PROPORTION OF OCCUPATIONAL EYE INJURIES AND THEIR RISK FACTORS: A SINGLE-CENTER STUDY

By

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Abstract

Introduction: Occupational ocular injuries account for about 3-4% of all occupational injuries in the United States while in Egypt, account for 36.7% .The impact of occupational ocular injuries affects the future of workers and inhibits the productivity. **Aim of Work:** To measure the proportion and risk factors for occupational eye injuries and to compare between occupational and non occupational eye injuries among patients attending the emergency department of the Ophthalmology center; Mansoura University. **Materials and Methods:** A total of 357working patients with eye injuries were subjected to a specially designed questionnaire covering the personal, socio-demographic, occupational history, general and ocular medical history and accident analysis. All patients underwent comprehensive eye examination. Ophthalmic B-scan ultrasound was performed gently in closed-globe injury cases .**Results:** All patients had unilateral eye injuries; the overall prevalence of occupational eye injuries was 57.1%. The significant independent predictors of occupational eye injuries among participants were: being male , aged ≥40 years and educated below secondary. The risk of occupational eye injuries among participants increased in the day time and with history of similar accident before. The main cause of eye injuries was foreign bodies (74.5%). Conclusion and Recommendations: occupational eye injuries represented 57.1% of all

eye injuries among studied patients. Being male, aged 40 years or more, low education, day time work and previous occupational eye injuries were the significant independent predictors. Corneal injuries and simple eye injuries were the most prevalent. Regular occupational eye safety programs and a large scale multi-center study are recommended for more information about occupational eye injuries

Keywords: Foreign body trauma, Occupational eye injuries, Risk factors and Corneal injury.

Introduction

Ocular injury is a significant cause of visual morbidity worldwide which is commonly caused by domestic or work accidents, sports injuries, assault and road crashes (Patel, 2015). High proportion of eye injuries occur at workplace and the majority of these occupational injuries are minor injuries (Ngo and Leo,2008). The Occupational Safety and Health Administration (OSHA,2020) reported that thousands of people are blinded each year due to work-related eye injuries. The impact of occupational ocular injuries affects the future of workers and their families and inhibits the productivity, development and prosperity of the countries especially in many low- and middle-income countries (Alem et al., 2018).

Although 90% of occupational ocular injuries are preventable by using appropriate eye protective equipment and strict compliance (Kyriakaki et al.,2021)as well as adequate pre-employment training, still individuals working in hazardous occupations are at high risk (Mengistu et al., 2021). More than half of work-related eye injuries occur in the manufacturing, service and construction industries (Bureau of Labor Statistics, 2020).

Occupational ocular injuries account for about 3-4% of all occupational injuries in the US (Xiang et al., 2005) while in Egypt , account for 36.7% (Elhesy ,2016),therefore, it worth to better understand the patterns of different eye injuries for prevention strategies (Nowrouzi-Kia et al., 2020).

As the efforts towards investigation of workplace eye injuries or diseases in Egypt are very deficient, with under-reporting and under-diagnosis resulting in incomplete national registries, this study aims to estimate the proportion and risk factors of occupational eye injuries and to compare between occupational and non occupational eye injuries.

Aim of Work

To measure the proportion and risk factors for occupational eye injuries and

to compare between occupational and non-occupational eye injuries among patients attending the emergency department of the Ophthalmology center.

Materials and Methods

Study Design: It is a cross-sectional study with analytical component.

Place and duration of the study: The study was done in the emergency department at the Ophthalmology center of Mansoura University during the period from June 2022 to May 2023 (the emergency department receives along 3 days/week all patients with eye disorders "injuries/diseases " seeking urgent medical interference).

Study Sample:

All working patients attended the emergency department in the ophthalmology center with eye injury aged from 18 to 60 years.

Exclusion criteria: students, children, unemployed, retired and housewives.

Occupational eye injuries were operationally defined as: (a) any accident incurred by the worker during performance or because of work; (b) any accident incurred by the worker on their way to their workplace and return (Abbas et al., 2018).

