

# THE HIDDEN COST OF EYE INJURIES

Vision is intimately linked with our ability to navigate our environment and can strongly affect our mental, physical and economic well-being. Losing one's vision through an eye injury can lead to substantial long-term costs, and impact on an individual and their family & community. Eye injuries occur in a range of environments, including in the workplace, during sports and at home. Young working males are at the highest risk of eye injury. Up to 90% of eye injuries are preventable, with effective interventions including; education about the hazards, policies and training on the correct use of eye protection. Eye health professionals can play an important role in promoting and prescribing eye injury prevention strategies to help reduce this avoidable cause of vision loss.



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Annette is an Optometrist with extensive experience in product development, compliance, standardisation and quality control for sun, rx and eye protection.

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## KEYWORDS

eye injuries, eye protection, safety, injury prevention, vision loss

## Introduction: Why we should be more focused on ocular trauma

Our ability to see and interpret the world contributes to more than 90% of the information we process.<sup>(1)</sup> Impairment to our vision can affect many aspects of our life and have an affect on health<sup>(2, 3)</sup>, economy<sup>(4)</sup>, education<sup>(5)</sup> and psychological well-being<sup>(6, 7)</sup> for individuals, their families and the broader community. Eye injuries are responsible for 10-27% of operating theatre, 38-65% of A&E and 5-16% of all eye hospital patients<sup>(8)</sup>. An important contributor to vision loss, trauma is responsible for 5% of blindness<sup>(9)</sup> and can have a devastating impact on all ages<sup>(8)</sup>. Up to 90% of eye injuries are preventable, however<sup>(10)</sup>, and the first step in implementing prevention strategies is knowing who is at risk.

## Who is at risk of an eye injury?

Patterns of ocular trauma vary internationally, and a wide range of situations, environments and ages are implicated. A bimodal peak is commonly reported, with very young and middle-aged patients commonly reporting higher injury rates<sup>(11)</sup>. Almost universally, males report higher eye injury rates than females, with the exception of elderly individuals, where fall-related injuries lead to a slight reversal of this trend (see Figure 1).

Paediatric eye injuries deserve special attention due

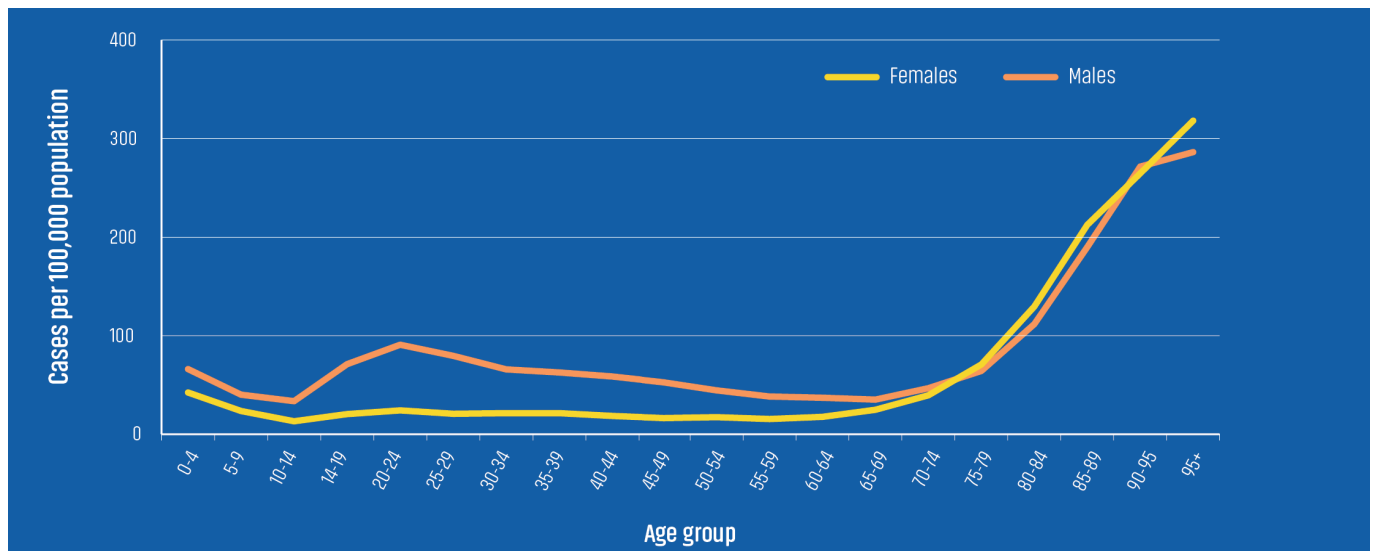


Figure 1: Age-specific rates of hospitalised eye injuries by gender, Australia 2010-2011 & 2014-2015 <sup>(41)</sup>

