

# Epidemiology of eye injuries in a high-income developing country

## An observational study

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### Abstract

Vision loss following eye trauma is a serious health problem worldwide. The aim of the study was to report the epidemiology of eye injury that requires hospitalization and surgery at a secondary referral center in a high-income developing country so as to give recommendations regarding its prevention.

All patients who had an eye injury that required surgical intervention between 2012 and 2017 at Al-Ain Hospital were retrospectively studied. Demography, cause of injury, and visual acuity before and after treatment were studied.

Results revealed that 141 patients were operated, 96 eyes with open globe and 48 with other injuries. The median (IQR) age was 25 (11.5–37) years, 89% were males. Majority of injuries occurred at work (50.4%) followed by home (31.2%). Sharp objects (24.1%) and blunt trauma (16.3%) were the most common mechanism of injury. Eye injury was less during the weekends (Friday and Saturday) and during the summer vacation. Cornea injuries (48.2%) were the most frequent cause for visual acuity deterioration followed by lens/cataract (23.4%). Among injured eyes, 30 eyes (21.3%) retained intraocular foreign bodies. There was significant improvement of the visual acuity after surgery ( $P < .0001$ , Wilcoxon signed rank test).

Our study has shown that eye injury is a major risk for visual loss of young people which is mainly work-related. Use of personal protective equipment for the eyes and adopting legislative eye safety regulations will reduce the impact of eye injuries in our community.

**Abbreviations:** AAHEC = Al-Ain Hospital Research Ethics Committee, IOFB = intraocular foreign body, VA = visual acuity.

**Keywords:** epidemiology, eye injuries, hospitalization

## 1. Introduction

Despite advancements in medical technology for sight preservation and restoration, eye injuries remain a major cause of visual loss.<sup>[1–4]</sup> The consequences of eye injuries on human suffering and the economic loss are underestimated.<sup>[5]</sup> Landen et al<sup>[6]</sup> reported an annual incidence of 3.5/100,000 inhabitants of perforated eye injuries in the United States. About 2.4 and 7.9 per 1000 nonindigenous and indigenous adults, respectively, had monocular vision loss from eye injury in Australia.<sup>[7]</sup> Around three-quarter million patients are annually hospitalized with eye injury worldwide<sup>[2]</sup>. Furthermore, about quarter of visits to eye

clinics, half of eye emergency cases, and 10% of all admissions in eye departments are caused by eye injuries.<sup>[2]</sup> The annual cost for hospitalized eye injured patients was estimated to be \$155 million in Australia<sup>[8]</sup> and US\$200 million in the United States.<sup>[2]</sup> UAE is a high-income developing country. The tremendous expansions of enterprises and attractions of investors exponentially increased the UAE population including the workforce. Legislative regulations mandate eye protection at UAE. Nevertheless, there is lack of industrial inspectors and safety officers in the community.<sup>[9]</sup> Al-Ain city is the fourth largest city in the UAE which is located in the eastern region of the Emirate of Abu Dhabi. It has an estimated population of 765,000. We aimed to study the epidemiology of eye injuries that required surgery at Al-Ain Hospital so as to give recommendations regarding their preventions.

## 2. Patients and methods

All patients who had an eye injury requiring admission and surgical intervention at Al-Ain Hospital during the period of January 2012 to March 2017 were retrospectively studied. The data collection was approved by the Al-Ain Hospital Research Ethics Committee (AAHEC-09-17-071). Al-Ain Hospital is the main referral center for eye injuries in Al-Ain city. The patients were identified from the operating room database. A special study protocol was designed and tested. The data were collected as hard copy and then transferred into an Excel sheet. Data entry and accuracy were checked by randomly auditing 10% of all cases. A total of 141 consecutive patients (144 eyes, eyelid, or adnexal injuries) were included in the study.

