



Epidemiological Profile of Pediatric Ocular Trauma in Hamadan, 2020

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Abstract

Background and aims: Ocular traumas are among the most important causes of visual acuity loss and acquired unilateral blindness in children, with permanent effects on their psychological and social development. The epidemiology of ocular traumas, especially those of children in different societies, is affected by the culture and level of education, lifestyle, and socioeconomic level. Considering that no accurate statistics on these injuries have been reported in Hamadan, Iran, this study aimed to investigate the epidemiology of various types of injuries in children following ocular traumas in Hamadan.

Methods: This cross-sectional study included 293 patients under 18 years of age with ocular trauma who were visited in Farshchian Sina hospital in 2019. A detailed medical history was obtained including demographic information, type of injury, initial and final visual acuity, cause of injury, mother's occupational status, and the delay between trauma and the examination, and the examiner-recorded definitive care. Finally, the data were analyzed using Excel software, and a significance level of 0.05 was used.

Results: Out of 293 patients examined, 38.91% were female, and 61.09% were male. Children aged 1-5 years (30.72%) were the most commonly affected group, followed by those aged 6-10 years (29.35%). There were 19 cases of chemical injury, 33 cases of penetrating trauma, and 241 cases of blunt trauma. The mean initial vision in patients was 0.31 ± 0.347 logMAR, and the mean final vision was 0.06 ± 0.084 logMAR. In 94 patients, it was impossible to check visual acuity due to their lower age. Besides, 49.83% of injuries happened at home.

Conclusion: In this research, the most common type of ocular trauma was blunt trauma in male patients, which occurred at home in the presence of the mother. Therefore, it is obvious that the most effective way to prevent these incidents is that parents should pay more attention to their children, implement well-established safety precautions while playing at home, and use standard play equipment.

Keywords: Epidemiology, Pediatric ocular trauma, Eye injury, Blindness

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Introduction

Potentially preventable ocular trauma is one of the most important causes of acquired blindness in children.¹ Children are more susceptible to traumas due to the nature of their activities and immature motor skills.² These traumas sometimes cause irreversible social and psychological damage. The number of people suffering from blindness caused by trauma is estimated to be 18 million people worldwide.^{3,4}

Ocular emergencies are significant components of health care and constitute 7% of all bodily injuries.⁵ The epidemiological parameter varies with age, gender, and region. The Baltimore Eye Survey reported a 14.4% lifetime prevalence of eye injury in the general population.⁶ In the United States, nearly 2.4 million ocular traumas occur annually, 35% of which are observed in people aged 17 years of age and younger.⁷ In an epidemiological study, Maurya showed that about 30% of ocular injuries occurred in children up to 18 years old.⁸ Another study showed that

the annual rate of hospitalization due to ocular trauma is 8.85 to 15.2 cases per 100 000 individuals.⁹

The ocular injuries range from slight injuries to severe injuries with visual loss. It has been reported that 95% of ocular injuries are less serious and do not require hospitalization.^{10,11}

Ocular trauma is the main cause of acquired blindness and the second major cause of reduced visual acuity in children.¹² According to research conducted in the USA, 8%-14% of all traumas in children are of ocular type.¹⁰ Pediatric ocular trauma is different from adult ocular trauma in terms of the objects involved in injury and management. The frequency of these injuries is higher in developing countries.⁴

Based on the Birmingham Eye Trauma Terminology (BETT), ocular traumas are divided into 2 general categories: open-globe and closed-globe injuries. Eye injuries can also occur following thermal or chemical trauma. Eye traumas in children are usually accidental

and unilateral. They can be prevented in up to 90% of cases by better education, monitoring, and eye protection.¹²

Additionally, the American Academy of Pediatrics (AAP) and the American Association of Ophthalmology (AAO) have both recommended that children who participate in sports activities should use appropriate protective equipment.¹³ However, 84% of children do not use any eye protection equipment in high-risk situations.¹⁴

A number of studies have shown that more ocular injuries occur in boys since they have an aggressive nature and spend more time outdoors playing. The incidence of injuries from toys was higher in 2-4-year-old children. Injuries from desk supplies were more prevalent in the 5-8-year-old age group, and sport-related injuries were more prevalent in older children.¹⁵

