Original Article

Work Related Ocular Injury: Nepal

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Abstract

Introduction: Occupational eye injuries comprise a major source of ocular trauma. Knowledge of the epidemiology of occupational eye injuries is essential to formulate viable safety strategies. **Objectives:** To evaluate the demographics, patterns of protective eye wear use, and patterns of occupational eye injury among workers in Hetauda, Nepal. **Materials and methods**: Community based cross-sectional prospective survey was carried out from September 2010 to July 2011. Survey included all workers irrespective of their age and those who are willing to participate in survey by filling details on structured questioners and comprehensive eye examination at community level. **Results**: 1236 surveys were collected. 38.3% (473) of workers surveyed reported experiencing a work-related eye injury. Over two-thirds [68.3% (844)] of workers surveyed reported never wearing safety eyewear while at work. There was a positive correlation between male sex (P<0.001), reported previous work-related injury (P<0.001), and attending school (P=0.016) and use of personal protective equipment (PPE). **Conclusions**: The population studied demonstrates a significant level of work related injury. There are potentially modifiable factors that could lead to increased use of eye protection.

Key words: Eye, Occupational injury, Nepal, Vision, Protective equipment

Introduction

Ocular trauma is a major public health problem with the potential to cause severe ocular morbidity, (Dannenberg et al. 1992; Lombardi et al. 2009) and a significant portion of ocular trauma is due to occupational injury (Dannenberg et al. 1992; Fong & Taouk 1995; Mansouri et al. 2010; Soong et al. 2010). Work-related injury is a leading cause of ocular trauma in both developing and industrialized countries (Glynn et al. 1988; MacEwen 1989; Dannenberg et al. 1992; Mela et al. 2005; Lindstedt 2009; Mansouri et al. 2010; Soong et al. 2010).

Work-related eye trauma tends to be severe when compared with injury sustained outside of the workplace (Brilliant et al. 1985; Mela et al. 2005). As a result, the burden of work-related ocular injury is relatively high (Lombardi et al. 2009). In developing countries like Nepal, ocular injury tends to be particularly severe and

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frequent (BRILLIANT et al. 1985). According to the Nepal Blindness Study conducted in 1981, trauma is the second leading cause of all unilateral blindness, and the eighth leading cause of bilateral blindness (BRILLIANT et al. 1985; Lombardi et al. 2009). The medical expenditure and income loss (i.e. due to missed days of work) associated with work-related eye injuries can significantly decrease one's quality of life. The severe nature of many work-related eye injuries results in prolonged hospital stay, frequent surgical intervention, and a subsequent rise in overall medical expenditure. Even after treatment, work-related ocular trauma has been shown to decrease victims' personal and household per capita income significantly. This is in addition to the emotional depression and anxiety that most victims report, which all contribute to the burden of work-related ocular trauma (Le et al. 2012).

In developing countries, like Malaysia and Iran, the incidence of work-related ocular injuries is highest amongst young adult males, and this is likely secondary to documented low rates of personal protective equipment (PPE) use when undertaking high-risk activities (Mansouri et al. 2010; Soong et al. 2010). In a recent study by Ramakrishnan et al., all patients presenting with work-related injuries secondary to corneal metallic foreign bodies recalled a definite history of an incident leading to the injury (Ramakrishnan et al. 2012). This suggests that most injuries resulting in considerable loss of vision are preventable. Similar findings have been made in the developed world, as evidenced by the National (U.S.) Society for the Prevention of Blindness estimate that 90% of all eye injuries could be prevented with protective equipment (Burlew 1991). These findings collectively suggest that there is a serious and necessary role for safety strategies to prevent work-related eye injures.

From a public health perspective, current epidemiologic information on occupational eye injuries is crucial in designing and implementing safety strategies in the work place. Up to this point, very little data exists regarding ocular trauma arising from work-related injuries and the use of protective equipment in Nepal. The present study aimed to evaluate the demographics, patterns of PPE use, and patterns of eye injury amongst workers receiving on-the-job eye screening exams in Hetauda, Nepal.