The sample size was calculated using the Free Info program (https://www.openepi.com/SampleSize/SSPropor.htm). A previous similar study (Elhesy ,2016), found that workplace injuries represented 36.7% of patient eye injuries and accordingly, the calculated sample size was357with 95% confidence level and 5% precision. Eye injuries related to work were 204 patients while 153 were non-work related injuries.

Study Methods:

I-The following data was collected through a **face-to-face interview questionnaire** with eligible patients after stabilization of their condition:

(A) Personal and socio-demographic data, occupational history including; job title, work duration/ year, working hours/day, shift work, physical and chemical exposures at workplace and if using eye personal protection equipment (PPE).

(B) General and ocular medical histories e.g: hypertension, diabetes, allergy to any substance, as well as previous eye injury and/or surgery and/ or previous ocular foreign body during employment.

(C) Accident analysis (time, place, cause).

II- A comprehensive **eye examination** by an ophthalmologist including visual acuity testing (uncorrected and best corrected), slit lamp examination, intraocular pressure measurement using Goldman applanation tonometer, and dilated fundus examination. Ophthalmic B-scan ultrasound was performed gently in closed-globe injury cases where posterior segment evaluation is not possible.

Eye injury is classified according to anatomy of the eye into: Eye lids injuries (lid wound or lid ecchymosis), conjunctiva injuries (sub-conjunctival hemorrhage, conjunctival chemosis or laceration), cornea injuries (corneal aberration, ulcer, foreign body, edema, or full thickness laceration), crystalline lens injuries (cataract or lens subluxation), retina and vitreous injuries (vitreous hemorrhage, retinal hemorrhage, commitio retinae{refers to traumatic retinopathy secondary to direct or indirect trauma to the globe}, or retinal detachment) and multiple injuries. Injuries were also categorized according to Birmingham Eye Trauma Terminology System into simple injuries; including subconjunctival hemorrhage, corneal abrasion, ulcer or foreign body, and serious injuries; full thickness laceration, lens or retinal injuries (Dogramaci et al., 2021).

Consent

Informed consent was obtained from each participant sharing in the study after assuring confidentiality.

Ethical Approval

Ethical approval was obtained from the Ethical Committee at the Faculty of Medicine, Mansoura University, with approval number IRB (R.22.06.1744. R1), and followed ethical guidelines.

Data Management

Data were analyzed using SPSS software (version 17.0 for Windows; SPSS Inc., Chicago, IL, USA). Descriptive statistics were calculated for all variables (qualitative) that were presented as frequencies and percentages. Chi-squared test was used for categorical data to compare between occupational and non occupational eye injuries according to different associated factors. Crude Odd's ratio (COR) and their 95% CI were calculated. Multivariate binary logistic regression was done to detect the independent predictors of occupational eye injuries with calculation of Adjusted Odd's ratios (AOR) and their 95% CI. The statistical significance level was set at ≤ 0.05.

Results

Table (1): The socio-demographic characteristic of the studied population.

Univariate analysis					Regression analysis		
Characteristics	**Total No.**	**Occupational eye injuries No(%)**	**Test of significance**	**COR** (95% CI)	**β**	**P**	**AOR**(95% CI)
Overall	357	204(57.1)					
Age (years):							
<40(r)	206	102(49.5)	χ^2=11.6	1	0.5	**0.03***	1.7(1.1-2.8)
≥40	151	102(67.5)	**p≤0.001***	2.1(1.4- 3.2)			
Sex :							
Male	293	192(65.5)	χ^2=46.9	8.2(4.2-16.1)	1.8	**≤0.001***	6(2.8-12.8)
Female(r)	64	12(18.8)	**p≤0.001***	1			
Educational level:							
Below Secondary	185	118(63.8)	χ^2=6.9	1.8(1.2-2.7)	0.5	**0.04***	1.6(1.1-2.6)
Secondary/above(r)	172	86(50.0)	**p=0.004***	1			
Marital status:							
Married	270	162(60.0)	χ^2=3.7	1.6(0.9-2.6)			
Unmarried (r)	87	42(48.3)	P=0.06	1			
Current smoking cigarettes:							
Yes	199	138(69.3)	χ^2=27.3	3.2(2.04-4.9)			
NO(r)	158	66(41.8)	**p≤0.001***	1			