In Canada, sports activities are the second most important cause of eye trauma in children.¹⁶ Penetrating injuries occur more commonly in boys, and most of these ocular injuries occur at home in the absence of appropriate adult supervision due to the entrance of foreign bodies into the eyes, use of desk supplies, and playing with toys. This issue shows the importance of parental care in preventing traumas.⁷

Recent studies in the United States show an annual decrease in eye trauma among children due to various reasons, such as the use of airbags and seat belts, progress in the manufacture of car glass, improvement in the safety of household chemical products, and increase in the tendency towards sedentary life in children.¹⁷ Contrary to the overall decrease of 26% in pediatric eye traumas between 2006 and 2014, the number of cases caused by sports and animal bites has been growing.¹⁸ Eye damage following trauma is known to cause various socio-economic problems, which is still one of the most important causes of disability.¹⁷ According to the World Health Organization, childhood blindness is preventable in up to 90% of cases.¹⁸ It is, therefore, necessary to obtain information about the demographic patterns, causes, and factors affecting pediatric eye trauma in different regions to achieve this goal.

Generally, epidemiological studies can provide helpful information for developing practical strategies by specifying the age range, prevalence, and causes of eye trauma among different groups. The burden and pattern of pediatric ocular injuries in Iran are poorly known, and considering that no significant research has been conducted in this field in Hamadan, we decided to investigate the prevalence of eye trauma in children under 18. The results of this research can be helpful for more training and future planning in preventing the occurrence of these ocular traumas.

Materials and Methods

This descriptive case-series study was conducted from April 2019 to March 2020 at Farshchian Sina hospital in Hamadan.

All patients under 18 years of age with ocular trauma

referred to the emergency department and ophthalmology clinic from April 2019 to March 2020 were included in this study. Therefore, the sample size was not calculated for this study. The convenient sampling method was used for the sampling of participants. After obtaining informed consent from patients' parents, they were included in the study. The exclusion criterion was the lack of consent of patients or their parents.

Visual acuity measurement, complete eye examination with a slit lamp, and ophthalmoscopy were performed in all included patients. A predesigned checklist was used for data collection. According to this checklist, age, gender, cause of trauma, place of occurrence, delay to visit, and mother's occupation were asked. The type of trauma, type of eye damage, initial vision, final vision, type of treatment, status of the day of trauma (ordinary day or holiday), and treatment by a general practitioner, ophthalmologist, or ophthalmology intern were included in the questionnaire.

Based on the BETT, traumas were classified into two groups, including open-globe and closed-globe injuries, and their prevalence was calculated based on the cause, age range, and gender. Medical or surgical intervention was performed based on the type of eye injury. One month after completing the treatment period, re-examination was done. For data analysis, quantitative variables were reported as the mean and standard deviation, and qualitative variables were reported as frequency and percentage. Besides, the chi-square test was used to test the association between categorical variables. The significant level was considered to be 0.05. Stata version 14.2 was used for data analysis.

Results

Of 293 patients, 179 were boys and 114 were girls. In this study, the patients were classified into four age ranges: 0-5 years, 6-10 years, 11-15 years, and >15 years, and the highest prevalence of trauma was observed in the 0-5 age range with 90 cases (30.72% of patients), followed by 6-10 years age group with 86 cases (29.35%). Seventy-three patients (24.91%) were 11-15 years old, and 44 patients (15.02%) were over 15 years of age (Figure 1).

Regarding the nature of injuries, the traumas were divided into 2 categories: open-globe and closed-globe injuries. In this study, 19 cases of chemical trauma, 33 cases of open globe, and 241 cases of closed globe injuries were recorded (Figure 2).

The prevalence of non-penetrating traumas was 40% and 31% in girls and 60% and 69% in boys, respectively. Additionally, 31.6% of chemical injuries were observed in girls and 68.4% in boys. The relationship between the type of injuries and the gender of children was significant.

