Public Health Aspects of Ocular and Adnexal Trauma

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ABSTRACT

Purpose: Ocular and adnexal injury is a common but neglected problem, it is one of the main causes of uni-ocular blindness. The purpose of this article is to review the public health aspects of ocular and adnexal trauma with respect to epidemiology, knowledge gap, and future research direction, and to highlight preventive and promotive activities necessary to address this disease of public health importance.

Methods: Online literature search for publications on Ocular and Adnexal injury, ocular trauma, and Public health facets of ocular injury was done. Databases such as Medline/ PubMed, Google Scholar, Cochrane database for eyes, and African Journals Online (AJOL) were searched. Search terms included "public health", "ocular injury" and "prevention" with appropriate use of Boolean operators.

Results: There are no recent global estimates on the prevalence of ocular and adnexa injury. Prevalence ranges from 8 to 1,140 per 100,000 persons across national and geographical regions, with a male preponderance and bimodal age distribution of 18-44years and the elderly age 60 years and above.

Occupational, home, domestic, road traffic accidents and assaults were common causes of eye injuries. Trauma causes a variable extent of damage to ocular structures, with the final visual outcome dependent on the structures injured and promptness and quality of treatment given. Both ocular trauma and post-traumatic blindness are preventable using appropriate preventive measures such as health promotion, education, public health policy, legislation and advocacy.

Conclusion: Ocular and adnexal trauma is a public health disease, and the primary focus should be on prevention as well as immediate and appropriate intervention to injured persons

Keywords: *Ocular and adnexal trauma, eye injuries, eye protective devices, prevention, public health.*

INTRODUCTION

Vision is considered the most important and precious among our senses, accounting for a considerable part of the information we process[1]. Ocular health and vision have far-reaching and significant consequences in many areas of life, including well-being, sustainable growth, progress, and financial stability[1,2]. Our eyes instinctively defend themselves against a wide variety of threats. The eyelids, eyelashes, blink reflex and orbit cavity provide natural and innate defenses[3] but ocular and adnexa injury still occurs. Globally, an estimated 596 million people have distance vision impairment, of whom 43 million are blind[2], the proportion contributed by ocular injury is not distinctly captured as ocular injury is accounted as contributory to part of cornea, cataract and vitreoretinal causes of blindness. Ocular and adnexal injuries remain one of the primary causes of blindness, while the majority of eye injuries lead to uniocular sudden visual loss[4–7], bilateral involvement and visual loss occurring following bilateral injury are also reported[8–12,]. Bilateral cases are widespread in wars, terrorist attacks and assaults[11,14–16] As at 1988, it was estimated that approximately 19 million people had unilateral blindness, 1.6 million individuals had bilateral blindness and 2.3 million persons had bilateral visual impairment from ocular and adnexal injuries. Recent global estimates are not available.

A multidisciplinary approach involving the oculoplastic, maxillofacial, anterior segment and vitreoretinal surgeons is often required to care for victims adequately. Nonetheless, many people, families, and populations continue to suffer due to a lack of prompt access to high-quality, affordable eye care, resulting in vision impairment and blindness. Eye injury also comes at a high cost to the society [17,18] to families and countries due to time lost to seeking care, hospital expenses, specialist treatment, repeated follow up and rehabilitation[4,16–18]. While the major focus has been on the treatment of affected individuals, understanding the public health angle to prevention and treatment is required to address this problem adequately. Eye injuries are majorly preventable and effective preventive strategies are the primary goal of preventing ocular trauma and blindness from ocular and adnexa injury[2,4,19–21]. The aim of this article is to review the magnitude, distribution, causes, determinants and deterrents of ocular trauma and preventive interventions required.

METHODS

Literature was searched for online publications on Ocular and Adnexal trauma with focus on Public health through Medline/PubMed, Google Scholar, Cochrane database for eyes, and African Journals Online (AJOL).

Inclusion criteria were the articles published on ocular trauma prevalence, distribution, patterns, causes and preventive strategies. The search terms included “Ocular injury”, “eye injury”, “trauma to the globe”, “public health and eye injury”, “globe rupture”, “protective goggles”, “occupational eye injury”. The full-text publications were downloaded and information on causes, pattern, and preventive strategies of eye trauma was collected using a proforma. Editorials, Letters to the editors and comments were excluded.

