	2(0.3)
Undefined	8(1.1)
Activities	
Baling/lifting/loading	35(4.7)
Climbing/descending stairs	64(8.6)
Handling objects	181(24.4)
Movements	219(29.5)
Operating equipment	140(18.9)
Riding/operating vehicle	102(13.7)
Violence	1(0.1)
Media	
Falling from height	68(9.2)
Fire/explosion	3(0.4)
Leakage	10(1.3)
Lifting	11(1.5)
Loss of machine control	124(16.7)
Struck by object	195(26.3)
Traffic accident	106(14.3)
Tripping / slipping	225(30.3)

Table (2): Distribution of correlates of reported non-fatal Injuries for different industries.

	Food	Petroleum	Metal & machinery	Mining, quarrying and glass industries	Construction and plant	Wood and Textile	Transport and storage	Communication and energy	Services
	no (%) 54(100)	no (%) 40(100)	no (%) 180(100)	no (%) 167(100)	no (%) 43(100)	no (%) 44(100)	no (%) 97(100)	no (%) 37(100)	no (%) 72(100)
Activities									
Baling/lifting/loading	5(9.3)	0.0(0.0)	13(7.2)	7(4.2)	1(2.3)	0.0(0.0)	7(7.2)	1(2.7)	1(1.4)
Climbing/descending stairs	4(7.4)	1(2.5)	11(6.1)	4(2.4)	4(9.3)	1(2.3)	8(8.2)	2(5.4)	29(40.3)
Handling objects	9(16.7)	12(30.0)	52(28.9)	51(30.5)	8(18.6)	8(18.2)	24(24.7)	3(8.1)	12(16.7)
Movements	21(38.9)	11(27.5)	31(17.2)	54(32.3)	11(25.6)	16(36.4)	37(38.1)	16(43.2)	19(26.4)
Operating equipment	8(14.8)	3(7.5)	43(23.9)	43(25.7)	13(30.2)	15(34.1)	7(7.2)	3(8.1)	2(2.8)
Riding/operating vehicle	7(13.0)	13(32.5)	30(16.7)	8(4.8)	6(14.0)	4(9.1)	14(14.4)	12(32.4)	8(11.1)
Violence	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	1(1.4)
Media									
Falling from height	5(9.3)	3(7.5)	14(7.8)	14(8.4)	2(4.7)	1(2.3)	24(24.7)	5(13.5)	0.0(0.0)
Fire/explosion	0.0(0.0)	0.0(0.0)	2(1.1)	2(1.2)	1(2.3)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
Leakage	0.0(0.0)	1(2.5)	3(1.7)	0.0(0.0)	1(2.3)	3(6.8)	0.0(0.0)	1(2.7)	1(1.4)
Lifting	2(3.7)	0.0(0.0)	5(2.8)	0.0(0.0)	0.0(0.0)	0.0(0.0)	1(1.0)	0.0(0.0)	1(1.4)
Loss of machine control	6(11.1)	4(10.0)	38(21.1)	45(26.9)	8(18.6)	11(25.0)	5(5.2)	4(10.8)	1(1.4)
Struck by object	13(24.1)	8(20.0)	55(30.6)	52(31.1)	12(27.9)	8(18.2)	29(29.9)	2(5.4)	14(19.4)