In terms of the relationship between the type of trauma and the age of patients, more than 60% of traumas occurred in the age range of less than 10 years. Besides, penetrating traumas were more common in the age range of 1-5 and 11-15 years, respectively. Chemical injuries in the age ranges investigated have similar prevalence rates

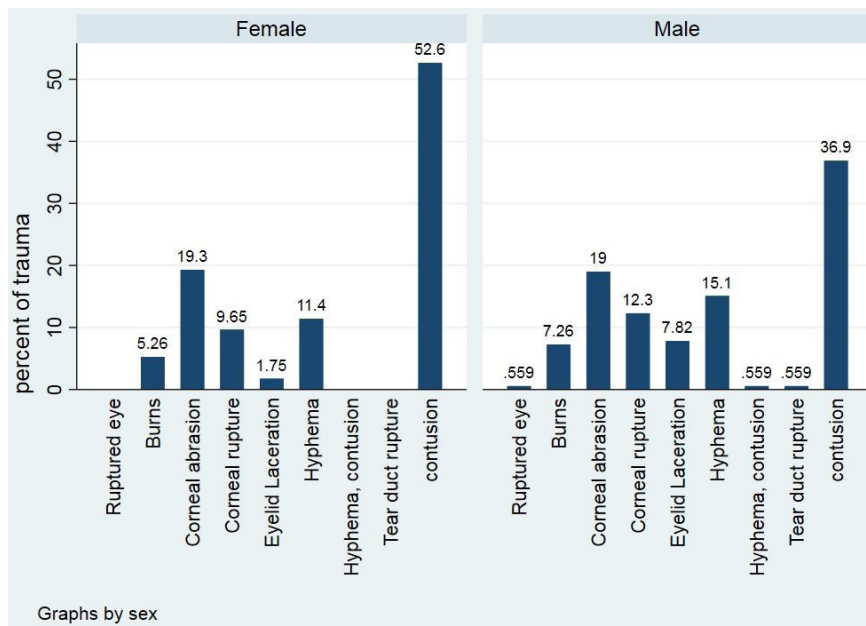


Figure 1. Frequency of Types of Injuries by Age

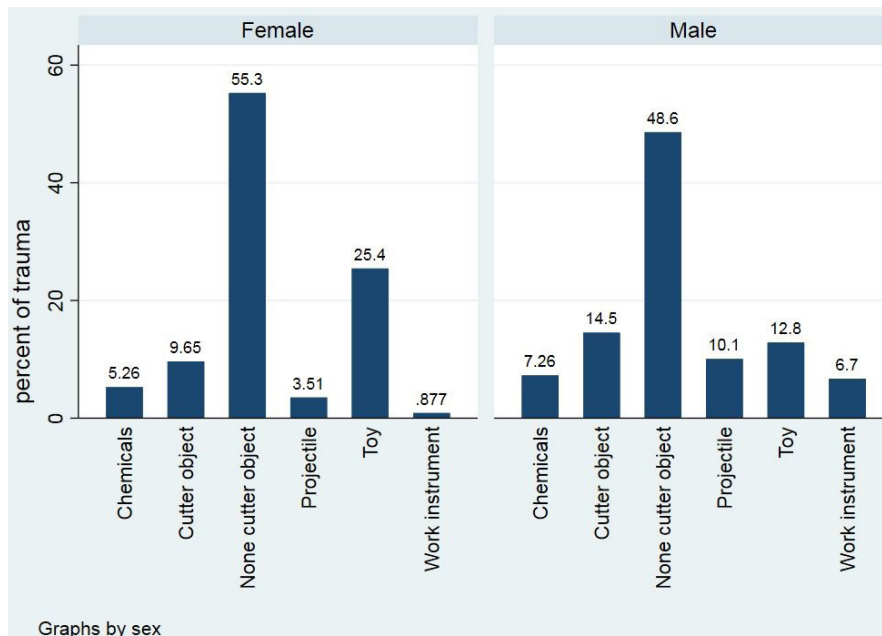


Figure 2. Frequency of the Causes of Injuries by Age

in both genders (Table 1).