to their high incidence and the potential for lifelong implications for a child's social, health, developmental and economic prospects <sup>(12-14)</sup>. Although children accounted for only 17.7% of the population in the early 20th century, they represented almost half of the non-occupational eye injuries <sup>(15)</sup>. The consequences of vision loss for children mean that it makes sense to have a special focus on improving eye injury prevention strategies related to children.

A wide range of objects and substances, including household cleaning chemicals and toys <sup>(16)</sup>, stationery items such as scissors, pens and pencils <sup>(17) (18)</sup>, fireworks <sup>(19) (20) (21)</sup>, glass bottles, photo frames and toy guns <sup>(22)</sup> have all been responsible for eye injuries. Ocular trauma in children in India is often associated with exposure to the lime found in 'chuna', an additive in chewing tobacco <sup>(23)</sup>. Increasing rates of myopia have also contributed to an increase in spectacle-related ocular trauma <sup>(24)</sup> in Taiwan <sup>(17)</sup>. Eye injuries are generally classified according to the environment or mechanism of injury, with common environments including occupational, sports, festivals, combat, road traffic and in and around the home.

### Occupational eye injuries

Eye hazards associated with work environments are as significant and numerous as the injuries that result from them. Industrial environments commonly associated with eye injuries include forestry, fishing, farming, construction and mining <sup>(25)</sup>. Working with metal, whether hammering, grinding or cutting, is one of the most significant sources of work-related eye injuries. Other common work-related eye injuries occur during welding or from artificial radiation <sup>(26)</sup> or chemicals <sup>(27)</sup>.

Advances in eye protection design and work, health and safety regulations have helped reduce work-related eye injuries. However, the rates remain high in

developing countries <sup>(28)</sup>. Vision plays an important role in worker safety <sup>(29)</sup> and employers should ensure visual needs are met with appropriate visual correction incorporated into safety eyewear.

Employers have an important role in ensuring the safety of their employees. Specialists such as health and safety engineers must ensure that PPE, including eye protection, is selected, fitted and worn correctly. To ensure that employees comply with eye protection policies, it is critical that an appropriate selection of comfortable and well-fitted eye protection is available. Advances in prevention measures have resulted in a reduction of vision loss, particularly in occupational environments in developed countries, but more clearly needs to be done to reduce the still-high incidence of eye injuries in developed and developing countries.

### Sports-related eye injuries



Figure 2: Metallic foreign bodies in the cornea



**"Patterns of ocular trauma vary internationally, and a wide range of situations, environments and ages are implicated. A bimodal peak is commonly reported, with very young and middle-aged patients commonly reporting higher injury rates."**

Sporting activities contribute to eye injuries in both children<sup>(30)</sup> and adults<sup>(31)</sup>. Common eye injuries sustained during sport include lid lacerations, orbital fractures, retinal detachment and closed globe injuries. The incidence of eye injuries depends on both hazards and sports participation rates, with football in Australia<sup>(30)</sup>, basketball in the US<sup>(31)</sup>, floorball in Switzerland and Sweden<sup>(32)</sup>, and camogie and hurling in Ireland<sup>(33)</sup> all being significant contributors. The presence of a bat or ball, and the likelihood of collision or contact with other players, increases risks in sports. Adapted rules and equipments, as well as mandated eye protection can all contribute to reducing sports eye injuries.

#### **Festival-related eye injuries**



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**Figure 3:** Blowout fracture of right eye

Festivals associated with cultural, religious, national and regional events bring communities together and celebrate milestones – and are often related to the use of fireworks, which are a significant contributor to eye injuries<sup>(20)</sup>. Celebrations such as New Year's Eve, Diwali, Chinese New Year and the Fourth of July are associated with extensive use of fireworks. Almost half of firework-related injuries involve the eye and one in six lead to permanent vision loss<sup>(34)</sup>. Thermal burns caused by fireworks commonly affect the hands (38%) and eyes (45%)<sup>(4)</sup>. Young males are the group most commonly affected<sup>(35)</sup><sup>(36)</sup>. Countries such as India, Netherlands, China, the US and Iran have all reported firework-related eye injuries during festivals<sup>(37-42)</sup>.