RESULTS AND DISCUSSION

Global and National Prevalence

Globally, estimates on ocular injury are from the study published in 1998 reporting approximately 1.6 million people blind from ocular and adnexal injuries, an additional 2.3 million people with bilateral low vision and almost 19 million with unilateral blindness or low vision[10]. Furthermore, an estimated 55 million eye injuries that restrict activity by more

than one day occur every year, globally. Since this report, which was reported as underestimation due to lack of data from the developing countries and even under-reporting from the developed nations, there have been no global estimates, ocular injuries is thus a neglected disorder. There is a wide variation in the epidemiology of eye injuries as reported in different parts of the world due to influence of sociocultural factors, sports, economic and recreational activities as well as reporting systems.[4,22,23]

Pockets of available national estimates reported 11.9 and 25.5/ 100,000 population in Australia[24], 2.4 and 7.9 per 1000 prevalence of monocular vision loss from eye injury occur among non-indigenous and indigenous Australian respectively[25,]. Korean National Emergency Department Information System reported Seventy thousand (3.7 percent) major trauma cases occur in Korea each year out of 1.9 million cases of trauma in general, with increasing incidence year after year[26]

It is also reported that in the United States of America, 6.98 per 1000 population had eye injury requiring treatment in 2001. [27] Between 2006 and 2011, 77.9% of all visits to emergency departments in the United States had primary or other diagnosis of ocular trauma.[28] In a Nigerian survey report, it was stated that 1.1% of blindness is as a result of ocular injury and 11.1% of corneal scars are related to ocular trauma. [29] However, in broad-spectrum data about the treated eye injuries in inpatient and outpatient settings, data varies from 0.08 to 11.40% of all cases of Ophthalmic presentations [6,30,31,32,33].

Ocular Trauma and COVID-19

The COVID-19 epidemic has had a wide-ranging impact on ocular trauma. Studies have reported that during COVID-19 lockdown, the number of ocular injuries which happened at home increased by more than 3 times compared to the figures in the last 5 years. This increase is due in part to more "Do It Yourself" (DIY) injuries as people stayed at home, but it is also attributable to an increase in falls, which is surprising and reason unknown. Moreover, there were longer wait times between the injury and presentation in the hospital, implying that patients were hesitant to seek medical attention during the pandemic[34,35] Other reports indicate an increase in household injuries due to chemical exposure as a result of quarantine-related lifestyle modifications.[36]

On the other hand, in a comparative study, conducted in Italy, a dramatic 68.4% drop in the number of eye injuries recorded during the pandemic was observed compared to the same time period during the previous year. They anticipated that changes in behavior during the isolation could be linked to a lower incidence of trauma[37]. This notion appears to be supported by the decrease in sports injuries and injuries in children during school closures.

Age Distri bution

The age distribution for ocular trauma is bimodal, with the maximum incidence in young adults in the age range of 18–44 years[4,8,23,30,31,38-41] and a second peak in the elderly individuals aged 60 years and above.[25,41,42,43] Ocular trauma generally occurs more in males than in females[4,9,9,11,13,15,23,31,41,41,43-45]. The males are more likely to be involved in outdoor activities, sports, work related injuries and travels. Eye injuries accompany seven percent 7% of all bodily injuries and account for up to fifteen percent of all eye diseases among children[44,46-48]. Because of the relatively high rate of trauma in the young age group, the number of eye injuries has grown significantly. According to various studies, children account for 20–50% of ocular injury admissions[43], Ocular trauma is the most prevalent cause of unilateral blindness in pediatric age groups, particularly in underdeveloped nations. It is easily avoidable with the supervision by parents and baby carers[4,20,44]

Causes of Ocular and Adnexal Injury

Multiple causes can elicit ocular and adnexal traumas. Domestic[21,31,49] and industrial accidents[21,44,51] (for example, from using a hammer resulting in Intraocular Foreign Bodies) or liquid chemicals or cleansers, violence and wars[4915,51], assaults[14,11,52] physical and sports injuries[53–55] as well as car accidents[34,42,56] are all common causes of eye injuries. Extreme UV light hazards from different sources like during welding or exposure to the snow reflected sunlight are also reported[20] . Several other reported sources of eye injuries include cosmetic laser treatment, explosives, fireworks, harmful substances and snake bite. [51,58,57,58,59,61,62,]