Regarding the type of instrument, most of the injuries (202 cases) were caused by non-penetrating objects (hands, balls, toys, sports equipment, etc). The trauma caused by working tools was investigated in two age ranges: 11-15 (54%) and >15 years (46%). Most traumas caused by toys were observed in children 1-5 years old (50%), and major injuries caused by blast trauma occurred in children aged 6-10 (45%).

In general, injuries caused by traumas are mainly in the form of contusion (126 cases), followed by corneal abrasion (56 cases), hyphema (41 cases), corneal and scleral laceration (34 cases), and eyelid and nasolacrimal duct laceration (17 cases).

Table 1. Frequency of Trauma Types by Age

Trauma	Age				Total
	1-5	6-10	11-15	>15	
Non-penetrating	73 (30.3%)	76 (31.5%)	61 (25.3%)	31 (12.9%)	241 (100%)
Penetrating	11 (33.3%)	5 (15.2%)	10 (30.3%)	7 (21.2%)	33 (100%)
Chemical	6 (31.6%)	5 (26.3%)	2 (10.5%)	6 (31.6%)	19 (100%)
Total	90 (30.7%)	86 (29.4%)	73 (24.9%)	44 (15.0%)	293 (100%)

Nineteen cases of chemical burns have been recorded. In all injuries, the number of boys was higher than that of girls. The highest prevalence of contusion injuries

was observed in children 1-5 years old. Besides, the highest number of injuries leading to corneal and scleral lacerations (11 cases) was observed in children 11-15 years old, followed by children 1-5 years old (10 cases). In the case of burns, two age ranges of 1-5 years and > 15 years constituted 63.6% of the victims (Table 2).

Almost half of all traumas occurred at home (49.83%), which includes 46% of blunt traumas, 59.38% of penetrating traumas, and 69.22% of chemical burns. These statistics can be affected by the conditions following the COVID-19 epidemic, where children have been at home most of the time. The primary and secondary visual acuity were measured in logMAR in 203 children (Table 3).

Moreover, 231 cases (78.8%) underwent medical examination in less than 12 hours, and 279 cases (95%) within 24 hours from the time of trauma (Table 4). Besides, 210 trauma cases (about 71.5%) occurred on regular days, and 83 cases (28.5%) occurred during holidays. Most patients (82.94%) received medical treatment, and 17.06% of cases underwent surgical intervention. Additionally, 78.2% of the patients had housewife mothers, and the rest had working mothers (Table 4).

Discussion

Ocular injuries are among the most common causes of acquired blindness in children.⁹ Pediatric ocular injuries differ from those of adults in many ways. Children are more exposed to ocular injuries due to high mobility, risky behaviors, immature motor skills, and the anatomical

condition of the eyes.^{1,2} Eye trauma constitutes 7% of all bodily injuries and 10-15% of all eye diseases.⁵ The AAP reported that 66% of all ocular injuries occur in individuals 16 years of age or younger, with the highest frequency occurring between 9 and 11 years of age.¹⁹ Most ocular injuries occur in boys due to their more aggressive nature. They tend to spend more time outdoors and play risky games. In most studies, the male-to-female ratio varies from 3:1 to 5.5:1.²⁰ The number of people with blindness caused by trauma has been estimated to be 18 million worldwide. It has also been determined that 3.3 to 5.7 million children under 15 years of age in the United States suffer from eye traumas, but about 95% do not require hospitalization.^{10,11}

The results of most studies indicate a high frequency of injuries in boys aged 5-9 years. These injuries are mostly caused by sharp objects and occurred at home.^{8,18,21,22} The results of a study conducted by Gabias et al in 2018 in Canada showed that among 289 recorded trauma cases, the prevalence of trauma was higher in males. Most of the traumas occurred in 5- to 9-year-old children who played at home without supervision. Sports-related traumas are mainly observed in the age group of 10 to 18 years, and hockey is known to account for most of the traumas that