#### **Combat-related eye injuries**

The profile of eye injuries associated with combat has changed over the last century as a result of a range of factors, including the increased use of improvised explosive devices (IEDs)<sup>(43)</sup>. With large numbers of small, high-energy particles deployed, IEDs are used to disable soldiers and have been associated with an increase in ocular morbidity<sup>(44)</sup>. Eye injuries represented 13% of hospitalised casualties in the 1990s, a significant increase over the 2% seen during World War 1<sup>(45)</sup>.

A range of open-globe injuries, many of which are associated with intraocular foreign bodies, and closed-globe injuries are associated with combat for both soldiers and civilians<sup>(46)</sup>. Many militaries across the world now recognise the benefit of eye protection not only to soldiers but also for maintaining good vision during military exercises<sup>(45)</sup><sup>(47-49)</sup>.

#### **Eye injuries around the home**

Easily accessed consumer products around the home can result in eye injuries including to young children (0-4 years-old) in the case of cleaning chemicals, and primary school aged children (5- 9 years) in the case of pens, pencils, knives, forks and toys<sup>(50)</sup>. Studies from the United States have shown that children,





**Figure 4:** Acid burn

especially in those aged 0-4, are most represented in consumer product-related eye injuries <sup>(51)</sup>. Eye injuries from products such as toys, air soft and non-powdered guns <sup>(52)</sup>, yo-yos <sup>(53)</sup> and remote-controlled helicopters <sup>(54)</sup> have also been reported in the literature. Household products such as cleaning chemicals <sup>(23)</sup>, carbonated drink bottles <sup>(55)</sup> and elastic luggage straps <sup>(56)</sup> are also implicated in children's eye injuries. Interaction with animals such as dogs, cats and birds, both domestic and wild, can result in eye injuries as well, with children at particular risk due to their size and inexperience in dealing with animals <sup>(50)</sup> <sup>(57)</sup>.

Absence of education regarding hazards and appropriate

eye protection has resulted in eye injuries at home representing an increasing proportion of all eye injuries <sup>(58)</sup>. Hammering and grinding metal <sup>(59)</sup> and falls are commonly associated with eye injuries in and around the home. Falls are a particular risk factor for young pre-ambulant children and the elderly, and can result in severe eye injuries <sup>(59)</sup>. More education about hazards at home and the need for eye protection, for those at risk, is clearly needed.

### Road traffic-related injuries

Road traffic-related ophthalmic trauma has been reported as a significant source of eye injuries <sup>(60)</sup>. Developments in motor vehicle design and regulations, including laminated windscreens, seatbelts and airbags, have contributed to reducing motor vehicle-related eye injuries in developed countries <sup>(61)</sup>. Developing countries such as India, however, continue to report high numbers of road traffic-related ocular trauma <sup>(62)</sup>.

### The cost of eye injuries

We do not have a complete picture of the costs and impact of eye injuries. The most comprehensive data on the impact of eye injuries was published by the World Health Organization in 1998 <sup>(8)</sup> with an estimate of 55 million eye injuries restricting activity by more than one day occurring every year internationally. An estimated 13/100,000 people suffer an eye injury that



**Figure 5:** Hierarchy of controls for hazards



**Figure 6:** Prescription eye protection system for occupational applications

requires hospitalisation, and 19 million people suffer from unilateral blindness or low vision from trauma annually. More than 20 years on, the incidence of eye injuries has been estimated at between 11.9 and 25.5/100,000 in Australia <sup>(11) (63)</sup>.

The damage caused by injuries extends far beyond direct medical costs, and has economic, social and psychological implications. There is limited data detailing the cost of ocular trauma, but an estimate of the total cost of eye injuries in the US in 1990 was US\$200 million (64). In Australia, the average medical cost of an eye injury requiring hospitalisation was calculated to be AU\$23,717, with a total annual cost of approximately \$155 million in 1995 <sup>(65)</sup>. The number of eye injuries requiring hospitalisation in the five years to 2015 in Australia was 52,000 <sup>(11)</sup> and the average cost was AU\$181,322 per injury <sup>(63)</sup>. The direct medical cost of eye injuries in patients admitted to hospital per year in Australia could therefore be extrapolated to be AU\$2,357 million.