Traffic accident	9(16.7)	16(40.0)	29(16.1)	8(4.8)	5(11.6)	6(13.6)	11(11.3)	14(37.8)	8(11.1)
Tripping / slipping	19(35.2)	8(20.0)	34(18.9)	46(27.5)	14(32.6)	15(34.1)	27(27.8)	11(29.7)	47(65.3)
Site of injury									
Head	1(1.9)	1(2.5)	3(1.7)	4(2.4)	2(4.7)	0(0.0)	6(6.2)	3(8.1)	4(5.6)
Eye	0(0.0)	0(0.0)	4(2.2)	5(3.0)	2(4.7)	3(6.8)	1(1.0)	1(2.7)	2(2.8)
Face and neck	1(1.9)	4(10.0)	10(5.6)	1(0.6)	2(4.7)	1(2.3)	2(2.1)	0(0.0%)	2(2.8)
Shoulder, chest & ribs	3(5.6)	5(12.5)	16(8.9)	7(4.2)	0(0.0)	1(2.3)	5(5.2)	8(21.6)	3(4.2)
Arm, elbow and forearm	5(9.3)	5(12.5)	17(9.4)	24(14.4)	3(7.0)	13(29.5)	12(12.4)	2(5.4)	5(6.9)
Wrist and hand	2(3.7)	3(7.5)	5(2.8)	9(5.4)	5(11.6)	2(4.5)	1(1.0)	0(0.0)	0(0.0)
Fingers	11(20.4)	5(12.5)	47(26.1)	56(33.5)	12(27.9)	6(13.6)	21(21.6)	5(13.5)	6(8.3)
Back	3(5.6)	1(2.5)	18(10.0)	13(7.8)	0(0.0)	3(6.8)	10(10.3)	2(5.4)	1(1.4)
Pelvis and thigh	3(5.6)	2(5.0)	5(2.8)	3(1.8)	1(2.3)	2(4.5)	5(5.2)	3(8.1)	1(1.4)
Knee and leg	18(33.3)	8(20.0)	22(12.2)	18(10.8)	7(16.3)	4(9.1)	16(16.5)	1(2.7)	7(9.7)
Feet and toes	6(11.1)	5(12.5)	30(16.7)	23(13.8)	9(20.9)	6(13.6)	18(18.6)	10(27.0)	38(52.8)
Skin and multiple site	0(0.0)	0(0.0)	2(1.1)	2(1.2)	0(0.0)	3(6.8)	0(0.0)	0(0.0)	1(1.4)
Missed	1(1.9)	1(2.5)	1(0.6)	2(1.2)	0(0.0)	0(0.0)	0(0.0)	2(5.4)	2(2.8)
Type of injury									
Amputation									
Fracture	3(5.6)	1(2.5)	11(6.1)	14(8.4)	5(11.6)	2(4.5)	2(2.1)	0.0(0.0)	3(4.2)
Bruising, contusions	17(31.5)	19(47.5)	61(33.9)	72(43.1)	16(37.2)	9(20.5)	33(34.0)	21(56.8)	38(52.8)
Foreign body	23(42.6)	12(30.0)	51(28.3)	32(19.2)	11(25.6)	13(29.5)	33(34.0)	8(21.6)	5(6.9)
Sprain/ligament tear	1.0(1.9)	0.0(0.0)	4(2.2)	5(3.0)	1(2.3)	0(0.0)	1(1.0)	2(5.4)	3(4.2)
Cuts, lacerations, punctures	3(5.6)	1(2.5)	17(9.4)	25(15.0)	5(11.6)	6(13.6)	17(17.5)	5(13.5)	16(22.2)
Burn	6(11.1)	5(12.5)	28(15.6)	17(10.2)	4(9.3)	11(25.0)	11(11.3)	0.0(0.0)	4(5.6)
Inflammation	0.0(0.0)	2(5.0)	7(3.9)	2(1.2)	1(2.3)	1(2.3)	0.0(0.0)	1(2.7)	1(1.4)
	0.0(0.0)	0.0(0.0)	1(0.6)	0.0(0.0)	0.0(0.0)	2(4.5)	0.0(0.0)	0.0(0.0)	0.0(0.0)

