Workplace eye injuries: a literature review

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ABSTRACT

Although rules and regulations for eye protection in the workplace exist, injuries continue to occur. Non-compliance with existing guidelines and the high rate of not issuing protective eye devices by employers reflect the lack of adherence to the Occupational Health and Safety Act. The purpose of this paper is to highlight the need for eye healthcare providers to provide advice on the use of personal protective equipment and to promote eye health awareness in the workplace. A literature review of studies reporting occupational eye injuries and workplace safety was conducted to identify the common reasons for continued injuries despite safety guidelines. There are differences in the types and incidence rates of eye injuries between developed and developing countries as well as between rural and urban workforces. Although there is legislation that addresses eye protection in South Africa, educating employees and employers about eye safety, and compliance with safety regulations, is necessary to improve ocular health and safety amongst workers.

Keywords: **compliance, occupational health and safety, ocular health, injuries, prevention**

INTRODUCTION

In developing countries, healthcare resources in the workplace are often limited and do not reach those in greatest need.[1] This distracts the healthcare focus of workplace managers from instituting prevention controls to providing services to those who have been careless or negligent. As a result, the accident rates remain higher than necessary and the health and lives of workers continue to be at risk.[1] This is also the case for ocular incidence rates, with the possibility of ocular trauma rates being higher in newly established factories, particularly small scale industries in developing countries, due to poor working conditions, long hours at work and poor organisational safety measures.[2] Emerging international literature acknowledges the importance of identifying potential hazards, resulting in ocular accidents in the workplace but, despite measures to reduce risks and prevent these injuries, the use of safe machinery and proper protective devices is generally inadequate.[1,3] Occupational ocular trauma remains the most common cause of acquired monocular blindness, particularly in industrialised countries.[3] Knowledge about the epidemiology of workplace injuries will therefore serve as an essential tool in the formulation of workplace safety measures.

Ocular injuries can occur anywhere in the environment; however, the risks appear to be higher among workers in industries such as mining, manufacturing, construction and agriculture.[4] The location where the injury occurs is related to the environmental hazards present.[4] Eye injuries occur in the workplace through exposure to chemicals, lasers or heat from expansion of industrial products, without adequate safety precautions.[5] Previous studies have reported that the workplace is the most common location in which adults experience eye injuries.[6-8] Islam et al.[9] and Mackiewicz et al.[10] reported a higher incidence of injuries in the agriculture, fisheries and forestry industries than manufacturing and construction sectors in the United States of America (USA) and Poland, respectively. The main causes of injuries in rural poor communities are agricultural practices whereas, in more developed communities, industrial activities are more likely to be responsible for the injuries.

Epidemiology of ocular injuries

The number of cases of ocular trauma causing temporary or permanent visual loss has been reported to be close to 70 000 each year in the USA, while approximately 1 000 preventable ocular injuries are incurred every day in the workplace.[9] In 1998, the annual incidence rate of work-related ocular injuries was 567 per 100 000 employees in the USA (3 699 injuries among 652 956).[9] Data released by the National Institute for Occupational Safety and Health (NIOSH) estimated that 900 000 occupational eye injuries occurred in 1982 and that most were caused by ocular foreign bodies, 84% of which were minor, as cited in a study by Islam et al.[9] Ocular injuries were reported to account for 5.0% - 6.1% of all workers compensation claims in Singapore in 2006.[7,8]

Reports have indicated that ocular trauma victims are predominantly active middle-aged men,[4,11] the resultant visual loss imposing an enduring burden of social, psychological, economic and financial implications.[12] Males appear to be more affected than females: Islam et al.[9] highlighted that, in industries where a greater proportion of females is

employed, a higher incidence rate is still seen among male employees.

Industry

Rates of work-related eye trauma vary worldwide, with studies reporting estimates of 70% in the United Kingdom (UK), 38.9% in Taiwan, 32.8% in Greece, 19.6% in Scotland and 14.3% in the USA.[7,8] In Singapore, the annual incidence of work-related eye injuries accounted for 8% of all occupational injuries in 2006[7,8] with 56.4% of all eye injuries being work-related, and 54.1% of patients being injured on industrial premises. It was reported in 1967 to 1976 that more than 70% of all serious eye injuries occurred in the workplace due to the lack of knowledge about protective devices, especially in heavy industry, in Glasgow, Scotland.[13,14] In rapidly developing economies, occupational accidents occur mostly in the manufacturing sector.[2,3,15] According to Kanski,[16] two-thirds of accidental burns occur at work. Saini and Sharma[17] also reported that 80% of chemical injuries in the workplace in Finland were as a result of accidental exposure to acids and alkalis.