### Eye injury prevention

A focus on the improved treatment of eye injuries is an important developing subspecialty in ophthalmology. However, prevention remains the most effective measure. The aim should be to avoid exposure to hazards, with elimination, substitution, engineering controls and administrative controls reducing risk and personal protection equipment (PPE) representing the last line of defence in the hierarchy of hazard controls (see Figure 5).

Successful interventions to prevent eye injuries fall broadly into four key areas: education & awareness, legislation, standards and eye protection <sup>(12)</sup>. When substitution or elimination of hazards are not possible, PPE provides the last line of defence. A wide range of styles and sizes for eye and face protection are available.

It is important to ensure that the selection of eye protection is based on risk analysis as well as a clear understanding of the individual needs of the wearer in order to maximise compliance. Compliance with eye protection programmes is a key factor in the effectiveness of injury prevention programmes and is influenced by characteristics like fit and comfort <sup>(66)</sup>.

The use of eye protection has been demonstrated to reduce eye injuries in sports such as field hockey <sup>(67)</sup>, ice hockey <sup>(68)</sup>, squash <sup>(69)</sup>, women's lacrosse <sup>(70)</sup>, and occupational settings. Introducing eye protection for junior sports players can be an effective way of conditioning players to make protective equipment a standard part of their kit. Many sports now have voluntary standards for eye protection <sup>(71)</sup>. Recent surveys have shown that compliance rates for eye protection have been increasing in the United States <sup>(72)</sup>.

### Eye protection standards

Standards are essential to ensure that products are made without qualities that can lead to injury or harm during use, and to provide important information and guidance on the labelling and handling of products. Whilst standards can be voluntary, many are made part of legislation and therefore mandatory. Standards organisations such as ISO, ANSI and ASTM through committees of industry, consumer and academic experts facilitate the development of standards. Occupational <sup>(73)</sup>, sports <sup>(74)</sup> and sunglass standards are all relevant to eye injury prevention <sup>(75)</sup>. Standards for occupational eye protection indicate minimum performance criteria and provide an appropriate level of protection to avoid or minimise exposure to hazards. ANSI and ASTM in the US <sup>(76-78)</sup> and EN and ISO standards in Europe <sup>(79), (80)</sup> refer to eye and face protection.

Any investment in preventing injuries must first identify at-risk groups and develop appropriate measures of effectiveness. Evidence-based interventions such as education, legislation and product standards rely on data to ensure that risk groups are identified and measured.

### **The role of professionals in reducing vision loss from eye injury**

Eye injuries are increasingly associated with activities at home. Common hazards include manual tasks such as hammering and drilling, typically during home repair, as well as readily available consumer products. Health and safety representatives as well as eye care professionals can play an important role in giving advice on these hazards, identifying people at risk and advising on appropriate prevention measures.

Emphasis should be given to people who have had prior intraocular surgery, eye injury or conditions such as keratoconus, and for those undertaking high-risk activities at work or outside. In the elderly, falls are commonly associated with injuries around the home. It is important that optometrists and ophthalmologists be aware of the hazards and advise their patients about the correct precautions, including the use of eye protection.

### **Correct use of appropriate eye protection**

Using the right eye protection can reduce the incidence and severity of eye injuries. Agriculture, mining, manufacturing and fishing all present hazards to workers and a high proportion of eye injuries occur in these fields. Mandatory occupational health and safety requirements and the successful deployment of eye injury prevention strategies have reduced the number of occupational injuries, however. Even so, compliance continues to be an issue, with patients with eye injuries usually reporting not wearing eye protection due to problems with comfort or fogging of the eye protection as a result of poor fit<sup>(81)</sup>. It was estimated that the correct use of eye protection for work-related and do-it-yourself-type home projects which involved ocular hazards in Australia would have saved AU\$59 million in the period from November 1989 to April 1991.

A misconception amongst patients is that normal spectacle lenses provide eye protection – in fact, normal spectacles or sunglasses are instead known to potentially convert blunt trauma into a more devastating penetrating eye injury from lens fragments.

Improvements in technology and design, as well as legislation and public advocacy programmes, have improved compliance, enabling a reduction in occupational eye injuries. While factors such as task and occupation and previous ocular trauma<sup>(82)</sup> have been found to be associated with the correct use of eye protection, rates of wear remain low, indicating a need for better education and health promotion strategies.