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Studied variables included age, sex, nationality, side of the eye involved, occupation, date of injury, hospital stay, total number of follow up visits, activity at time of injury, place where injury occurred, eye protection at time of injury, cause of injury, visual acuity at presentation, zone of open globe injury, presence of intraocular foreign body (IOFB), final visual acuity (VA), and reasons for VA limitation. When available, VA of the injured eye was obtained at initial and at follow-up visits using a Snellen acuity chart. If VA measuring was not possible by the previous method, then count fingers, detection of hand movements, and light perception were assessed. The VA was converted into logMAR unit for the purpose of the analysis. VA of 20/20 was converted to 0, 20/40 to 0.3, hand motion to 3 logMAR, light perception vision to 3.7, and no light perception to 4.7. Open globe injuries were classified as follows: zone I included injuries limited to the cornea and/or corneoscleral limbus, zone II were full-thickness wound involving the anterior 5 mm of the sclera, and zone III were full-thickness scleral rupture posterior to zone II.<sup>[10]</sup>

Data were entered into an Excel spread sheet and then coded. Data were tabulated and presented as number (%), mean (SD), or median (range) as appropriate. Fisher exact test was used to compare the categorical data of 2 independent groups. Wilcoxon signed rank test was used to compare visual acuity at presentation and follow-up in the same patients. Data were analyzed with the PASW Statistics version 25, SPSS Inc, Chicago, IL.

### 3. Results

A total of 141 patients (144 injured eyes) were admitted and surgically treated between 2012 and 2017 at Al-Ain Hospital. The median (IQR) age was 25 (11.5–37) years. Males were 89% of the patients. Majority were from the Indian subcontinent (65%) (Table 1). Table 2 shows the activity of the patients when they sustained the eye injury. Majority occurred while playing (21%), followed by hammering (18%) (Table 2). Out of the 30 eye injuries that occurred while playing, 28 (93%) were in children having an age of 10 years or less, 19 of them were boys (64%), and 15 injuries (50%) were due to blunt trauma. More than half of the injuries (50.4%) occurred at work followed by home (31.2%) (Table 3). There was significant difference in the place of injury between males and females ( $P < .0001$ , Fisher exact test). Majority of male injuries occurred

**Table 2**

**Activity at time of eye injury of 141 patients who required surgical intervention after admission to Al-Ain Hospital during the period of January 2012 to March 2017.**

Activity	Number (%)
Playing	30 (21%)
Hammering	25 (18%)
Construction/Carpentry/Repairing	17 (12%)
Grinding	8 (6%)
Driving/Riding	6 (4%)
Cleaning	5 (3.5%)
Farming	5 (3.5%)
Cutting	5 (3.5%)
Others	19 (13.5%)
Unknown	21 (15%)

**Table 3**

**Place of eye injury occurrence of 141 patients who required surgical intervention after admission to Al-Ain Hospital during the period of January 2012 to March 2017.**

Place	Number (%)	Male n=124	Female n=17	Children n=39	Adults n=101
Work	71 (50.4)	71 (57.3)	0 (0)	0 (0)	71 (70.3)
Home	44 (31.2)	29 (23.4)	15 (88.2)	29 (74.4)	14 (13.9)
Street and highways	9 (6.4)	9 (7.3)	0 (0)	2 (5.1)	7 (6.9)
Farm	6 (4.3)	6 (4.8)	0 (0)	0 (0)	6 (5.9)
Others	9 (6.3)	7 (5.6)	2 (11.8)	8 (20.5)	1 (1)
Unknown	2 (1.4)	2 (1.6)	0 (0)	0 (0)	2 (2)

Data are presented as number (%). Children include those <18 years old. We could not do more refined categorization of age because of small numbers of age groups. There were only 2 geriatric patients >65 years old in the adult group. Age was missing in one patient.

at work (57.3%), whereas majority of female injuries occurred at home (88.2%). Furthermore, there was significant difference in the place of injury between children and adults ( $P = .001$ , Fisher exact test). Majority of adult injuries occurred at work (70.3%), whereas majority of child injuries occurred at home (74.4%). Table 4 shows the cause of injury. Majority were