Causes/hazards of ocular injuries in the workplace

Lamellar lacerations have been reported to be the most frequent type of ocular injury in the construction industry, with 71.3% of cases of superficial corneal foreign body being associated with welding, grinding, cutting, metal, hammering and drilling, and 60% being associated with high-speed machinery, involving grinding activities and hacking.[7] A survey conducted in Portugal showed a prevalence rate of 29.6% of intraocular foreign bodies (IOFBs) which was more frequent when working with metallic objects (50%).[18] The incidence of endophthalmitis was 5.7% with a trend for a higher risk with IOFBs.[18] Dhir et al.[19] reported that the use of a hammer and chisel was responsible for IOFBs in 61.1% patients followed by working on power driven machines and tools (24.4%) in India in 1980. The other reported modes of injury were dynamite blasts, gun shots and glass bottles. Murillo-Lopez et al.[6] also showed that work-related injuries were often as a result of IOFBs made of metal in 79.0% of cases, wood in 9.7%, stone in 7.0% and glass in 4.3%, with subsequent presentation to an emergency department for evaluation being essential.[6,18]

Agriculture

The risks of eye injuries in agriculture remain high, as preventive measures are often insufficient or absent. Agriculture-related incidence of eye injuries is approximately four times higher than in industry, as there is a greater range of possible eye hazards when a worker undertakes a number of different tasks during the course of the day and measures to protect the eyes cannot be readily applied.[10] In the early 1990s, Thylefors[11] reported that injuries sustained in agricultural societies were superficial, but often led to rapidly progressing corneal ulceration and blindness. Khatry et al.[20] estimated "the annual incidence of eye injuries in agriculture to be 3.46 per 10 000 people, which was higher than in industry (1.9 per 10 000 people) but lower than in construction (5.3 per 10 000 people)". Saari and Aine[21] found that the blindness rate was 21.9% after analysing various eye injuries in agricultural workers (superficial, blunt and penetrating) in Finland. A study conducted by Gyasi et al.[22] in Ghana showed that most ocular injuries occurred in the agriculture industry.

In agricultural workers, vegetation such as twigs and branches cause many eye injuries. Abraham et al.[23] showed that 67.0% of injuries in rural Tanzania were caused by a stick and that, after treatment, most patients had poor visual acuity in the affected eye. A study in Malawi, where 80% of the working population engaged in agriculture and lived in rural areas, only 1.5% of the ocular injuries were related to agricultural activities.[24] This finding may be attributed to the fact that eye injuries occurring in the fields are often too minor to warrant admission to hospital as well as the low level of farm mechanisation in Malawi.[24] According to a study by Canavan and Archer.[25] in Ireland, only 4.0% of the total eye injuries in the period 1976 to 1979 resulted from agricultural pursuits, despite the study hospital being situated in a community with a large rural population. Mechanisation in the agriculture industry in Ireland resulted in a greater number of injuries,[25] despite a corresponding reduction in the number of workers employed in the industry.

Personal protective equipment

Personal protective equipment (PPE) can be used to protect the wearer's face, including the eyes, from a variety of hazards such as particles, light, heat, wind blast, sea spray, and balls and pucks used in sports.[26,27] According to Cockerhem,[26] protective devices are divided into two types, depending on their function: primary protectors which are devices worn in

conjunction with a secondary protector, e.g. goggles, or alone; and secondary protectors which are devices used only in conjunction with a primary protector,[26] e.g. face shields made of polycarbonate to stop low-velocity projectiles, windblown dust, or sand, which will also afford some protection against a direct blow to the eye.[26,27] The conditions under which people work will determine which type of PPE they are required to use for their personal protection to minimize the risk of an eye injury. In addition, the type of work done will determine what kind of device is suitable for that environment.[15,27,28]