### **Conclusion**

Vision has an impact on our ability to navigate our daily lives. Vision loss and blindness can significantly lower health and quality of life<sup>(83) (7) (3) (84) (85)</sup>. The direct economic cost of eye injuries should be viewed as the tip of the iceberg, as many patients are left with lifelong social and economic consequences. The money and time invested in wearing the correct eye protection are far less costly than these consequences. Eye health professionals can play a key role in the prevention of ocular trauma by advising patients of the hazards and consequences commonly associated with ocular trauma. The cost and implications of an eye injury extend far beyond the immediate medical cost, making the need for prevention of eye injuries a major priority.



#### **KEY TAKEAWAYS**

- Identify patients at risk of eye injury.
- Identify when and which eye protection is appropriate.
- Regular prescription spectacles do not provide impact eye protection.
- Eye health practitioners play an important role in helping prevent vision loss from eye injuries.

## REFERENCES

- Koch K, McLean J, Segev R, Freed MA, Berry MJ, 2nd, Balasubramanian V, et al. How much the eye tells the brain. *Curr Biol*. 2006;16(14):1428-34.
- Crew JM, Spilsbury K, Morlet N, Morgan WH, Mukhtar A, Clark A, et al. Health Service Use and Mortality of the Elderly Blind. *Ophthalmology*. 2015;122(11):2344-50.
- Crew JM, Morlet N, Morgan WH, Spilsbury K, Mukhtar AS, Clark A, et al. Mortality and hospital morbidity of working-age blind. *Br J Ophthalmol*. 2013;97(12):1579-85.
- Davie G, Lilley R. Financial impact of injury in older workers: use of a national retrospective e-cohort to compare income patterns over 3 years in a universal injury compensation scheme. *BMJ Open*. 2018;8(4):e018995.
- Morgan-Warren PJ, Mehta P, Ahluwalia HS. Visual function and quality of life in patients who had undergone eye removal surgery: a patient survey. *Orbit*. 2013;32(5):285-93.
- Frank CR, Xiang X, Stagg BC, Ehrlich JR. Longitudinal Associations of Self-reported Vision Impairment With Symptoms of Anxiety and Depression Among Older Adults in the United States. *JAMA Ophthalmol*. 2019;137(7):793-800.
- Karaman S, Ozkan B, Gok M, Karakaya I, Kara O, Altintas O, et al. Effect of eye trauma on mental health and quality of life in children and adolescents. *Int Ophthalmol*. 2017;37(3):539-44.
- Negrel AD, Thylefors B. The global impact of eye injuries. *Ophthalmic Epidemiol*. 1998;5(3):143-69.
- Thylefors B. Epidemiological patterns of ocular trauma. *Aust N Z J Ophthalmol*. 1992;20(2):95-8.
- Pizzarello LD. Ocular trauma: time for action. *Ophthalmic Epidemiol*. 1998;5(3):115-6.
- Towell A, McKenna K. Eye injuries in Australia, 2010–11 to 2014–15. Injury research and statistics series no. 194. . Canberra: AIHW; 2018. Contract No.: Cat. no. INCAT 114.
- Hoskin AK, Philip SS, Yardley AM, Mackey DA. Eye Injury Prevention for the Pediatric Population. *Asia Pac J Ophthalmol (Phila)*. 2016;5(3):202-11.
- Philip SS, Hoskin AK. Children's protective eyewear: the challenges and the way forward. *Med J Aust*. 2014;201(2):87-8.
- Solomon A. State of the World's Sight. Vision 2020: the Right to Sight 1999–2005. . Geneva: WHO; 2005.