Alcohol and drug abuse:							
Yes	10	5(50.0)	χ^2=0.2	0.7(0.2-2.6)			
NO(r)	347	199(57.3)	p=0.6	1			
Underlying medical condition:							
#Diabetes mellitus	30	17(56.7)	χ^2=0.003,P=0.9	0.9(0.5-2.1)			
#Hypertension	204	27(13.2)	χ^2=0.9,P=0.3	1.4(0.7-2.7)			
Residence :							
Urban	128	74(57.8)	χ^2=0.03	1.1(0.7-1.6)			
Rural(r)	229	130(56.8)	p=0.8	1			

#: The reference group (r) are those without diabetes or hypertension, *: significant p value ≤ 0.05

Table 1 showed that the overall prevalence of occupational eye injuries among the study population was 57.1%. The significant independent predictors of occupational eye injuries among participants were: being male ,aged ≥40 years and educated below secondary: (AOR:6,95% CI:2.8-12.8, AOR: 1.7,95% CI:1.1-2.8and AOR: 1.6,95% CI:1.1-2.6, respectively).

Table 2: Accident analysis and injury characteristics among patients with eye injury.

Characteristics	Total No=357	Occupational eye injuries No=204 No (%)	Test of significance	COR (95% CI)	Regression analysis		
					β	P	AOR(95% CI)
Accident time:							
Day	278	176(63.3)	χ^2=19.5	3.1(1.9-5.3)	1.1	**≤0.001***	2.9(1.7-5.1)
Night (r)	79	28(35.4)	**p≤0.001***	1			
Occupational eye accident before:							
Yes	82	73(89.0)	χ^2=44.2	8.9(4.3-18.5)	2.1	**≤0.001***	8.4(3.5-20.6)
NO(r)	275	131(47.6)	**p≤0.001***	1			
Previous non-occupational eye injury:							
Yes	91	69(75.8)	χ^2=17.4	3.04(1.8-5.2)			
NO (r)	266	135(50.8)	**p≤0.001***	1			
Previous ocular surgery:							
Yes (r)	36	19(52.8)	χ^2=0.3	1			
NO	321	185(57.6)	p =0.6	1.2(0.6-2.4)			

#: The reference group (r) are those without diabetes or hypertension *: Significant p value ≤ 0.05

Table 2 showed that the risk of occupational eye injuries among participants increased in the day time (AOR: 2.9,95% CI: 1.7-5.1)and with history of similar accident before (AOR:8.4,95% CI:3.5-20.6) .

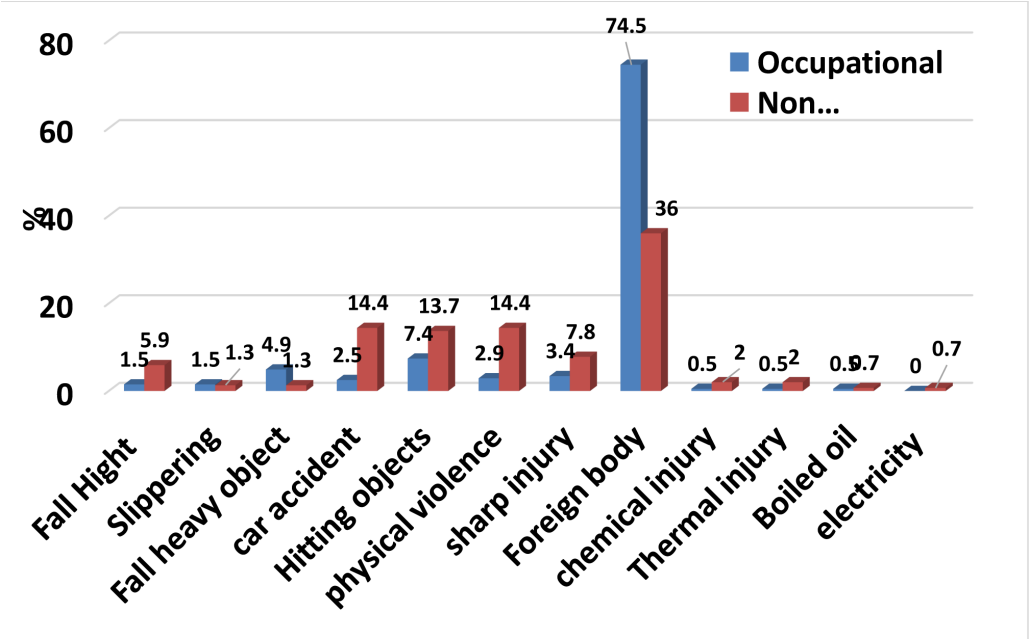

Figure (1): Accident external causes in occupational and non-occupational eye injuries.