Despite the improvements in recent years in the development of PPE, particularly safety goggles, the incidence of eye injuries in the UK remains high in the workplace, in sports and at home.[13] Ocular trauma has not decreased in Singapore, despite the work practice policies and legislation of strict guidelines on the mandatory wearing of protective eye devices for workplace safety.[7] This suggests inadequate protection practices and a lack of knowledge among workers about the dangers of operating machines without the use of PPE. It may also be due to inappropriate channelling of available resources that are meant to improve workplace safety. A retrospective study conducted by Ngo and Leo[7] at a tertiary hospital in Singapore showed that 34.0% of patients were not provided with any PPE and that 44.7% were non-compliant with wearing protective eyewear. In 2001, in Singapore, Voon et al.[29] found that 43.7% of patients had not used protective eyewear at the time of injury even though it was available, while 34.6% had not been provided with any PPE. Five years later, Woo and Sundar,[30] in the same country, found that 32.0% of reported cases had not been issued with PPE, while 38.7% had not used the PPE that was available to them. In an iron forging industry in the Eastern Province of Saudi Arabia, Ballal[15] reported, in 1991, that more than a third of those who were injured were not wearing eye protection at the time of injury, and that 76.6% of accidents were as a result of projectile foreign bodies. Similarly, Vasu et al.[3] found that 76.7% of workers from the agriculture and mining industries in India were not wearing the recommended protective device at the time of injury.

The use of alcohol and illicit drugs has been suggested to be a contributor to the non-use of PPE in the workplace. This is because the judgement of people who are intoxicated is impaired, or they exhibit greater risk-taking behaviour.[31] Vasu et al.[3] found that 13.9% of those incurring occupational injuries were under the influence of alcohol and not wearing the recommended PPE. Smith et al.[32] reviewed the National Trauma Eye Registry data from 28 states in the USA from 1985 to 1991 and found that 35.0% of those who incurred eye injuries in the workplace were intoxicated and not using PPE at the time of injury. A few years later, in the period 1987 to 1999, Dannenberg et al.[31] documented the high rate of 52.0% of alcohol/drug usage in the workplace in Kentucky and Alabama, USA, that resulted in the non use of PPE, suggesting an indirect aetiological cause of ocular injuries. Periodic monitoring of the levels of alcohol, and counselling for those affected, can minimize injuries in the workplace.

A limited number of surveys on ocular trauma in South Africa appear in the ophthalmic literature, particularly in the workplace. In 2009, in the Limpopo province, Sithole et al.[33] investigated eye protection practises among welders in the maintenance and construction industry, and found that 89.0% of them reported wearing PPE when working. The most common protective devices used were helmets (57%), goggles (22%), and face shields (15%). However, 60% used inefficient protective devices, such as sunglasses. Sixty-one percent reported occasional exposure to welding flashes when not wearing any eye protection. Although the majority of the welders wore protective devices while welding, a few did not always use such devices. They concluded that eye protection practices among the welders appeared to be inadequate to avoid hazards associated with welding.[33]

A review by Meallet[34] showed that the setting in which an injury occurs has a marked impact on the severity and the prognosis for visual recovery. In many settings, such as the workplace and sports events, eyewear is mandated but is not worn at the time of injury,[30,34] with an estimated 90% of eye injuries being preventable if protective eyewear was worn.[26,34] Desai et al.[35] reported 74 injury cases where protective eyewear should have been worn, with less than half of these (47%) being aware of any risk of injury associated with the activity they were pursuing. Protective eyewear was available for 48.6% of these patients, but only a fifth (19.4%) wore it.

In the USA, a Bureau of Labor Statistics (BLS) study cited by Lombardi et al.[36] estimated that 60% of those experiencing a work-related eye injury were either wearing the wrong type of protective eyewear or not wearing any protective eyewear at the time of injury. The emergent association in the study was with the age of the worker, where young participants were reported to be less likely to use personal protective eyewear and less likely to perceive the risk of eye injury, due to lack of experience.[36]

There are various reasons for the non-compliance of wearing PPE. Fogging, scratching and somatic issues, such as headache or nausea, are significant factors related to the non-use of personal protective eyewear.[34,36] The main risks of being injured were the cheap quality of personal protective eyewear, lack of enforcement or low management priority, laziness, rushing around, invincibility, lack of awareness of hazards, and performance of low risk tasks in studies by Meallet et al.[34] and Lombardi et al.[36] Other reported factors are inconvenience, cost, inappropriateness for the task and interference with prescription glasses.[36] In Canada, Crebolder and Sloan[37] showed that, in a combat military environment, eye gear restricts soldiers' activities, resulting in routine failure to wear protective goggles. However, they face the possibility of injury through exposure to fragmentation, handling of ammunitions, flying debris and equipment. Complaints such as fogging impairing vision have been raised against wearing lenses for protection. New developments suggest that an anti-fog coating applied to the lens surface reduces fog accumulation.[37] Safety devices must provide adequate protection while being both unobstructive and comfortable.[3,37]