- Garrow A. A Statistical Enquiry into 1000 Cases of Eye Injuries. *Br J Ophthalmol*. 1923;7(2):65-80.
- Moren Cross J, Griffin R, Owsley C, McGwin G, Jr. Pediatric eye injuries related to consumer products in the United States, 1997–2006. *Journal of AAPOS : the official publication of the American Association for Pediatric Ophthalmology and Strabismus / American Association for Pediatric Ophthalmology and Strabismus*. 2008;12(6):626-8.
- Liu ML, Chang YS, Tseng SH, Cheng HC, Huang FC, Shih MH, et al. Major pediatric ocular trauma in Taiwan. *J Pediatr Ophthalmol Strabismus*. 2010;47(2):88-95.
- Staffieri SE, Ruddle JB, Mackey DA. Rock, paper and scissors? Traumatic paediatric cataract in Victoria 1992–2006. *Clinical & experimental ophthalmology*. 2010;38(3):237-41.
- Krishnaiah S, Nirmalan PK, Shamanna BR, Srinivas M, Rao GN, Thomas R. Ocular trauma in a rural population of southern India: the Andhra Pradesh Eye Disease Study. *Ophthalmology*. 2006;113(7):1159-64.
- Wisse RP, Bijlsma WR, Stijlma JS. Ocular firework trauma: a systematic review on incidence, severity, outcome and prevention. *Br J Ophthalmol*. 2010;94(12):1586-91.
- Serrano JC, Chalela P, Arias JD. Epidemiology of childhood ocular trauma in a Northeastern Colombian region. *Arch Ophthalmol*. 2003;121(10):1439-45.
- Poon AS, Ng JS, Lam DS, Fan DS, Leung AT. Epidemiology of severe childhood eye injuries that required hospitalisation. *Hong Kong Med J*. 1998;4(4):371-4.
- Vajpayee RB, Shekhar H, Sharma N, Jhanji V. Demographic and clinical profile of ocular chemical injuries in the pediatric age group. *Ophthalmology*. 2014;121(1):377-80.
- Hoskin AK, Philip S, Dain SJ, Mackey DA. Spectacle-related eye injuries, spectacle-impact performance and eye protection. *Clin Exp Optom*. 2015;98(3):203-9.
- Forrest KY, Cali JM. Epidemiology of lifetime work-related eye injuries in the U.S. population associated with one or more lost days of work. *Ophthalmic Epidemiol*. 2009;16(3):156-62.
- Northey LC, Bhardwaj G, Curran S, McGirr J. Eye trauma epidemiology in regional Australia. *Ophthalmic Epidemiol*. 2014;21(4):237-46.
- Bizrah M, Yusuf A, Ahmad S. An update on chemical eye burns. *Eye (Lond)*. 2019.
- Jovanovic N, Peek-Asa C, Swanton A, Young T, Alajbegovic-Halimic J, Cavaljuga S, et al. Prevalence and risk factors associated with work-related eye injuries in Bosnia and Herzegovina. *Int J Occup Environ Health*. 2016;22(4):325-32.
- Legood R, Scuffham P, Cryer C. Are we blind to injuries in the visually impaired? A review of the literature. *Inj Prev*. 2002;8(2):155-60.
- Hoskin AK, Yardley AM, Hanman K, Lam G, Mackey DA. Sports-related eye and adnexal injuries in the Western Australian paediatric population. *Acta Ophthalmol*. 2016;94(6):e407-10.
- Haring RS, Sheffield ID, Canner JK, Schneider EB. Epidemiology of Sports-Related Eye Injuries in the United States. *JAMA Ophthalmol*. 2016;134(12):1382-90.
- Maxen M, Kuhl S, Krastl G, Filippi A. Eye injuries and orofacial traumas in floorball—a survey in Switzerland and Sweden. *Dent Traumatol*. 2011;27(2):95-101.
- Crowley PJ, Condon KC. Analysis of hurling and camogie injuries. *Br J Sports Med*. 1989;23(3):183-5.
- Jeyabal P, Davies L, Rousselot A, Agrawal R. Fireworks: boon or bane to our eyes? *Int Ophthalmol*. 2019.