Materials and Methods

This is a cross sectional community based prospective study. From September 2010 to July 2011, 1236 workers in Hetauda, Nepal, were interviewed following complimentary eye screening examinations provided by Hetauda Community Eye Hospital's Work-Related Ocular Trauma Project, which is conducted in conjunction with Working Vision, Inc., a US-based 501(c)3 not-for-profit organization (www.workingvision.net). The study protocol was approved by the ethics committee of Hetauda Community Eye Hospital, and was conducted according to the tenets of the Declaration of Helsinki. Individual examinations and interviews were conducted during single visits to 16 different manufacturing sites. Informed consent was obtained prior to survey administration, and as part of the consent process, workers were informed that they would receive an eye screening examination.

Factory screenings were conducted by an ophthalmologist (Ben Limbu) and trained ophthalmic technicians. Visual acuity was recorded at the time of examination using a Snellen acuity chart at a distance of 20 feet. The ophthalmologist examined the anterior and posterior segments using a portable slit lamp (SHIV NIPPON SL-1, LED, Nippon Instruments, Mumbai, India) and a hand-held direct ophthalmoscope. Further eye examination, including IOP measurement with a Schiotz tonometer, Schirmer test, Fluorescein

dye test, and fundus evaluation under mydriasis, was performed on an as-needed basis. Complicated cases were referred to Hetauda Community Eye Hospital for further work-up and confirmation of diagnosis.

A standard 15-question survey was completed through an in-person interview. Trained ophthalmic technicians conducted the interviews. Information about age, sex, safety eyewear usage, previous history of ophthalmic disorders (including prior work-related eye injuries), level of education, and duration of employment in manufacturing was collected.

Statistical Analysis

Results were reported as mean ± standard deviation (SD) for continuous variables and percentages (%) for categorical variables. Continuous variables between groups were compared by the t-test or one-way ANOVA test. Categorical variables were compared using the chi-square test. Individual predictors for PPE use were first considered in uni-variable logistic analyses to estimate the strength of association between the individual predictor and reported PPE use. All predictors were simultaneously considered in a multivariable logistic regression model to control for potential confounders. All statistical analyses were performed with commercially available software (Stata version 11; StataCorp, College Station, TX, USA). The alpha level (type I error) was set at 0.05.

Results

A total of 1236 workers (Table 1) with an average age of 36.51 (± 11.94) years, who had worked for an average duration of 152.49 (± 149.05) months, participated in both the eye screening examination and post-exam interview. All workers who presented for our eye examination agreed to participate in our study.

82.4% (1019) of workers were male and 17.6% (217) were female. Compared to female workers, male workers were younger, had a lower duration of work, and had a higher level of education (Table 2). 79.0% (977) of workers reported attending at least primary school, and 27.1% (335) reported a higher level of education (i.e. above grade 10).

Of the workers surveyed, 38.3% (473) reported experiencing at least one ocular injury while at work. Gender had a significant effect on the ocular injuries, with 31.3% (68) of females workers compared to 39.7% (405) of male subjects reporting having experienced an ocular injury while at work (P=0.021). A larger percentage of males also reported using PPE (Table 2). Among workers who had experienced a work-related eye injury, 77.2% (365) sought treatment following the injury. Among workers who sought treatment, 86.3% (315) received medical treatment while 13.7% (50) required surgical treatment. 79.1% (317) of the male workers with eye injuries sought treatment while 70.1% (48) of the female workers with injury sought treatment. This difference did not reach statistical difference (P=0.120).

68.3% (844) of workers reported never wearing safety eyewear while at work (Figure). Of the 31.7% (392) of workers who reported currently wearing protective eyewear at work, 47.7% (187) reported wearing protective eyewear at all times during work, which represented only 15.1% of the entire study population.

Using uni-variable logistic models, age, male sex, attending school, duration of work, and reported previous work-related injury all had a significant effect (P<0.001) on the use of PPE at work (Table 3). When all of these factors were combined in a multivariable model to control for potential confounders, only male sex (P<0.001), reported previous work-related eye injury (P<0.001), and attending school (P=0.016) had a significant effect on use of PPE. Duration of work was negatively associated with PPE use, although this relationship did not reach statistical significance (P=0.121).