Figure 1 showed that the main cause of eye injuries among both occupational and non occupational eye injuries was foreign bodies (74.5% and 36%, respectively)

Table 3: Occupational eye injuries according to job characteristics

Job characteristics	Occupational eye injuries **No**=204 **No (%)**
Job experience (years):	
≤20	158(77.5)
>20	46(22.5)
Mean±SD	1410.1±
Shift work:	
Yes	116(56.9)
NO	88(43.1)
Daily maximum working hours:	
≤8	100(49.0)
>8	104(51.0)
Mean±SD	92.5±
Similar accidents among colleagues	
Yes	105(51.5)
NO	34(16.7)
Don't know	65(31.9)
Eye #PPE use at work:	
Yes	81(39.7)
NO	123(60.3)

#:e.g. eye goggles, face shield, spectacles

Table 3 showed that occupational eye injuries were more frequent among those working for ≤ 20 years , having shift work , working > 8 hours/day , having co workers in the same job with eye injury before and those who do not use eye PPE : 77.5% , 56.9%, 51.0%, 51.5% and 60.3% , respectively.

Table 4: Distribution of occupational and non-occupational#eye injuries according to eye anatomy and severity among the studied population.

	Occupational eye injuries 204 (100.0) No (%)	Non Occupational eye injuries 153 (100.0) No(%)
Anatomy of eye		
Cornea	147 (72.1)	83 (54.4)
Multiple Injury	16 (7.8)	24 (15.68)
Conjunctiva	15 (7.4)	20 (13.07)
Eyelid	14 (6.9)	18 (11.76)
Crystalline lens	10 (4.9)	4 (2.61)
Retina & Vitreous	2 (0.9)	4 (2.61)
Level of injury severity		
$Simple injuries	135 (66.5)	85 (55.5)
@Serious injuries	69 (33.5)	68 (44.5)

#:per eye= per patient (all unilateral eye lesion) (mutually distributed), $:Subconjunctival hemorrhage, corneal abrasion, ulcer or foreign body, @: Full thickness laceration, lens or retinal injuries.

Table 4 showed that corneal injuries and simple eye injuries were the most common among both occupational and non occupational eye injuries (72.1% ,66.5% and 54.4%,55.5% respectively) .

Discussion

A significant proportion of eye injuries, that result in visual morbidity worldwide, is occurring in the workplace (Kyriakaki et al.,2021). The lifetime prevalence of job related ocular injuries to an individual is 4% (Forrest and Cali , 2009).

The present study detected that the overall prevalence of occupational eye injuries among the studied population was 57.1%(Table 1) and this could be attributed to the shortage of workplace safety regulations and outdated policies as well as level of enforcement in middle and low income countries in general including Egypt. This was in agreement with studies done in India by(Krishnaiah et al., 2006), in Singapore by (Woo and Sundar ,2006) and in Thailand by (Voraporn et al., 2015), that detected similar prevalence of occupational eye injuries (56% , 56% and 50%, respectively). However, a lower prevalence was detected in Egypt (36.7%) by (Elhesy ,2016), and in Bosnia and Herzegovina (27.5%) by(Jovanovic et al.,2016) while much lower prevalence (5.6%) was detected in Italy by (Gobba et al., 2017). Higher prevalence (85.0%) among welders was reported in Nigeria (Nwala et al., 2014).

The current work found that being male increased the risk of occupational eye injuries (AOR: 6),(Table 1) , which was in concordance with a study in the United States that detected that males were at higher risk of occupational eye injuries (RR= 1.22)(Zhou et al., 2023) . However, another study in US proved that controlled exposures (means adjusting hazardous work exposures in both sexes) make females at higher risk than males for occupational injuries (Smith et al., 2005).