**Table 4**

**Cause of injury of 141 patients who had eye injuries and required surgical intervention after admission to Al-Ain Hospital during the period of January 2012 to March 2017.**

Cause	Total n=141	Male n=124	Female n=17	Children n=39	Adults n=101
Sharp object	34 (24.1)	29 (23.4)	5 (29.4)	12 (30.8)	22 (21.8)
Blunt object	23 (16.3)	18 (14.5)	5 (29.4)	10 (25.6)	13 (12.9)
Nail	16 (11.3)	16 (12.9)	0 (0)	0 (0)	16 (15.8)
Hammer on metal	11 (7.8)	11 (8.9)	0 (0)	0 (0)	11 (10.9)
Fall	9 (6.4)	7 (5.6)	2 (11.8)	6 (15.4)	2 (2)
MVC	9 (6.4)	9 (7.3)	0 (0)	2 (5.1)	7 (6.9)
Wire	7 (5)	6 (4.8)	1 (5.9)	1 (2.6)	6 (5.9)
Tree branch/thorns	7 (5)	7 (5.6)	0 (0)	1 (2.6)	6 (5.9)
PMFB	6 (4.3)	5 (4)	1 (5.9)	1 (2.6)	5 (5)
Others	16 (11.3)	14 (11.3)	2 (11.8)	5 (12.8)	11 (10.9)
Unknown	3 (2.1)	2 (1.6)	1 (5.9)	1 (2.6)	2 (2)

Data are presented as number (%). Children include those <18 years old. We could not do more refined categorization of age because of small numbers of age groups. There were only 2 geriatric patients >65 years old in the adult group. Age was missing in 1 patient. MVC= motor vehicle collision, PMFB=projectile metallic foreign body.

**Table 1**

**Demography of 141 patients who had eye injuries and required surgical intervention after admission to Al-Ain Hospital during the period of January 2012 to March 2017.**

Variable	Number (%)
Sex	
Male	124 (89%)
Female	17 (12%)
Age	26 (15.5)
Nationality	
Pakistani	33 (23%)
Bangladeshi	28 (20%)
Emirati	25 (18%)
Indian	14 (10%)
Syrian	9 (5%)
Omani	6 (4%)
Egyptian	6 (4%)
Others	20 (16%)

Data are presented as mean (SD) or number (%) as appropriate.

caused by sharp objects (24.1%) (Table 4). There was significant difference in the cause of injury between children and adults ( $P=.001$ , Fisher exact test). All nail and hammer on metal eye injuries occurred in adults. There was no significant difference in the cause of injury between males and females ( $P=.3$ , Fisher exact test). Eye injuries were less during the weekend (Friday [7.1%] and Saturday [12.8%]) and during summer vacation (June–September) (Fig. 1).

Overall, 83 of the injured eyes were on the left side (58.9%), 55 on the right side (39%), and 3 were bilateral (2.1%). Sixty-seven (46.5%) eyes had zone I injury, 27 (18.75%) zone II, and 5 (3.5%) zone III. One patient had zone I and II, and 2 eyes had zone II and III involvement. Overall, 36 eyes sustained eyelids injury, 9 eyes had only traumatic cataracts, and remaining had other types of ocular injuries. Among the traumatized eyes, 30 eyes (21.3%) retained intraocular foreign bodies (IOFB): 17