Eye screening examinations (Table 4) revealed that 2.3% (28) of workers were blind unilaterally according to the World Health Organization (WHO) definition. Table 5 lists the frequencies of ocular conditions in each eye. 59.5% (735) of participants had one or more ocular conditions in at least one eye. The most common eye conditions were presbyopia and refractive error.

Table 1: Worker demographic and clinical characteristics.

Variable	n (Categorical Variables) mean (Continuous Variables)	% (Categorical Variables) ± SD (Continuous Variables)
Gender		
Male	1019	82.4%
Female	217	17.6%
Age (years)	36.51	± 11.94
Male	35.59	± 11.66
Female	40.82	± 12.29
Work duration (months)	152.49	± 149.05
Male	130.16	± 129.92
Female	257.31	± 184.63
Work-related eye injury	473	38.3%
1 event	157	12.7%
2 events	108	8.7%
3 events	70	5.7%
4 events	37	3.0%
5 events	22	1.8%
>5 events	79	6.4%
PPE* use at work (Yes)	392	31.7%
Male	374	30.3%
Female	18	1.5%
Always Uses PPE*	187	15.1%
Sometimes Uses PPE*	205	16.6%
Never Uses PPE*	844	68.3%
Attended School	977	79.0%
Male	854	69.1%
Female	123	10.0%
Education level: Primary ≤ Standard 5 years	311	25.2%
Education level: Secondary ≥ Standard 5 years	332	26.9%
Education level: Higher > Standard 10 years	335	27.1%

*PPE=personal protective equipment

Table 2: Comparison of worker characteristics based on gender.

Variable	Male: *Categorical: n (SD) Continuous: mean (%)*	Female: *Categorical: n (SD) Continuous: mean (%)*	P-value
Age	35.59 (11.66)	40.82 (12.29)	<0.001
Duration of work	130.16 (129.92)	257.32 (184.63)	<0.001
Attended School	854 (83.8%)	123 (56.7%)	<0.001
Education level: Primary ≤ Standard 5 years	254 (29.7%)	57 (46.3%)	0.679
Education level: Secondary ≥ Standard 5 years	298 (34.9%)	34 (27.64%)	<0.001
Education level: Higher > Standard 10 years	303 (35.4%)	32 (26.0%)	<0.001
PPE* use	374 (36.7%)	18 (8.3%)	<0.001
History of work-related eye injury	405 (39.7%)	68 (31.3%)	0.021

*PPE=personal protective equipment

Table 3: Univariable and multivariable logistic regression models for determination of relationship between worker characteristics and personal protective eye use.

Variable	**Univariable Logistic Model**		**Multivariable Logistic Model**	
	OR	**P-value**	**OR**	**P-value**
Age	0.981	<0.001	1.001	0.888
Sex	6.411	<0.001	4.995	<0.001
Attending school	2.251	<0.001	1.564	0.016
Duration of work	0.998	<0.001	0.999	0.121
History of work-related eye injury	2.047	<0.001	1.993	<0.001

Table 4: Visual acuity frequencies.

Visual Acuity	**Right Eye**		**Left Eye**	
	n	**%**	**n**	**%**
6/18 – 6/6	1181	95.6%	1192	96.4%
6/24-6/60	38	3.1%	33	2.7%
<6/60-3/60	6	0.5%	7	0.6%
<3/60	7	0.6%	4	0.3%
NLP*	4	0.3%	0	0%

*NLP = no light perception

Table 5: Frequencies of eye disorders.