Table 2. Frequency of Types of Injuries by Age

Age	Injury				Total
	1-5	6-10	11-15	> 15	
Contusion	49 (38.9%)	39 (31.0%)	26 (20.6%)	12 (9.5%)	126 (43%)
Eyelid laceration	4 (25.0%)	5 (31.3%)	4 (25.0%)	3 (18.8%)	16 (5.5%)
Corneal laceration	10 (29.4%)	6 (17.6%)	11 (32.4%)	7 (20.6%)	34 (11.6%)
NLD laceration	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	1 (0.3%)
Corneal aberration	18 (32.1%)	18 (32.1%)	13 (23.2%)	7 (12.5%)	56 (19.1%)
Burns	6 (31.6%)	5 (26.3%)	2 (10.5%)	6 (31.6%)	19 (6.5%)
Hyphema	3 (7.3%)	12 (29.3%)	17 (41.5%)	9 (22.0%)	41 (14%)
Total	90 (30.7%)	86 (29.4%)	73 (24.9%)	44 (15.0%)	293 (100%)

Table 3. Average Initial and Final Vision by Trauma

Trauma	Average Vision	
	Initial VA LogMAR	Final VA LogMAR
Closed globe injury	0.24 (1.30 -0.10)	0.10 (0.10-0)
Chemical	0.18 (0.88-0.38)	0.10 (0.48-0)
Open globe injury	1.00 (<1.30 -0.88)	0.78 (<1.30 -0.48)

Table 4. The Effect of Various Factors on the Prognosis and Final Vision of Patients

Study factors	The Final Vision		Calculated Chi ² and P Value
	Final VA LogMAR < 0.88 36 People	Final VA LogMAR > 0.18 167 People	
Age range			
<10 years	15	72	Chi ² : 0.0253; P value: 0.873
>10 years	21	95	
Sex			
Male	29	106	Chi ² : 3.8795; P value: 0.04
Female	7	61	
Type of trauma			
Closed-globe injury	18	149	Chi ² : 37.2995; P value: <0.0001
Open-globe injury	15	8	
Chemical	3	10	
Day			
Holiday	17	48	Chi ² : 4.6464; P value: 0.03
Ordinary	19	119	
Delay to visit			
Within 12 hours	26	135	Chi ² : 1.3399; P value: 0.247
After 12 hours	10	32	
Therapeutic intervention			
Surgical	18	16	Chi ² : 34.6996; P value: <0.0001
Medical	18	151	

occur in this group. The final visual acuity at discharge was 20/30 or better in 86.7% of cases.¹⁸

A study conducted by Qayum et al in India in 2018 showed that 271 of 357 patients (76%) were under 12 years of age, and the male-to-female ratio was 2.9: 1. A total of 242 cases (67.8%) suffered non-penetrating trauma, and the cause of trauma in 35% of the cases was a fall from a height. Among the penetrating traumas, traumas with needles, knives, glass, and pens were the most common factors. Moreover, 47.8% of the cases happened at home, 17.9% in the street, and 14.9% in the playground.²³

In another study conducted in Tehran in 2011 by Sharifzadeh et al, 600 patients under 17 years of age who were referred with various types of eye trauma were examined. In this study, the average age of the subjects was 7.9 years, and the male-to-female ratio was 2.3: 1. More than 70% of patients were referred in less than 12 hours after trauma. Additionally, 57.7% of the traumas happened at home. Besides, of 387 patients who were followed up, 334 cases had a visual acuity of 0.5 or better, and 12 of them had a visual acuity of less than 0.1 LogMAR. Moreover, 86.3% of patients had non-penetrating traumas, 9% had penetrating traumas, and 4.7% had chemical injuries.²⁴

Similar to most previous studies, the results of this study show a higher prevalence of damage in boys than in girls.^{8,21,22,25} This can be due to the less supervision of families on male children and the greater activity of boys. In our study, the male-to-female ratio was 1:5. In previous studies, this ratio varied from 1.6 to 5. In the age range of 0-5 years, the frequency of injuries in both genders was almost equal. However, with increasing age, the frequency in girls decreased, indicating that girls are under more supervision and have safer activities than boys as they grow older.