Table (3): Distribution of correlates of residual impairment and disability resulting from reported non-fatal occupational injuries.

	Complete cure N=643 N(%)	Residual impairment and disability N=99 N (%)	Odds ratio (95% CI)¥	P- value
Age: years				
<30	254(88.5)	33(11.5)	r	-
30-39	215(82.4)	46(17.6)	1.65(1.02-2.67)	0.04*
40-49	107(91.5)	10(8.5)	0.72(0.34-1.46)	0.38
50-60	67(87.0)	10(13.0)	1.15(0.54-2.45)	0.71
Sex				
Female	72(92.3)	6(7.7)	r	-
Male	571(86.0)	93(14.0)	1.95(0.83-4.62)	0.12
Industries				
Food	46(85.2)	8(14.8)	r	-
Petroleum	33(82.5)	7(17.5)	1.22(0.40-3.70)	0.72
Metal and Machinery	162(90.0)	18(10.0)	0.64(0.26-1.56)	0.32
Services	64(88.9)	8(11.1)	0.72(0.25-2.06)	0.53
Mining, quarrying and glass	138(82.6)	29(17.4)	1.21(0.52-2.83)	0.66
Construction and plant	34(79.1)	9(20.9)	1.52(0.53-4.35)	0.43
Communication and Energy	36(97.3)	1(2.7)	0.16(0.02-1.34)	0.12
Transport and Storage	86(88.7)	11(11.3)	0.74(0.28-1.96)	0.53
Wood and Textile	37(84.1)	7(15.9)	1.09(0.36-3.28)	0.88
Activities				
Movements	208(95.0)	11(5.0)	r	-
Operating equipment	93(66.4)	47(33.6)	9.56(4.74-19.25)	0.000**
Handling objects	156(86.2)	25(13.8)	3.03(1.45-6.34)	0.002*
Riding/operating vehicles	90(88.2)	12(11.8)	2.52(1.07-5.93)	0.02*
Others ^a	96(96.0)	4(4.0)	0.79(0.24-2.54)	0.68
Media				
Tripping/slipping	220(97.8)	5(2.2)	r	-
Loss of machine control	80(64.5)	44(35.5)	24.2(9.72-63.19)	0.000**
Struck by objects	171(87.7)	24(12.3)	6.18(2.31-16.52)	0.000**
Traffic accidents	92(86.8)	14(13.2)	6.70(2.34-19.13)	0.000**
Falling from height	58(85.3)	10(14.7)	7.59(2.50-23.06)	0.000**
Others ^b	22(91.66)	2(8.33)	4.00(0.73-21.84)	0.08
Site of injury				
Upper limb [#]	95(84.1)	18(15.9)	r	-
Fingers	123(71.9)	48(28.1)	2.06(1.13-3.77)	0.01*
Shoulder, chest, ribs, back	98(98)	2(2.0)	0.21(0.05-0.95)	0.02*
Pelvis and thigh	21(80.8)	5(19.2)	1.26(0.42-3.77)	0.68
Lower limb	232(92.8)	18(7.2)	0.41(0.20-0.82)	0.009*
Head, eye, face and neck	59(91.0)	6(9.0)	0.54(0.2-1.43)	0.20
Multiple sites	15(88.22)	2(11.76)	0.70(0.15-3.35)	0.65
Type of injury				
Bum, foreign body, inflammation, wound	298(94.9)	16(5.1)	r	-
Ligament lesion	86(92.5)	7(7.5)	1.52(0.6-3.80)	0.37
Fracture	248(85.5)	42(14.5)	3.15(1.73-5.75)	0.000**
Amputation	11(25.6)	32(74.4)	54(23.16-126.7)	0.000**
HCV ^c	0(0.0)	2(100.0)	-	-

¥ 95% confidence interval, * Statistically significant, ** Highly statistically significant

Apart from fingers, a climbing stairs, balling, lifting and loading, b fire, lifting and leakage, c Hepatitis C Infection

Table (4) : Proportions of more than 30 working days lost in different industries and sites of injuries

Industries and sites of injury	Proportions of >30 working days lost
Industries	
Food	37.0%
Petroleum	45.0%
Metal and Machinery	44.4%
Services	51.4%
Mining, quarrying and glass industries	54.5%
Construction and plant	48.8%
Communication and Energy	54.1%
Transport and Storage	35.1%
Wood and Textile	43.2%
Site of injury	
Head	58.3%
Eye	11.1%
Face and neck	39.1%
Shoulder, chest & ribs	29.2%
Arm, elbow and forearm	59.3%
Wrist and hand	40.7%
Fingers	55.0%
Back	25.0%
Pelvis and thigh	57.7%
Knee and leg	40.2%
Feet and toes	52.7%
Skin and multiple site	37.5%