Eye condition	Right Eye		Left Eye	
	n	%	n	%
NAD*	543	43.9%	542	43.9%
Refractive error	142	11.5%	146	11.8%
Presbyopia	334	27.0%	335	27.1%
Presbyopia + Refractive error	38	3.1%	39	3.2%
Infectious Conjunctivitis	5	0.4%	7	0.6%
Pterygium	42	3.4%	46	3.7%
Allergic Conjunctivitis	7	0.6%	8	0.7%
Chronic Conjunctivitis	14	1.1%	14	1.1%
Senile Cataract	25	2.0%	26	2.1%
Pseudophakia	10	0.8%	7	0.6%
Other Post Segment Disease	8	0.7%	6	0.5%
Dry Eye	41	3.3%	42	3.4%
Chalazion	4	0.3%	2	0.2%
Entropion	0	0.0%	0	0.0%
Corneal Opacity	25	2.0%	20	1.6%
Corneal ulceration	2	0.2%	2	0.2%
Pinguecula	75	6.1%	74	6.0%
Bitot's Spot	0	0.0%	0	0.0%
Strabismus	1	0.1%	3	0.2%
Glaucoma	5	0.4%	4	0.3%
Trauma Cataract	1	0.1%	1	0.1%
Optic Atrophy	2	0.2%	3	0.2%
Stye	1	0.1%	1	0.1%
Episcleritis	2	0.2%	5	0.4%
Scleritis	0	0.0%	0	0.0%
Uveitis	0	0.0%	0	0.0%
Blepharitis	5	0.4%	6	0.5%

*NAD=No Active Disorder

Discussion

Although work-related ocular trauma is a major cause of visual morbidity worldwide, minimal information is available regarding its epidemiology outside the United States (Klopfer et al. 1992; McGwin et al. 2005) and other industrialized nations (Blomdahl & Norell 1984; LP 1995). Moreover, there are considerable discrepancies in ocular trauma incidence, prevalence, and worker characteristics when one compares epidemiological studies conducted in developing countries with those conducted in industrialized nations. These variations can be explained by differences in study design, cultural norms, and location (rural versus urban), and each of these differences highlights the need for additional regional studies. The goal of this study was to evaluate the demographics, patterns of PPE use, and prevalence of work-

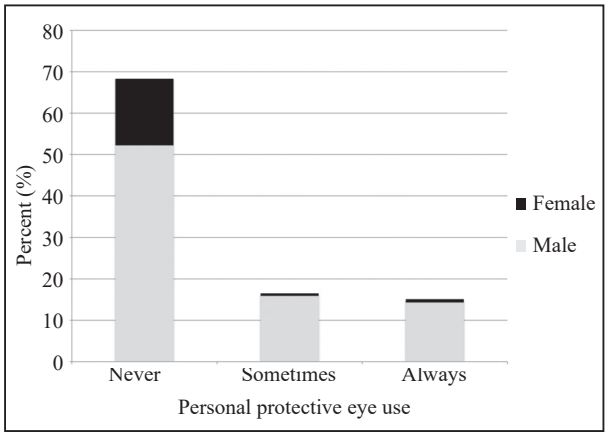

Figure: Prevalence of personal protective equipment (PPE) use. Most participants (68.3%) reported never using PPE during work. 16.6% of the study population reported using PPE at some times, and 15.1% reported using PPE at all times during work.

related ocular trauma amongst a population of workers in Hetauda, Nepal. To the best of our knowledge, this is the first study examining the epidemiology of work-related ocular trauma in Nepal.

Our study population consisted mainly of young (mean age of 36.51±11.94 years) males (82.4%), and this was similar to other work-related ocular trauma studies from developing nations (Krishnaiah et al. 2006; Cillino et al. 2008).

Our population demonstrated a significant level of work-related injury, with more than one-third (38.3%) of workers surveyed reporting at least one previous work-related eye injury. The high proportion of work-related eye trauma amongst our patients may be attributed to several causes, including a low PPE usage rate. In our study, less than one-third (31.7%) of the workers reported wearing PPE while at work, and only 15.1% (187) of workers reported using PPE at all times.

Personal protective eyewear is highly effective in preventing work-related eye injuries (Mancini 2005; Forst et al. 2006).

In our study, we found that male sex, attending school, and previous history of work-related eye injury were positively associated with PPE use. Workers with previous injuries likely understood the preventative merits of protective eyewear and altered their PPE usage behavior after sustaining their ocular injuries. However, even among the subset of workers with a history of ocular injury, more than half (58.6%) reported never using PPE. This shows that additional factors may affect PPE usage. Yu et al. demonstrated that a simple, employer-enforced requirement for PPE use increases its use in the workplace and decreases the risk of work-related eye injury,(Yu et al. 2004) and Lombardi et al. highlighted the importance of comfort, fit, and fogging tendency in PPE usage.(Lombardi et al. 2009) Future studies should investigate potential barriers to PPE use in this region and other developing countries.