In our study, most of the injuries occurred in the age range of <10 years (about 60% of the patients), which is consistent with the studies conducted by Gabias et al¹⁸ and Qayum et al²³ and is different from the study conducted by Ashaye.²⁶

Of the 293 patients included in our study, 238 cases were non-penetrating trauma, 32 cases were penetrating trauma, and 19 cases were chemical trauma. These findings are in line with those reported by Qayum et al, Sharifzadeh et al, and Al Wadei et al.²³⁻²⁵

The similarity with previous studies can be seen in terms of the cause of trauma and the type of injury, including contusion, corneal scratch, and hyphema, respectively. In this study, the majority of the injuries were caused by non-penetrating objects (hands, stationery, etc) and happened at home.^{8,23}

In our study, 6.4% of the injuries occurred in working children. This rate was 2.5% in the study of Al Wadei et al,²⁵ and it was 9.8% in the study of Ashaye,²⁶ which is proportional to the socio-cultural status and the economic level of different societies.

In this study, 71.5% of traumas occurred on ordinary days, and 28.5% occurred during holidays. Despite the

COVID-19 pandemic and the subsequent shutdown in 2019, there has been a significant relationship between the severity of injuries (based on initial and final vision) and holidays, which can be attributed to the injuries on Chaharshanbeh Suri.

In our study, the mean initial vision was 0.31 ± 0.34 logMAR, and the mean final vision was 0.06 ± 0.084 logMAR, which are consistent with the studies conducted by Qayum et al and Sharifzadeh et al.^{23,24} However, the results contradict the study conducted by Madan et al and other studies carried out only on hospitalized patients.^{21,24,26,27}

Moreover, 78.18% of the mothers of injured children in this study were housewives, although this has not been investigated in previous studies. In 231 cases, a medical visit was made within 12 hours of the trauma, and 279 cases were referred to medical centers in less than one day, which shows that parents are aware of the consequences of eye injuries.²⁸

In this study, surgical treatment was performed in 17% of the patients. The statistical differences with studies conducted by Sharifzadeh et al (25%), Mayouego Kouam et al (6.79%), and Shoja & Miratashi (58.3%) are due to the difference in the study population as sometimes only hospitalized patients have been studied.^{24,29,30}

The gender of the patients is one of the influential factors in the prognosis and the final vision of the patients, depending on the type of injuries related to the gender, and it has a significant relationship with the prognosis of the patients. A significant difference in prognosis was also observed based on the type of trauma, therapeutic intervention, and the initial vision of the patients. Due to the severity of injury in penetrating traumas, the initial vision and final vision of the patients were lower.

Additionally, the prognosis of the patients was insignificant depending on the age and delay until the visit. Comparing the prognosis of the injuries that occurred on a holiday and an ordinary day, a significant difference was observed in this context because most of the severe traumas that occurred on the holidays were related to Chaharshanbe Suri.

Conclusion

Children are more susceptible to eye injuries due to the nature of their activities, immature motor skills, and risky behaviors. Severe ocular trauma in children is accidental; however, a safe environment should be provided. In line with other studies, this study, considering the effect of various factors on the prognosis of pediatric ocular trauma, showed that the most important preventive factor is parental monitoring of children's playing games and toys (especially boys) at home. It is recommended that children should be supervised by parents while playing games. Parents should limit their access to dangerous working tools such as knives and scissors, prevent their use of sharp-edged household objects, limit their access to dry plants and leaf blades, keep household detergents

away from children's reach, and provide the necessary training for children who have pets.

Authors' Contribution

Conceptualization: Fatemeh Eslami.

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Formal analysis: Amin Doosti-Irani.

Funding acquisition: Mokhtar Naseri.

Investigation: Mokhtar Naseri.

Methodology: Amin Doosti-Irani.

Project administration: Amin Doosti-Irani.

Resources: Nooshin Bazzazi.

Software: Amin Doosti-Irani.

Supervision: Nooshin Bazzazi.

Validation: Fatemeh Eslami.

Visualization: Nooshin Bazzazi.

Writing—original draft: Nooshin Bazzazi.

Writing—review & editing: Nooshin Bazzazi.

Competing Interests

None.

Ethical Approval

The study proposal was approved by the Ethics Committee of Hamadan University of Medical Sciences (IR.UMSHA.REC.1399.291).