Occupational-related policies and eye safety promotion

Accidents can occur anywhere and anytime but, through training, education and safety practices, they can be prevented or reduced. At managerial position down to the workers, attitudes toward safety should be addressed and analysed to determine if they are occupation-related, sports-related or home-related.[7,15,38] Strict compliance with the use of PPE can result in the reduction of injuries.[3,7,36] The loss of workdays can be greatly reduced by reinforcing strict implementation of occupational eye safety programmes, as well as reviewing eyewear designs.[7,15] Workplace safety is the responsibility of managers, supervisors and workers. Non-compliance among workers over the last few years and the high rate of not issuing PPE by employers, reflect that the guidelines set out by the Factories Act (1918) are not being appropriately implemented.[7,15,38] The South African Occupational Health and Safety (OHS) Act No. 85 of 1993[39] was drawn up in consultation with trade unions and employers, and is the main Act that deals with all aspects of health and safety in the workplace. This Act places the responsibility for the provision of safe working conditions upon the employer and compels the employee to act responsibly.[39] Customers must also be informed about any potential dangers of product use by the manufacturer or supplier of PPE. It is extremely important for all employees in any industry to be aware of potential hazards in order to protect themselves and their fellow employees at all times in the workplace. A suitable protective device can be recommended after determining the concentration and physical nature of the substance being handled. Face shields and goggles can be used for eye protection, but a full face shield is most appropriate as it also protects the skin. Employees wearing spectacles are advised to wear eye shields with side shields over spectacles for maximum protection.

The South African OHS Act of 1993 requires the availability of eye wash facilities at all times. Workers must ensure that they know how to operate these facilities and where they are kept to be able to access them timeously. The Occupational Health and Safety Amendment Act of 1993 (No. 181 of 1993)[39] stipulates that "no employer or user shall permit welding operations to be undertaken, unless: i) the person operating the equipment has been fully instructed in the safe operation and use of such equipment and in the hazards which may arise from its use; ii) effective protection is provided and used for the eyes and where necessary, for the face and body of persons performing such operations, as well as against heat, incandescent or flying particles and dangerous radiations; iii) the workplace is effectively partitioned off where practical and where not practical, all the other persons exposed to the hazards are warned and provided with suitable protective equipment".[39] Both Acts, however, do not include details of the specific types of devices for different types of welding operations and the chemical industry. While the need for an increase in the use of eye protection is indicated by the prevalence of eye injuries in the workplace, most PPE has restrictions, resulting in a reluctance to use it when carrying out risky duties.

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Socio-economic implications

The nature and circumstances of ocular injuries differ from country to country because they are related to differing levels of industrialisation, safety standards at the work place, access to health services and sociological peculiarities.[40] In developing countries, activities such as carpentry, agriculture, chiselling and hammering are responsible for many eye injuries. The majority of cases involve young and working groups, highlighting the socio-economic burden of ocular injury in these communities.[4,7,41] Lack of access to preventive healthcare at all levels in developing countries has worsened the situation, while industrial workers are the ones that require the most attention. It is therefore of concern that, in rural areas where the necessary healthcare services are scarce, more injuries are reported.[21,42,43] The high cost of ocular trauma results in the loss of income. Similarly, the cost of medical and rehabilitation services necessitates the need for making preventive measures a priority.[4]

CONCLUSION

The eye remains a high risk organ for work-related accidents,

with industrial blindness being a potential outcome despite efforts for primary prevention. The rate of monocular blindness among rural populations appears to be higher than in industry due to exposure to risky environments, particularly related to farming activities. Preventing eye injuries in industry is, however, more controlled, although eye injuries still occur. In developing countries, the types or modes of injuries may be different to those in developed countries, due to differences in occupations. High risk behaviour in industrialised countries and urban societies creates opportunities that lead to ocular trauma. The lack of proper protective eyewear, appropriately skilled personnel in health facilities, and awareness of the need for protection by manual workers, has contributed to the high risk of eye injuries, suggesting an urgent need for increased education about relevant safety precautions.[7,36]

CONFLICT OF INTEREST

There is no competing interest.

LESSONS LEARNED

1. Eye injuries are common in the workplace.
2. The types and incidences of eye injuries differ between developed and developing countries as well as between rural and urban workforces.
3. Eye injuries occur primarily due to non-compliance with protective eyewear and lack of adherence to the Occupational Health and Safety Act.
4. There is a need for increased educational and awareness programmes about eye safety and compliance with safety regulations.

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