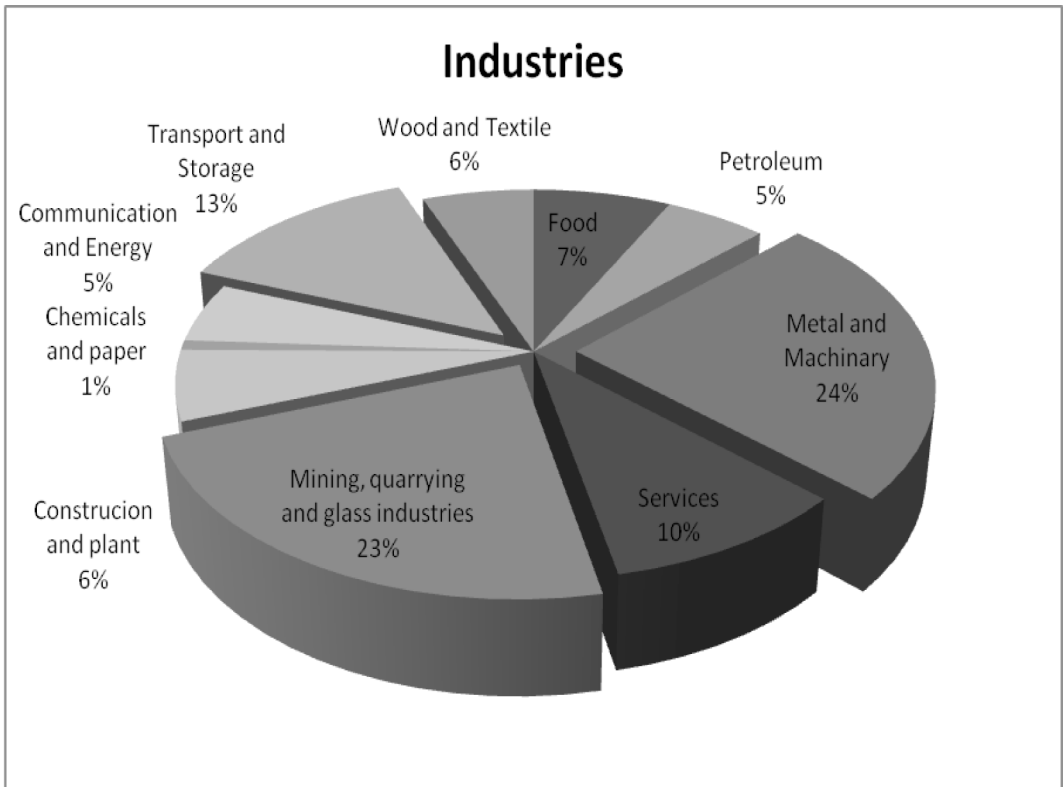


Figure 1. Distribution of reported non-fatal injuries according to type of industry.

Discussion

Suez governorate is considered to be one of the largest industrial areas in Egypt. It hosts industries of both private and public sectors. Pattern of distribution of reported injuries may be assumed to be representative of occupational injuries in modern industries of Egypt. The present study used data of 742 occupational injuries notified to HIO Suez governorate branch over 2 years period from 2008-2009. It examined the insurance claims and therefore, it was difficult to measure the true incidence rate of non-fatal injuries in different industries. In Egypt, till now, the agricultural workers are not under the coverage of Health Insurance Organization hence their workplace injury claims are not reported to the Health Insurance System and consequently were not presented in our study.

Our study observed that, the largest proportion of reported non-fatal injuries occurred in the metal and machinery industries, followed by the mining, quarrying and glass industries, then transport and storage industries ranked third. Singapore's Ministry of Manpower reported the workplace injuries for the year 2007, with 53% of these cases arising from

manufacturing and construction (Singapore Ministry of Manpower, 2011). Also a higher percentage of injuries reported to HAS were from manufacture industries (17.5%) (HAS, 2011). Also mining and mineral extraction industry remains among the highest risk professions worldwide (Coleman and Kerkering, 2007). In the present study, the high proportion of injury claims in metal and machinery industries and also, mining, quarrying and glass industries could be explained by the fact that these industries constitute a high proportion of body of industries in Suez governorate. Also, some researchers have attributed the increased risk of injuries in these industries to the variety of adverse working conditions workers are exposed to (Mitchell et al., 1998).

In the present study, the age groups <30 years and 30-to-40 years had the highest proportion of claims of occupational non-fatal injuries. This is in accordance with Al-Dawood (2003) and Smith et al. (2005) who found that, the overall injury rates decreased with age. However, this is contrary to the findings in Norway (Bull et al., 1999) and Malaysian (Abas et al., 2011) studies which observed that occupational injuries peaked at the age group 40-59 years. In the present study however, the

higher proportion of injuries in the young age groups can be attributed to lack of experience, skills and negligence of safety rules and may reflect the shortage in pre-employment training courses in proper work practices and safety behavior. On the other hand, the age group of 50-years and over had a lower proportion of reported non-fatal injuries as they presumably occupied senior supervisor positions and hence, may be at a lower risk of exposure to risky situations.