Clinical Effects of Ocular Injury

Injury may involve the globe with or without the adnexa; they can be either closed ocular (blunt) trauma (Figure 1) or open globe injuries. Injuries can also be direct or indirect. Traumatic lid laceration, cornea injury, retinal tear, avulsion of the optic nerve, choroidal rupture, traumatic macular hole and commotio retinae are all examples of direct blunt trauma. On the other hand, few syndromes, namely Terson syndrome, fat embolism syndrome, and shaken baby syndrome, are indirect ocular trauma. Moreover, Purtscher retinopathy, Valsalva retinopathy, whiplash retinopathy solar and laser-induced retinopathy also comes under the heading of indirect ocular trauma.

Ocular penetrating and perforating injuries (commonly referred to as open globe injuries) can result in severe vision loss or can cause minimal damage with preserved vision. Superficial injury to the eye and adnexa is the most common and could have seasonal variations in occurence[60]

Determinants of Ocular Injury

1. *Home accident and child play:* Home accident occurs during the following events: Play with pointed and low-placed metal, toys, screws or nails, railing, and other sharps such as sticks, pencils, pens, scissors, compasses, arrows and needles. Pecks by domestic animals such as hen, splashing of household agents such as cleaners and bleach, hot oil and glue can also lead to eye injuries. Home injuries can also occur from stones and wood fragments while working or mowing the lawn

2. *Assault:* from domestic violence, gunshot wounds, chemical injury, rituals, communal clashes, and war-related injuries. Such injuries tend to be bilateral (Figure 2).

3. *Occupation and agricultural activities:* Occupation and agricultural activities such as stick injury while cultivating the land, people who handle chemicals, Industrial workers in carbonated drink factory, Injuries

Fig. 1: Severe damage to an eye following blunt trauma with Vision of Nil perception of light (NPL) at presentation

Fig. 2: Gunshot injury by armed robbers on a commercial driver

from industrial machinery, Workers in forestry, fishing, construction and mining industries.

4. *Road traffic accidents:* Road traffic-related ophthalmic trauma, from motorbikes, car crashes and involving pedestrians are also reported

5. *Festivals and celebration:* Festivals and celebration, Masquerade, Fireworks, cultural wedding ceremonies such as Fulani weddings where sticks and canes are freely used, Clubbing, carbonated drink like champagne explosion.

6. *Sports and recreational activities:* could be from low-risk sports typically not involving use of a ball, bat, or racket and with no body contact. Such sports include track/ field, swimming, gymnastics, and cycling. High risk sports involve the use of balls or bat rackets or a lot of body contact. These include baseball, hockey, football, basketball, racket sports, tennis, golf, and water polo. Very high-risk sports are boxing, wrestling, and contact martial arts.

Studies have reported that the majority of eye injuries happen during work and this accounts for more than 20-50% of the cases[6,14,23,61]. The home is the 2nd most common place and, more than 30% of the ocular injuries take place at home[32,41,58]. In Africa, farm work accounts for a large proportion of eye injuries[32]. Unsupervised play and sports are common causes of injury in children.[5,41] Injury in children can be from sharp objects[5,41] or blunt trauma[9,30,31,40,41,56,59,62,63]

There are economic, social, and psychosocial effects following ocular trauma on the affected individuals and their families. Reduction in quality of life, mental health problems (anxiety, depression), loss or change of job, severe changes in lifestyle, and, in some cases, irreversible physical impairment and disabilities and mortality have been reported following eye trauma[2,8,31]. Ocular trauma constitutes a substantial economic burden on the nation as well as a strain on the eye health facilities and human resources[4,18,49]

Late presentations to health care facilities often compound the outcome of result of eye injuries[6], In addition to the individual's costs, there is a direct and indirect financial cost to society and the environment. A study has reported that worldwide productivity loss from vision impairment is more than 400 billion a year[18,49].