References

- Kaur A, Agrawal A. Paediatric ocular trauma. *Curr Sci*. 2005;89(1):43-6.
- Tomazzoli L, Renzi G, Mansoldo C. Eye injuries in childhood: a retrospective investigation of 88 cases from 1988 to 2000. *Eur J Ophthalmol*. 2003;13(8):710-3. doi: [10.1177/112067210301300808](https://doi.org/10.1177/112067210301300808).
- Pascolini D, Mariotti SP. Global estimates of visual impairment: 2010. *Br J Ophthalmol*. 2012;96(5):614-8. doi: [10.1136/bjophthalmol-2011-300539](https://doi.org/10.1136/bjophthalmol-2011-300539).
- Abbott J, Shah P. The epidemiology and etiology of pediatric ocular trauma. *Surv Ophthalmol*. 2013;58(5):476-85. doi: [10.1016/j.survophthal.2012.10.007](https://doi.org/10.1016/j.survophthal.2012.10.007).
- Acar U, Tok OY, Acar DE, Burcu A, Ornek F. A new ocular trauma score in pediatric penetrating eye injuries. *Eye (Lond)*. 2011;25(3):370-4. doi: [10.1038/eye.2010.211](https://doi.org/10.1038/eye.2010.211).
- Katz J, Tielsch JM. Lifetime prevalence of ocular injuries from the Baltimore Eye Survey. *Arch Ophthalmol*. 1993;111(11):1564-8. doi: [10.1001/archophth.1993.01090110130038](https://doi.org/10.1001/archophth.1993.01090110130038).
- Prevent Blindness America. The Scope of the Eye Injury Problem. Prevent Blindness America; 2018.
- Maurya RP, Srivastav T, Singh VP, Mishra CP, Al-Mujaini A. The epidemiology of ocular trauma in Northern India: a teaching hospital study. *Oman J Ophthalmol*. 2019;12(2):78-83. doi: [10.4103/ojo.OJO_149_2018](https://doi.org/10.4103/ojo.OJO_149_2018).
- Desai P, MacEwen CJ, Baines P, Minassian DC. Incidence of cases of ocular trauma admitted to hospital and incidence of blinding outcome. *Br J Ophthalmol*. 1996;80(7):592-6. doi: [10.1136/bjo.80.7.592](https://doi.org/10.1136/bjo.80.7.592).
- Brophy M, Sinclair SA, Hostetler SG, Xiang H. Pediatric eye injury-related hospitalizations in the United States. *Pediatrics*. 2006;117(6):e1263-71. doi: [10.1542/peds.2005-1950](https://doi.org/10.1542/peds.2005-1950).
- May DR, Kuhn FP, Morris RE, Witherspoon CD, Danis RP, Matthews GP, et al. The epidemiology of serious eye injuries from the United States Eye Injury Registry. *Graefes Arch Clin Exp Ophthalmol*. 2000;238(2):153-7. doi: [10.1007/pl00007884](https://doi.org/10.1007/pl00007884).
- Mishra A, Verma AK. Sports related ocular injuries. *Med J Armed Forces India*. 2012;68(3):260-6. doi: [10.1016/j.mjafi.2011.12.004](https://doi.org/10.1016/j.mjafi.2011.12.004).
- American Academy of Pediatrics Committee on Sports Medicine and Fitness. Protective eyewear for young athletes. *Pediatrics*. 2004;113(3 Pt 1):619-22.
- Lethbridge-Cejku M, Schiller JS, Bernadel L. Summary health statistics for U.S. adults: National Health Interview Survey, 2002. *Vital Health Stat* 10. 2004(222):1-151.
- Moren Cross J, Griffin R, Owsley C, McGwin G Jr. Pediatric eye injuries related to consumer products in the United States, 1997-2006. *J AAPOS*. 2008;12(6):626-8. doi: [10.1016/j.jaapos.2008.07.005](https://doi.org/10.1016/j.jaapos.2008.07.005).