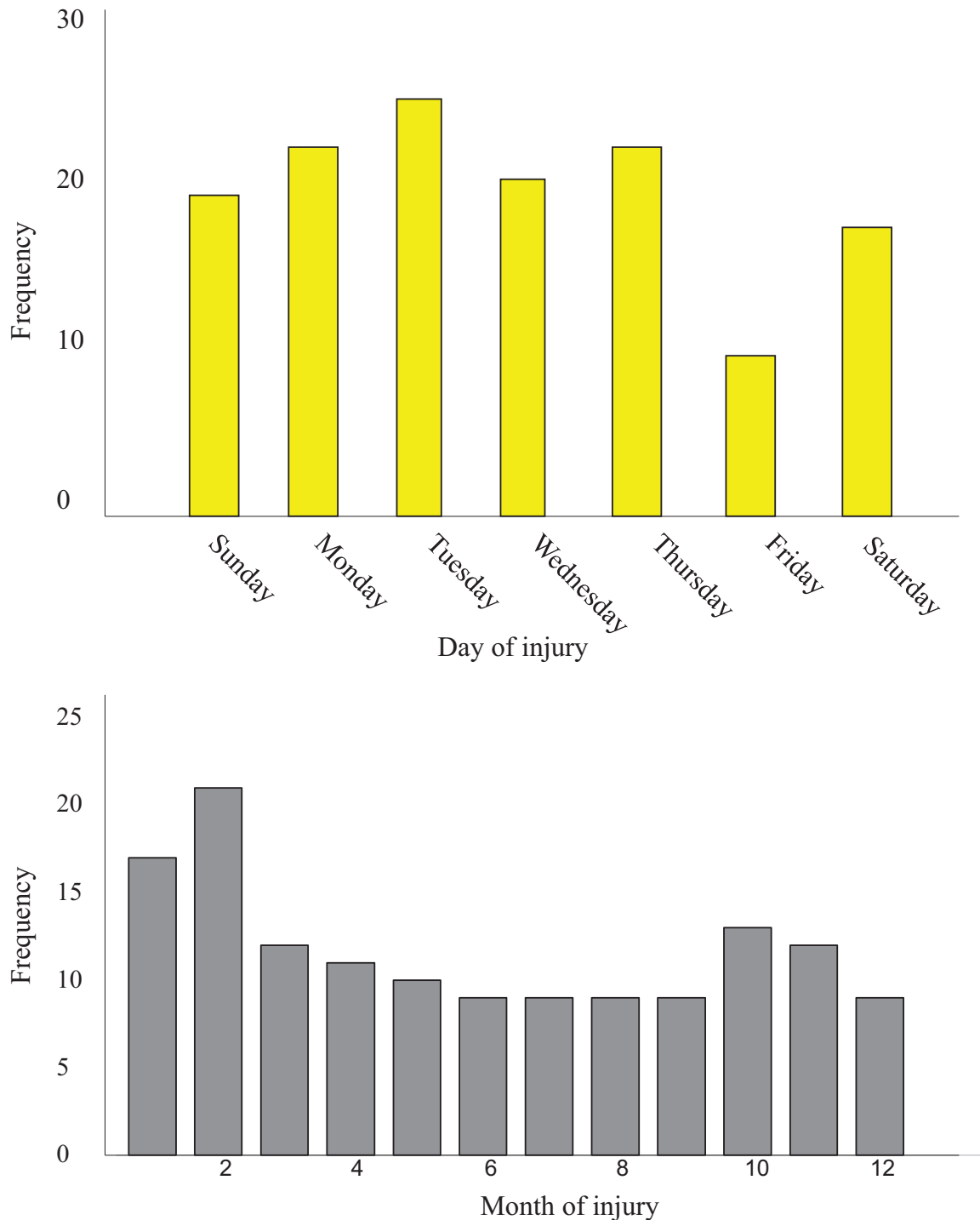


Figure 1. Eye injury was less during the weekends (Friday and Saturday) and during the summer vacation (June to September).

**Table 5**

**Causes for visual acuity limitation of 141 patients (144 injured eyes) who required surgical intervention after admission to Al-Ain Hospital during the period of January 2012 to March 2017.**

Cause	Number (%)
Cornea	68 (48.2)
Lens/Cataract	33 (23.4)
Vitreous	18 (12.8)
Sclera	15 (10.6)
Lid	14 (9.9)
Iris	11 (7.8)
Retina	10 (7.1)
Others	15 (10.6)