Prevention or Deterrents of Ocular Injury

This involves a multidisciplinary, multi-dimensional approach. A more comprehensive approach will be health Promotion. Health Promotion is social, educational, and political actions that enhance public awareness of health, foster healthy lifestyles, and community action in health support. This can involve Health education[6,8,47,64], Legislation[8], economic and regulatory activities[2,58] and Healthy public policy such as ban on use of fireworks in open spaces[65]. Ocular damage caused by fireworks is commonly associated with vision loss. Studies have reported that not only those who were directly involved in fireworks were injured but a large number of spectators were more likely to sustain ocular injuries than non-ocular injuries. Following are few guidelines that can reduce or minimize the rate of ocular traumas from fireworks. Fireworks should not be lighted in containers especially a glass or metal container, storing of unused fireworks in a cool, dry place away from open fire, Children should not be allowed to play with fireworks unsupervised. Safety barriers should be observed at least 200 meters away.

Organizational development using hierarchy of controls is well known in work places (Figure 3). Traditionally, a hierarchy of controls has been used as a means of determining how to implement feasible and effective control solutions.

The rationale or theme behind this hierarchy is that the control mechanisms at the top of the graph may be more effective and protective than those at the bottom but more costly. Following this hierarchy usually results

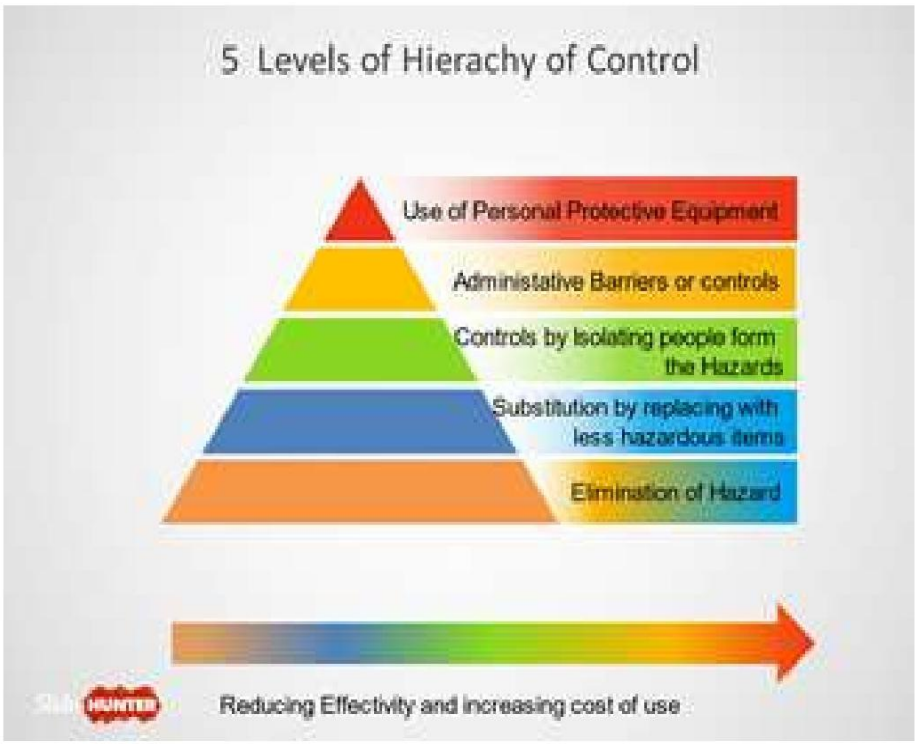

Fig. 3. Hierarchy of control

in adopting fundamentally safer systems, where the danger of disease or injury is significantly decreased.

i. Organization Development

There are specially designed safety glasses with or without side shields, goggles, face shields and helmets for persons working near hazardous radiation, such as welding, lasers, or fiber optics that should be worn to ensure safe work places. Use of machine guarding, work screens, or other engineering controls to protect staff while at work. Special handlings and instructions for tools that slip or malfunction. Workers are advised to always wear personal protective equipment (PPE) when working with or near hazards. The use of appropriate and proper fitting goggles, face shields, safety glasses, welding helmets, and full-face respirators is encouraged. There should be regular appraisal and reporting of workplace hazards. Ensure all eye and face protection meet applicable regulations and Eye and Face Protection Standards, Tools should be kept in good condition, and the damaged tool should be replaced or repaired, Spray nozzles of chemicals should be directed away from the eyes. Cords such as metals and rubbers can snap and cause eye injury

Over 9 out of ten cases of ocular trauma are preventable using appropriate protective wear and health education. Techniques and methods for avoiding ocular trauma need awareness of the cause, reason, mechanism of the injury, which may allow for more appropriate resource allocation toward preventing such injuries. However, in underdeveloped nations, a lack of health care facilities, infrastructure, poor patient health-seeking attitude, and substandard level of patient care are the major factors that all contribute to a worse prognosis for patients suffering from ocular injuries.