As reported above, gender had a significant effect on the prevalence of PPE use in the current study, even after adjusting for education, age, duration of work, and past history of ocular injury. This finding brings attention to potential female-specific barriers to PPE use. In a previous study, poor access to protective equipment was an important factor affecting women's occupational health and work-related injury level.(Choi 2005) This study also reported major challenges in improving women's occupational health, including a lack of both public education on women's occupational health and innovative solutions to improve it (Choi 2005). Future studies should investigate variations in access to PPE and PPE usage rates according to gender.

Ocular trauma frequently affects adult males. In our study, men reported more work-related eye injuries, and this finding was similar to previous reports (Glynn et al. 1988; Thylefors 1992; Mansouri et al. 2010; Soong et al. 2010). One hypothesis for this involves differing occupational exposure (i.e. men are more likely

to work in hazardous occupations). However, Smith et al. reported that eye injuries were higher in male workers even after adjusting for occupational exposure, suggesting that occupation does not fully explain the difference in reported work-related eye injuries (Smith et al. 2005). Other studies have demonstrated that compared to women, men are less likely to perceive threat from risky behaviors and are more likely to overestimate their abilities (DeJoy 1992; Howland et al. 1996). These findings could offer some explanation for the observed sex differences in work-related eye injuries.

The prognosis of ocular trauma is likely worsened by not seeking timely treatment (Brilliant et al. 1985). In our study, 22.8% of injured workers did not seek medical treatment. A study on the prevalence of ocular injury in Baltimore, Maryland, USA reported similar results with 18% of injured participants not seeking treatment (Katz & Tielsch 1993). Other studies have noted that patients with more severe eye injuries, especially those at risk of blindness, were more likely to seek timely medical attention (Brilliant et al. 1985). Eleven of the participants in our study with a history of ocular trauma were also unilaterally blind based on WHO criteria.

In our study population, refractive error and presbyopia were the most common ocular conditions noted on exam. Uncorrected refractive errors are the second leading cause of blindness, after cataract, and the foremost cause of low vision worldwide (Resnikoff et al. 2008). Apart from its direct clinical significance, visual impairment from ocular conditions has been shown to affect worker productivity(Ashaye & Asuzu 2005) and the incidence of injurious accidents in elderly individuals (Kulmala et al. 2008). Although public health efforts have largely reduced blindness and impaired vision secondary to refractive error in industrialized nations, refractive error remains a significant source of avoidable vision loss in developing countries like Nepal,(Dulal & Sapkota 2012) as is suggested by our study.

Although strengthened by a relatively large sample size and the use of a standardized survey, our study has limitations. This study only included workers who chose to attend the aforementioned screening and safety eyewear distribution programs, thus indicating a potential selection bias for participants who were more concerned with eye safety and health. These participants may have been more likely to wear protective eyewear. We also did not collect information on the time between injury and treatment or the type of practitioner sought for treatment (i.e. nurse vs. family physician vs. ophthalmologist etc.). Additionally, we did not record whether injured workers had used PPE at the time of their injuries, and thus we could not analyze the effect of PPE use on rates of injury. With that said, PPE use at time of injury likely would have been subject to recall bias. Lastly, we did not collect specific information on ocular hazards associated with each person's performed duties.

Conclusion

Our findings provide important epidemiological data about work-related eye injuries in Nepal. We demonstrated a significant level of work-related ocular injury and low rates of PPE use among the workers that we surveyed. The main predictors for PPE use were male, reported previous work-related injury, and attending school. Additionally, the current study demonstrated that gender had a significant effect on the incidence of work-related ocular injury and PPE use, with female workers reporting lower rates. Finally, our study suggested possible areas for interventions to increase PPE use. In turn, this data may eventually aid in the implementation of cost-effective, eye-safety measures for high-risk workers in Nepal and other developing countries.

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