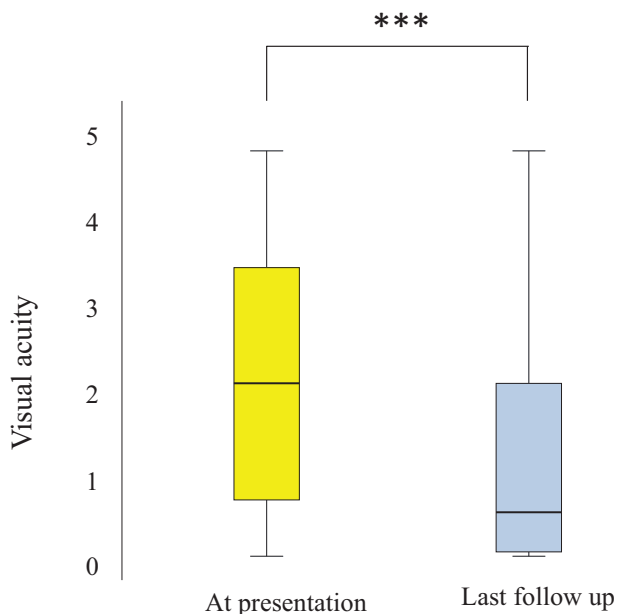
Some of the traumatized eyes had multiple causes for visual acuity limitation.

(12.1%) in the anterior segment, 11 (7.8%) in the posterior segment, and 3 (2.1%) in other anatomical regions.

Overall, 107 patients (75.9%) presented to the hospital at the same day of injury, 21 (14.9%) within 2 to 3 days after injury, 8 (5.7%) within 4 to 7 days after injury, and 5 (3.5%) presented after a week of injury within 10 to 30 days after injury.

The mean (SD) length of hospital stay was 3.16 (2.81) days. Majority of patients had follow-up after the surgical intervention. The mean (SD) follow-up visits were 3.17 (4.11) times (range, 0–26 times). Corneal injuries (48.2%) were the most frequent cause for visual acuity limitation followed by lens/cataract (23.4%) (Table 5).

Visual acuity at presentation and follow-up were available in 91 injured eyes. It significantly improved at follow-up (median 2 LogMAR [range 0–4.7]) compared with 0.3 (0–5) at presentation ( $P < .0001$ , Wilcoxon signed rank test) (Fig. 2). Major visual impairment (worse than 20/200) was significantly less in children compared with adults both at presentation and follow-up (4/14 [28.6%] compared with 56/91 [61.5%],  $P = .007$ , Fisher exact

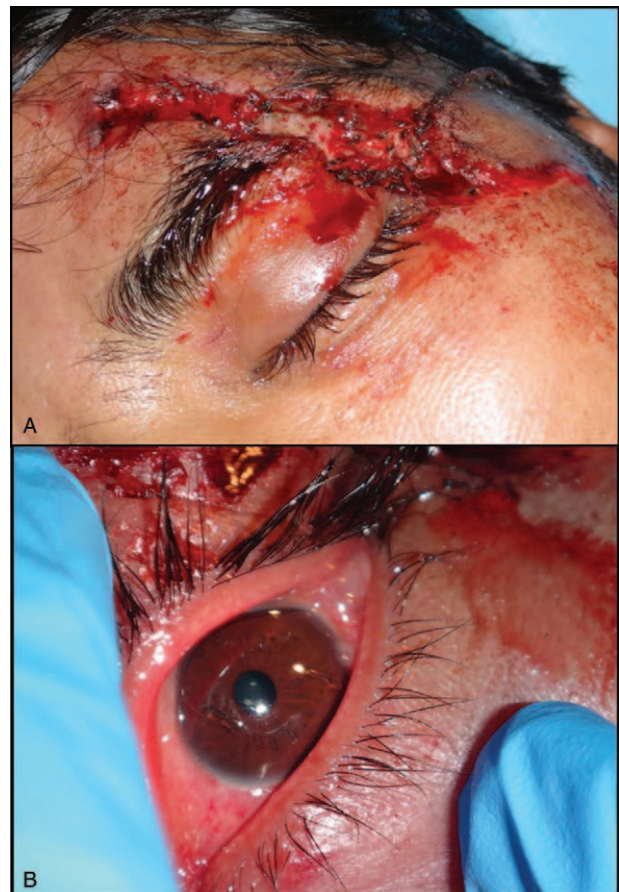


**Figure 2.** Box-and-whiskers plot of visual acuity (VA) at presentation and follow up. There was significant improvement of VA post-surgical repair ( $P < .0001$ , Wilcoxon signed rank test).