According to Ramos [66], ocular injuries account for 6% of all national injuries, with 60% of those wounded admitting to not using any eye protection.

ii. Health Promotion

Increase public knowledge and awareness about eye injuries through suitable mass media such as newspapers, electronic media like radio and television, social media handles such as

YouTube, Facebook and non-electronic media. Educating children starting from preschool age about objects, events, and actions that can cause eye injuries, this should be included in curriculum. Create awareness regarding eye injuries at the various group levels that could involve welders, football players, cyclists, and industrial workers. There should be involvement of stakeholders such as teachers, sports coaches, volunteers, and journalists. Advocacy to schools, school teachers and parents where corporal punishment still result to ocular injury in children

Globally, there are multiple campaigns and events organized to draw attention to eye injury and how to reduce this disease of public health importance. The United Nations (UN) assigned a whole week for global road safety, informative programs and conferences are arranged to eliminate violence against females, particular days are being celebrated for disabled people and for the victims of road traffic accidents. The main motive behind such events is to create awareness on injuries and its prevention.

Advocacy at the national level on the use of seat belts, speed limits, enforcing policies which will help prevent blindness from injuries such as vehicle carrying injurious objects without mark, legislation for health and safety at work, the banning of explosive firecrackers should be encouraged. Advocacy on a global level on issues such as banning anti-personnel mines will go along way to reducing the prevalence and incidence of ocular injury

Legislation are statutory laws that are enacted by a governing body to reduce exposure to hazards. Legislation can prescribe and proscribe sales of certain products which can cause injury or are hazardous in nature. These can be affected as follows; ensuring minimum standards are applied to product safety, providing appropriate labeling and instructions on toys and instruments including advising of age restrictions. Legislation banning the import of bubble guns, fireworks and sale of acids.

iii. Ophthalmological Society Development

National group on Ocular trauma for knowledge transfer on the treatment and management of ophthalmic trauma as well as to support advocacy efforts to reduce vision loss from trauma should be formed.

At present there are different societies working on ocular trauma and its complications such as APOTS (Asian Pacific Ophthalmology Trauma Society), ASOT (American Society of Ocular Trauma), COTS (Canadian Ophthalmology Trauma Society), Ocular Society Trauma of India, ISOT (International Society Ocular Trauma). There is the need for other National societies to do same.

iv. Research to Provide Data Nationally

There is the dire need to provide national, regional and global data on ocular and adnexa injury considering the scarcity of available data. The inconsistency on data reported should be addressed to allow for a more consistent recording of eye injury events and their consequences in order to provide more accurate data for planning eye care services. In addition, such data would also provide a better understanding of the changing patterns of eye injuries in different parts of the world. An ocular injury registry is advised nationally.

CONCLUSION

Eye injuries are the leading cause of vision loss in one eye and often affect younger working age. It continues to be a significant public health issue because of the significant cost, both short-term concerning treatment and hospital admission, and the long-term consequences to the community at large. It is imperative to take care of high-risk individuals exposed to specific hazardous conditions, particularly those who have had a previous eye injury, surgery, or one-eyed (amblyopic). The risks and consequences of vision loss for these high-risk individuals are even higher. Ocular trauma and post-traumatic blindness is mainly preventable.

Working together to gather data to understand when and why injuries occur is the first step in prevention. A clear, consistent message through advocacy, education, and product standards will help support prevention strategies and help to minimize the number and severity of injuries. As many of these injuries may be preventable, appropriate interventions could reduce the burden of ocular trauma. In addition, there should be a continual assessment of safety and health issues at home and in the workplace.

RECOMMENDATIONS

A focal group or subspecialty on ocular trauma is encouraged for each region or country. There is the need for training and retraining of all stakeholders in handling ocular trauma

Countries where there is no ocular injury registry should establish one to provide national data on causes and patterns of ocular injury and best preventive measures. Legislative and other government actions towards prevention of injury and provision of prompt treatment for victims is required.

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