- Podbielski DW, Surkont M, Tehrani NN, Ratnapalan S. Pediatric eye injuries in a Canadian emergency department. *Can J Ophthalmol*. 2009;44(5):519-22. doi: [10.3129/i09-093](https://doi.org/10.3129/i09-093).
- 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. doi: [10.1001/jamaophthalmol.2018.2062](https://doi.org/10.1001/jamaophthalmol.2018.2062).
- Archambault C, Gabias C, Fallaha N, Bélanger C, Superstein R. Pediatric ocular injuries: a 3-year review of patients presenting to an emergency department in Canada. *Can J Ophthalmol*. 2019;54(1):83-6. doi: [10.1016/j.cjco.2018.02.006](https://doi.org/10.1016/j.cjco.2018.02.006).
- Coody D, Banks JM, Yetman RJ, Musgrove K. Eye trauma in children: epidemiology, management, and prevention. *J Pediatr Health Care*. 1997;11(4):182-8. doi: [10.1016/s0891-5245\(97\)90125-5](https://doi.org/10.1016/s0891-5245(97)90125-5).
- Singh DV, Sharma YR, Azad RV, Talwar D. Profile of ocular trauma at tertiary eye center. *JK Sci*. 2005;7(1):16-21.
- Madan AH, Joshi RS, Wadekar PD. Ocular trauma in pediatric age group at a tertiary eye care center in central Maharashtra, India. *Clin Ophthalmol*. 2020;14:1003-9. doi: [10.2147/ophth.s244679](https://doi.org/10.2147/ophth.s244679).
- Barry RJ, Sii F, Bruynseels A, Abbott J, Blanch RJ, MacEwen CJ, et al. The UK Paediatric Ocular Trauma Study 3 (POTS3): clinical features and initial management of injuries. *Clin Ophthalmol*. 2019;13:1165-72. doi: [10.2147/ophth.s201900](https://doi.org/10.2147/ophth.s201900).
- Qayum S, Anjum R, Rather S. Epidemiological profile of pediatric ocular trauma in a tertiary hospital of northern India. *Chin J Traumatol*. 2018;21(2):100-3. doi: [10.1016/j.cjtee.2017.11.005](https://doi.org/10.1016/j.cjtee.2017.11.005).
- Sharifzadeh M, Rahmanikhah E, Nakhaee N. Pattern of pediatric eye injuries in Tehran, Iran. *Int Ophthalmol*. 2013;33(3):255-9. doi: [10.1007/s10792-012-9684-4](https://doi.org/10.1007/s10792-012-9684-4).
- Al Wadei EA, Osman AA, Macky TA, Soliman MM. Epidemiological features of pediatric ocular trauma in Egypt. *J Ophthalmol*. 2016;2016:7874084. doi: [10.1155/2016/7874084](https://doi.org/10.1155/2016/7874084).
- Ashaye AO. Eye injuries in children and adolescents: a report of 205 cases. *J Natl Med Assoc*. 2009;101(1):51-6. doi: [10.1016/s0027-9684\(15\)30812-9](https://doi.org/10.1016/s0027-9684(15)30812-9).
- El-Sebaity DM, Soliman W, Soliman AM, Fathalla AM. Pediatric eye injuries in upper Egypt. *Clin Ophthalmol*. 2011;5:1417-23. doi: [10.2147/ophth.s24679](https://doi.org/10.2147/ophth.s24679).
- Kinoshita M, Ihara T, Mori T. Characteristics of pediatric ocular trauma in a pediatric emergency department in Japan. *Am J Emerg Med*. 2023;70:75-80. doi: [10.1016/j.ajem.2023.05.012](https://doi.org/10.1016/j.ajem.2023.05.012).
- Mayouego Kouam J, Epée E, Azria S, Enyama D, Omgbwa Eballe A, Ebana Mvogo C, et al. [Epidemiological, clinical and therapeutic features of pediatric ocular injuries in an eye emergency unit in Île-de-France]. *J Fr Ophtalmol*. 2015;38(8):743-51. doi: [10.1016/j.jfo.2015.04.009](https://doi.org/10.1016/j.jfo.2015.04.009). [French].
- Shoja MR, Miratashi AM. Pediatric ocular trauma. *Acta Med Iran*. 1970;44(2):125-30.