The risk of occupational eye injuries increased with being aged ≥40 years (AOR:1.7) among the studied group (Table 1), and this may be referred to inattention while hurrying , eye PPE use negligence and easy fatigability. This finding was in harmony with the results detected by (Kanoff et al., 2010) from United States in their study on characteristics and outcomes of work-related open globe injuries. However , this was in contrast to that detected in Italy(Gobba et al., 2017)and in Turkey(Serinken et al., 2013)as the risk increased in younger age due to lack of experience and careless .

Being educated below secondary level increased the risk of occupational eye injuries (AOR:1.6) among the

studied population(Table 1) and this could be explained by poor knowledge about eye safety at work . This finding was similar to a work done in Indonesia that detected that the carpenters educated below university had higher prevalence of occupational eye injuries (Lubis et al., 2018).In contrast with this result, higher proportion of workplace eye injuries was found among those educated higher than secondary level in Bosnia and Herzegovina(Jovanovic et al.,2016). However, no association between occupational eye injuries and the level of education was reported in Ethiopia (Mengistu et al., 2021).

The risk of occupational eye injuries among the studied population was more common and increased in the day time (AOR: 2.9) (Table 2), which could be explained by exhaustion under sun light , and this was in accordance with Nigerian study(Ezisi ,2019).However , injuries related to occupational exposure were more at night as reported from previous study(Uwakwe ,2015).

Those patients with history of occupational eye accident before, had higher risk of occupational eye injuries (AOR: 8.4) (Table 2) , and this agreed with that detected in Italy where the workers with previous occupational eye injury were at potential risk for new eye injuries(Gobba et al., 2017). Similarly, a study in India found that the workers proneness to occupational injuries increased with previous ones (Regina et al., 2020) .

Occupational eye injuries were more frequent among those working for ≤20 years among the studied group, working > 8 hours/day and those not using eye protection devices(Table 3), which was in concurrence with the results detected by Lubis et al.,(2018) in their study on work-Related ocular trauma among the carpenters in Medan, Indonesia.

Also the current work found the more frequent occupational eye injuries among those working shift work and having co workers in same job with history of eye injury before(Table 3) and these findings were in accordance with studies of occupational eye injuries in Egypt (Abdelhakim and Nabil ,2019).

The main cause of occupational eye injuries was foreign body (74.5%), (Figure 1).Similar studies agreed with the current finding (Ho et al., 2007 ;Serinken et al., 2013; Ezisi ,2019; Fekih et al., 2021).Also chemical injury was a less common cause of eye injury due to occupational exposure (0.5%),

and this disagreed with that detected by Gobba et al., (2017) in their study on work-related eye injuries in a highly-industrialized area of Northern Italy and found that chemical injury was the second common cause of occupational eye injuries.

The occupational eye injuries which affected the cornea were 72.5% and simple injuries were 66.5% (Table4). These findings were supported by three studies conducted in Malaysia which reported that corneal laceration represented 61.5% of eye injuries (Soong et al., 2011) and the common anatomical site of injury was the cornea 43.60% (Thevi et al., 2012)and also the simple injuries were more common and accounted for 51.6%(Omar et al., 2022).

Conclusion

The current study showed that the prevalence of occupational eye injuries among the study population was 57.1% and the significant independent predictors of occupational eye injuries were: being male, aged ≥40 years, educated below secondary, day time and those with history of similar accident before. The frequency of occupational eye injuries increased among those working for ≤ 20 years , having shift work , working > 8 hours/day , having co workers in same job with eye injury before and those who do not use eye PPE. The main cause of eye injuries was foreign bodies and also the corneal injuries and simple eye injuries were the most common among both occupational and non occupational eye injuries.

Recommendations

Regular occupational eye safety programs and encouraging eye protection devices use which should be offered to workers especially those performing specific tasks with potential risk for eye trauma. Health education and pre employment training to workers should be provided to make safe workplace environment with instruction of an adequate occupational eye injury surveillance system. A large scale multi-center, or better a community-based study is warranted to give the full picture of occupational eye injuries. An eye injury national electronic registry will help in studying secular trend in both occupational and non-occupational eye injuries.

Conflict of Interest

All authors declared that there are no competing interests to disclose.

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