We found that men had eightfold higher risk of incurring non-fatal occupational injuries compared to women. A Norwegian study that examined insurance claims for occupational injuries found that men had a twofold of workplace injuries compared to women ((Bull et al., 1999). Also, men were noted to have a threefold rate of hospitalization for work-related injuries in a Canadian study (Dimich-Ward et al., 2004). In general, men are more likely to be exposed to activities that have an increased risk for sustaining occupational injuries (Abas et al., 2011). In Egypt, the workforce in industrial areas is predominantly comprised of men hence, the gender difference in the frequency rate of injuries would be biased.

The anatomical body site frequently reported in claims was the upper extremities followed by the lower extremities. This was in accordance with Smith et al. (2005) who found that the upper extremities were involved in the largest percentage of work-related injuries. Fractures occurring at work were also more likely to affect an upper extremity than a lower extremity.

Out of injured extremities, fingers and hands ranked first (23.0%), followed by ankle and toes (19.9%). These were nearly similar to percentage distribution of injured body parts reported by HAS 2008-2009 (HAS, 2011). Apart from the extremities, the eyes were injured in 2.4% of the total reported injuries in this research. The U.S. Department of Labor reported that, for the year 2002, eye injuries were involved in 3% of private workplace injuries and illnesses (Harris, 2004).

Fractures and bruises constituted the highest percentages of occupational injuries (39% and 25% , respectively). These results are contrary to the findings of the Malaysian study (Abas et al., 2011) that examined non-fatal occupational injuries and a USA study (Smith et al., 2005) that analyzed the work-related injuries in US adult population. Both of them reported

a higher percentage of wound injuries followed by fractures. The present study examined insurance reported claims of occupational injuries requiring more than three days off work, hence many of the superficial wound injuries missed being included in the analysis. Sprain and strain injuries represented 13% of reported occupational injuries. This was slightly higher than the rates reported in the Malaysian study (10%) (Abas et al., 2011). Amputations, usually of fingers, constituted 6% of the total injuries and this was much higher than rates reported by other studies (1-2%) (Abas et al., 2011 and HAS, 2011).

The main working activity contributing to injuries in our study was movement of the worker through the workplace (30%). These movements resulted in slipping, tripping or being struck by objects which were the main direct causes of the reported injuries (30% and 24% , respectively). The second ranked activities were handling objects and operating machines. These results are consistent with the findings from a Canadian (Alamgir et al., 2006), Malaysian (Abas et al., 2011) and Chinese (Perry et al., 2005) studies.

Variability in injury-generating activities and causes had been observed

between the different industries, such as operating vehicles, climbing stairs, or slipping, tripping, falling, and lifting or carrying an object, respectively. These categories can be used to identify priority problems or to focus prevention initiatives for different industries (Copley et al., 2010). In the present study, in food industries, services industries, transport and storage industries, most of the injuries happened while the victims moved or handled objects. Therefore, most frequent causes of accidents were tripping /slipping and being struck by objects. Improper environmental factors as slippery floors, poor housekeeping, and inadequate light may increase the tripping and slipping hazards. Consequently, the most common injuries were bruises, fractures and ligament sprains and strains. These were in accordance with Khanzode et al. (2010) and Patterson and Shappell (2010).

Another example is in the machinery and metal industry, the mining, quarrying and glass industries as well as the wood and textile industries where objects handling and working with dangerous equipment, tools and machinery were the most predominant working activities and hence, being struck by or against objects, or caught in or being crushed by various tools, equipment or

machinery parts were the most prevalent causes of injuries. Accordingly, fractures, bruises, cut wounds and amputations were widespread injuries in these industries. These were in agreement with the findings of Layne et al. (1994), Copley et al. (2010) and Abas et al. (2011).

Analyzing the non-fatal accidents severity according to the proportion of residual disability to the total reported injuries revealed that, the risk of developing residual disability was significantly higher in the age group 30-40 years (OR=1.65) when taking age group <30 years old as a reference group. This could be explained by an increasing proportion of risky job activities handed to this age group (Smith et al., 2005). Also, the apparent increase in the risk of severe non-fatal injuries in age group 50 to 60 years old may be attributed to the decrease in physical (e.g., loss of visual acuity, hearing loss, and osteoporosis) and mental abilities which may alter the quality of work performance and increase the likelihood of workers incurring high risky situations (Ghosh et al., 2004 and NJDH, 2003). Also, it may reflect the effect of the aging process in subject's capability for complete clinical recovery (Rogers and Wiatrowski, 2005).

The risk of disability was apparently higher in construction and plant industries (OR=1.52) when taking services industry as a reference group. Our finding is in accordance with previous studies which concluded that construction industry is one of the most risky industries with the highest fatal and severe non-fatal injuries (Rivara and Thompson, 2000 and Lehtola et al., 2008).