- Bagri N, Saha A, Chandelia S, Dubey NK, Bhatt A, Rai A, et al. Fireworks injuries in children: A prospective study during the festival of lights. *Emerg Med Australas*. 2013;25(5):452-6.
- Bull N. Legislation as a tool to prevent firework-related eye injuries. *Acta Ophthalmol*. 2011;89(8):e654-5.
- John D, Philip SS, Mittal R, John SS, Paul P. Spectrum of ocular firework injuries in children: A 5-year retrospective study during a festive season in Southern India. *Indian J Ophthalmol*. 2015;63(11):843-6.
- Frimmel S, de Faber JT, Wubbels RJ, Kniestedt C, Paridaens D. Type, severity, management and outcome of ocular and adnexal firework-related injuries: the Rotterdam experience. *Acta Ophthalmol*. 2018;96(6):607-15.
- Jing Y, Yi-qiao X, Yan-ning Y, Ming A, An-huai Y, Lian-hong Z. Clinical analysis of firework-related ocular injuries during Spring Festival 2009. *Graefes Arch Clin Exp Ophthalmol*. 2010;248(3):333-8.
- Kong Y, Tang X, Kong B, Jiang H, Chen Y. Six-year clinical study of firework-related eye injuries in North China. *Postgrad Med J*. 2015;91(1071):26-9.
- Chang IT, Prendes MA, Tarbet KJ, Amadi AJ, Chang SH, Shaffel SS. Ocular injuries from fireworks: the 11-year experience of a US level I trauma center. *Eye (Lond)*. 2016;30(10):1324-30.
- Saadat S, Naseripour M, Smith GA. The health and economic impact of fireworks-related injuries in Iran: a household survey following the New Year's Festival in Tehran. *Injury*. 2010;41(7):e28-33.
- Hoskin AK, Mackey DA, Keay L, Agrawal R, Watson S. Eye Injuries across history and the evolution of eye protection. *Acta Ophthalmol*. 2019.
- McVeigh K, Breeze J, Jaynes P, Martin T, Parmar S, Monaghan AM. Clinical strategies in the management of complex maxillofacial injuries sustained by British military personnel. *J R Army Med Corps*. 2010;156(2):110-3.
- Dusaj A, Baranwal VK. A study of the effectiveness of ocular protection. *International Journal fo Scientific Research*. 2016;5(7):23-4.
- Barak A, Elhalel A, Pikkell J, Krauss E, Miller B. Incidence and severity of ocular and adnexal injuries during the Second Lebanon War among Israeli soldiers and civilians. *Graefes Arch Clin Exp Ophthalmol*. 2011;249(12):1771-4.
- Gendler S, Nadler R, Erlich T, Fogel O, Shushan G, Glassberg E. Eye injury in the Israeli Defense Force: "an ounce of prevention is worth a pound of cure". *Injury*. 2015;46(7):1241-4.
- Hiiler D, Mitchener TA, Stout J, Hatch B, Canham-Chervak M. Eye injury surveillance in the U.S. Department of Defense, 1996–2005. *Am J Prev Med*. 2010;38(1 Suppl):S78-85.
- Jha KN. Indian Soldiers Need Eye Protection. *J Clin Diagn Res*. 2017;11(2):NE01-NE3.
- Yardley AE, Hoskin AK, Hanman K, Sanfilippo PG, Lam GC, Mackey DA. Paediatric ocular and adnexal injuries requiring hospitalisation in Western Australia. *Clin Exp Optom*. 2017;100(3):227-33.
- Chen AJ, Chan JJ, Linakis JG, Mello MJ, Greenberg PB. Age and consumer product-related eye injuries in the United States. *Rhode Island medical journal*. 2014;97(1):44-8.
- Laraque D, American Academy of Pediatrics Committee on Injury V, Poison P. Injury risk of nonpowder guns. *Pediatrics*. 2004;114(5):1357-61.
- Brown L. Yo-yo injuries. *Pediatric emergency care*. 2004;20(6):379-81.