test; and 3/27 [11.1%] compared with 36/90 [40%],  $P = .005$ , Fisher exact test). In contrast, major visual impairment was not statistically different between males and females both at presentation and follow up (57/87 [65.5%] compared with 3/9 [33.3%],  $P = .08$ , Fisher exact test; and 35/106 [33%] compared with 4/11 [36.4%],  $P = .99$ , Fisher exact test).

#### 4. Discussion

Our study has shown that eye injury is a major risk for visual loss among young people with majority of injuries being work-related. This is attributed to the low use of eye personal protective equipment (PPE) at work. Consistent with other epidemiological studies, ocular trauma was more frequent among young males compared with females.<sup>[4,11,12]</sup> Other studies have shown that work was the most common location for eye injury.<sup>[13–15]</sup> Similar to our study, around half of eye emergency unit visits were work-related.<sup>[12,16–18]</sup> Beshay et al<sup>[19]</sup> reported that 69% of IOFB occurred at work. Zone I was the most frequent type of open globe injury in our study. Kutlutürk et al<sup>[4]</sup> found that about 70% of eye injuries were zone I. Working with metal was the main cause of eye injury associated with IOFB in our study (Fig. 3). Canavan et al,<sup>[11]</sup> in a 10-year survey on 2032 patients, reported that the percentage of IOFB or intraorbital foreign bodies to be 8.4%; Kutlutürk et al<sup>[4]</sup> found that 11% of injured eyes had an



**Figure 3.** A 26-year-old sustained a penetrating eye injury to his left eye by metallic piece during work (A–B). There was an intraorbital foreign body that caused a retinal perforation and major visual loss of the left eye. The patient has given his written consent approving publishing his clinical images.

open globe injury. The percentage of IOFB was much higher in our study (21.3%).

The effectiveness of the eye PPE against severe eye injury is well-proven.<sup>[20–23]</sup> Nevertheless, the compliance of employees and its usage is not adequate. Zakrzewski et al<sup>[24]</sup> in their occupational eye injury study found that about 67% of their study population did not wear any eye PPE. McCarty et al<sup>[14]</sup> reported that <20% used the eye PEE at workplace. The data on PEE usage were missing in our study. Discussions with our research team indicated that data on personal protective eyewear at the time of eye injury were missing in the files. Shortage of recording the data on usage of PEE in an eye injury setting highlights the need of promoting methods of eye injury protection in the community. Furthermore, UAE should develop a national registry for eye injuries with proper prospective data collection. The collected data may help identifying groups at risk of eye injury which should be targeted by preventive policy measures.

We have to highlight that our study has certain limitations. First, it is from a single center. Eye injuries might have different patterns in other regions of UAE due to different developmental patterns and policies. Second, the retrospective nature of the study limits the amount of data collected like the education level of the patients, details of the injury incident, and use of protective equipment. As there are no published data concerning the epidemiology of eye injuries or personal eye protective equipment from UAE, we think that this study will highlight this important area. Third, we studied only patients who were operated rather than those who were treated at the community or emergency department. This reflects a selection bias. Our patients represent the tip of an iceberg of eye injury population. To address that, we are now running an observational study in the field of workplace to directly identify risk factors of eye injuries so as to give proper future practical preventive solutions.

## 5. Conclusion

In summary, our study has shown that eye injury is a major risk for visual loss among young people with majority of injuries being work-related. Direct assessment of usage of personal protective equipment for the eyes at work and developing legislative regulations and adopting them will reduce the impact of eye injuries in our community.

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