On studying the work activities which carried higher risk of developing disability compared to movements, operating equipment, tools and machines ranked the first (OR=9.56) followed by objects handling (OR=3.03) and lastly riding/operating vehicles (OR= 2.52). Also, loss of machine control (OR=24.2), falling from a height (OR=7.59), traffic accidents (OR=6.70) and being struck by objects (OR=6.18), respectively, were the most risky media for accidents which end in disability when taking slipping and tripping as a reference group. It has been observed that, accidents associated with loss of machine control, falling from a height as well as traffic accidents resulted in higher proportions of amputations, fractures, crushing and multiple site injuries with higher possibility of fatalities and residual disability (Fayad et al., 2003 and Leigh et al., 2004).

The probability of disability was observed to be significantly higher with injury of the fingers compared to other parts of the upper limb (OR=2.06). This could be explained by the greater probability of finger involvement in injuries associated with loss of machinery control which is considered the first cause of disability in the current study. Amputations and fractures significantly increase the risk of disability (OR=54 and 3.15 , respectively) compared to superficial and nonspecific wounds. Amputation is one of the disabilities resulting in handicapping when it involves body parts affecting the worker's occupational capability. Also, improper healing of fractures resulted in limitation of movements in extremity which may be considered as one of the most important causes of work related disability (Fayad et al., 2003 and Leigh et al., 2004).

The proportion of sick leaves more than 30 working days was higher in communication and energy industries and mining, quarrying and glass industries. In the former industries, the traffic accidents occupied the first rank as a cause of occupational injuries (37%). Road traffic accidents were reported to be the most dangerous category regarding their outcome either death or severe injuries that

require long hospital stay (Al-Masaeid et al., 1999). In mining, quarrying and glass industries, tripping and slipping, struck by objects and loss of machinery control were the most common causes of injuries. Injuries mediated by these causes were usually multiple and involved fractures which necessitate more hospital stay and prolonged rehabilitation (Fayad et al., 2003).

In the present study, injuries involving head and pelvis and thigh were associated with high proportion of sick leaves of more than 30 working days. Head injuries are usually severe due to the possibility of brain insult and usually require prolonged hospitalization (Fayad et al., 2003 and Langlois et., 2004). Also, injuries involving pelvis and thigh are usually severe with high medical cost and prolonged hospitalization (Fayad et al., 2003).

Recommendations

There is a need for comprehensive legislation requiring every employer to identify the hazards of his operations, assess the risks associated with the hazards, and take appropriate risk reduction measures to protect employees and other parties. In parallel, routine monitoring for employee adherence should be implemented.

Many enterprises in developed countries move more dangerous industries to developing countries where salaries are low and regulatory measures poor. The workers in developed and developing countries are entitled to the same human dignity and decent work, and this trend should be prohibited.

Proper pre-employment training programs in sound work practices and occupational health and safety should be designed and offered specifically to workers employed in dangerous jobs. Health surveillance should be done regularly to ensure adequate physical and mental capacities of the workers.

In addition, more rigorous risk reduction strategies should be adopted for specific subgroups and for particular jobs that were identified in the present study with a high risk for occupational injury as the metal and machinery industries, the mining, quarrying and glass industries, and the transport and storage industries. These risk reduction measures should depend on the hazards analysis methods.

As demonstrated in the present study a high proportion of occupational injuries was attributed to unsafe working

environment as slippery floors and poor housekeeping which increase tripping and slipping, falling and hazards of being struck by objects. Employer efforts to reduce risks of falling may include ensuring walkways are well-lit, removing slipping and tripping hazards, and use of more slip-resistant floors. Building a safe and healthy workplace is a prerequisite for improving health and minimizing injuries. The design and workflow at worksites should fit the workers to minimize physical and mental fatigue conducive to injuries. Compliance with hand and feet protection should be instituted.

A significant proportion of occupational injuries in this study was mediated by traffic accidents. Adequate efforts should be made to investigate these accidents using strategies as Haddon's matrix for proper assessment of their risk factors.

Qualitative data collection and analysis should supplement quantitative data collection and analysis as an essential tool for injury prevention and control. A build up of a computerized database registry for injuries and accompanying circumstances in HIO of Suez Governorate would be of great value in the regular surveillance of occupational injuries.

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