- Alphonse VD, Kemper AR, Rowson S, Duma SM. Eye injury risk associated with remote control toy helicopter blades. *Biomedical sciences instrumentation*. 2012;48:20-6.
- Kuhn F, Mester V, Morris R, Dalma J. Serious eye injuries caused by bottles containing carbonated drinks. *Br J Ophthalmol*. 2004;88(1):69-71.
- Da Pozzo S, Pensiero S, Perissutti P. Ocular injuries by elastic cords in children. *Pediatrics*. 2000;106(5):E65.
- Yardley AM, Hoskin AK, Hanman K, Wan SL, Mackey DA. Animal-inflicted ocular and adnexal injuries in children: A systematic review. *Surv Ophthalmol*. 2015;60(6):536-46.
- Matsa E, Shi J, Wheeler KK, McCarthy T, McGregor ML, Leonard JC. Trends in US Emergency Department Visits for Pediatric Acute Ocular Injury. *JAMA Ophthalmol*. 2018;136(8):895-903.
- Beshay N, Keay L, Dunn H, Kamalden TA, Hoskin AK, Watson SL. The epidemiology of Open Globe Injuries presenting to a tertiary referral eye hospital in Australia. *Injury*. 2017;48(7):1348-54.
- Glynn RJ, Seddon JM, Berlin BM. The incidence of eye injuries in New England adults. *Arch Ophthalmol*. 1988;106(6):785-9.
- Leonard JC. National Trends in Ocular Injury: Differing Studies, Common Call to Action. *JAMA Ophthalmol*. 2019;37(1):56-7.
- Swathi A, Matheen A, Charanya C, Sudhaker S. Prospective Study of Ocular Manifestation of Road Traffic Accidents on East Coast Road Presenting to Tertiary Care Centre in Tamilnadu. *International Journal of Health Sciences and Research*. 2016;6(8):84-8.
- Long J, Mitchell R. Hospitalised Eye Injuries in New South Wales, Australia. *The Open Epidemiology Journal*. 2009;2:1-7.
- Tielsch JM, Parver LM. Determinants of hospital charges and length of stay for ocular trauma. *Ophthalmology*. 1990;97(2):231-7.
- Fong LP. Eye injuries in Victoria, Australia. *Med J Aust*. 1995;162(2):64-8.
- Akbar-Khanzadeh F, Bisesi MS, Rivas RD. Comfort of personal protective equipment. *Appl Ergon*. 1995;26(3):195-8.
- Kriz PK, Comstock RD, Zurakowski D, Almquist JL, Collins CL, d'Homécourt PA. Effectiveness of protective eyewear in reducing eye injuries among high school field hockey players. *Pediatrics*. 2012;130(6):1069-75.
- Pashby T. Eye injuries in Canadian amateur hockey. *Can J Ophthalmol*. 1985;20(1):2-4.
- Finch C, Vear P. What do adult squash players think about protective eyewear? *Br J Sports Med*. 1998;32(1):55-61.
- Lincoln AE, Caswell SV, Almquist JL, Dunn RE, Clough MV, Dick RW, et al. Effectiveness of the women's lacrosse protective eyewear mandate in the reduction of eye injuries. *Am J Sports Med*. 2012;40(3):611-4.
- Dain SJ. Sports eyewear protective standards. *Clin Exp Optom*. 2016;99:4-23.
- Leisy HB, Cortisidis AL. Use of Protective Eyewear During Recreational Activities in Adults of the United States: Analysis from the 2016 National Health Interview Survey. *Ophthalmic Epidemiol*. 2019;26(3):216-22.
- AS/NZS 1337.1 Personal eye protection Part 1: Eye and face protectors for occupational applications. Sydney: Standards Australia/ Standards New Zealand, 2010.
- AS/NZS 4066 Eye protectors for racquet sports. Sydney: Standards Australia/ Standards New Zealand, 1992.
- AS/NZS 1067.1 Eye and face protection- Sunglasses. Part 1: Requirements. Sydney: Standards Australia/ Standards New Zealand, 2016.
- ANSI Z87.1 American National Standard for Occupational and Educational Personal Eye and Face Protection Devices. American National Standards Institute, Inc. 2010.
- ASTM F803-11 Standard Specification for eye Protectors for Selected Sports. ASTM International. 2011.
- ASTM F1776-12 S andard Specification for Eye Protective Devices for Paintball Sports. ASTM International. 2012.
- ISO 12312-1 Eye and face protection- Sunglasses and related eyewear- Part 1: Sunglasses for general use. Internationa Organization for Standardization. 2013.
- EN 166 Personal eye protection. Specifications. European Committee for Standardization. 2002.
- Fong LP, Taouk Y. The role of eye protection in work-related eye injuries. *Aust N Z J Ophthalmol*. 1995;23(2):101-6.
- Zakrzewski H, Chung H, Sanders E, Hanson C, Ford B. Evaluation of occupational ocular trauma: are we doing enough to promote eye safety in the workplace? *Can J Ophthalmol*. 2017;52(4).
- Crew JM, Lam G, Clark A, Spilsbury K, Mukhtar AS, Morlet N, et al. Hospitalization rates of children who are blind. *Clin Exp Ophthalmol*. 2013;41(8):773-8.
- Frank CR, Xiang X, Stagg BC, Ehrlich JR. Longitudinal Associations of Self-reported Vision Impairment With Symptoms of Anxiety and Depression Among Older Adults in the United States. *JAMA Ophthalmol*. 2019.
- Frost A, Eachus J, Sparrow J, Peters TJ, Hopper C, Davey-Smith G, et al. Vision-related quality of life impairment in an elderly UK population: associations with age, sex, social class and material deprivation. *Eye (Lond)*. 2001;15(Pt 6):739-44.