International Journal of Health Services Research and Policy
www.dergipark.org.tr/ijhsrp

IJHSRP

e-ISSN: 2602-3482

Research Article

INVESTIGATION OF THE PREVALENCE OF FOREIGN BODY EXPOSURE TO THE EYES AND THE USE OF PROTECTIVE EQUIPMENT IN THE EMPLOYEES OF THE ÇALI INDUSTRIAL ZONE

***Hafize Gokben ULUTAŞ*[1*] *Levent ÖZDEMIR*[2] *Nagihan Amuk HAMIDI*[3]**
***Derya DOĞANAY*[3] *Yusuf DURU*[3]**

[1]Department of Ophthalmology, University of Health Sciences, Bursa City Hospital, Bursa, Türkiye
[2]Department of Public Health, Bursa Uludağ University Faculty of Medicine, Bursa, Türkiye
[3]Department of Ophthalmology, University of Health Sciences, Yuksek Ihtisas Training and Research Hospital, Bursa, Türkiye
[*] Corresponding author; gokbenbilekulutas@gmail.com

Abstract: *This study aims to determine the prevalence of foreign bodies in the eyes of people working in the Bursa Çalı Industrial Zone. A survey was conducted to evaluate ocular foreign body exposures in workers working in Çalı Industrial Zone. The demographic characteristics of the participants, presence of foreign body exposure to the eye, use of protective goggles, and medical leave of absence were questioned. A total of 400 participants, 351 male (87.8%) and 49 females (12.2%), were included in the study. The mean age of the participants was 36.92±10.27 years, and the average working time in the sector was 8.87±8.06 years. Of the 400 participants included in the study, 153 (38.3%) had a history of ocular foreign body exposure. While the most frequently exposed foreign body was metal burrs (83.7%), the most exposed workers were welders (85.5%). Those who reported that they constantly used protective goggles at work were 42.1%, and those who used them occasionally were 48.7%. Ocular foreign body exposure rates detected in that industrial zone were relatively high. Although the use of protective goggles is high, ocular injuries still suggest that personal protective equipment and its use should be more effective. Any eye trauma that is prevented will reduce suffering, hospital admission, loss of workforce/labor, and the burden on the health system and the economy.*

Keywords: *ocular injury, corneal foreign body prevalence, occupational accident, protective goggles*

Received: January 3, 2024 *Accepted: April 16, 2024*

1. Introduction

Ocular trauma is a preventable public health problem worldwide [1]. Corneal foreign bodies are one of the leading causes of ocular trauma. Corneal foreign bodies cause symptoms such as eye pain, burning, stinging, and tearing. Depending on the penetration depth and localization of the foreign body, it may cause a decrease in visual acuity by creating a scar in the cornea. It can also cause severe problems such as keratitis and endophthalmitis [2]. The lifetime prevalence of ocular traumas is estimated to be 14.4% to 19.8% in the United States [3]. Epidemiological data on ocular traumas in our country were primarily obtained from patients admitted to emergency services. It has been observed that corneal foreign bodies are the most common cause of ocular trauma. It has been shown that foreign body traumas

in the eye occur most frequently in young adult males as work-related injuries and most frequently with metal burrs [4-7].

In our country, there has not been any prevalence study conducted in the work field with a risk of foreign body exposure in the eye. The foreign body in the eye is a significant health problem that can affect the visual functions of the person, affecting the country's economy due to the burden it creates on the health system and the loss of workforce.

With a population of over 4 million, Bursa is 4'th largest city. According to industry statistics, it is Türkiye's largest automotive production center. There are approximately 230 companies with 6000-7000 employees in Bursa Çalı Industrial Zone. Production is carried out in different business branches, emphasizing the automotive sector [8].

This study aims to determine the prevalence of foreign bodies in the eyes of people working in the Bursa Çalı Industrial Zone and to evaluate the employee's awareness about occupational safety, time, and workforce loss due to corneal foreign body injuries.

2. Materials and Methods

Employees of companies operating in different branches of industry in the Bursa Çalı Industrial Zone were included in this prevalence study. The number of employees included in the survey was determined from approximately 10,000 employees in the Çalı Industrial Zone. When calculating the sample size, 400 was found as an adequate number of sample to conduct the study with an error level 5% for 80% power and 0.05 significance . Employees were allowed to participate voluntarily after explaining the study's purpose and method. An ophthalmology resident administered the questionnaires through a face-to-face interview between March 2022 and May 2022. The survey consisting of 29 questions in total, was answered by 400 employees anonymously. After the questions, including demographic characteristics (age, gender, education level) and working background (sector, job, and year in the industry) of the participants, the history of foreign body exposure in the eye was questioned. Participants who answered yes were asked to continue with the survey. The nature of the foreign body, the number of times it was exposed, the type and timing of treatment, the use of personal protective equipment, and the training background were questioned.

2.1. Statistical Analysis

Statistical analyzes were performed using IBM SPSS ver.28.0 program (IBM Corp. Published 2021. IBM SPSS Statistics for Windows, Version 28.0. Armonk, NY: IBM Corp.). The statistical significance level was accepted as $\alpha=0.05$. Participants' demographic data were examined using the Shapiro-Wilk test, which showed normal distribution. Results are presented as percentages and mean ± standard deviation values are given. Categorical variables were compared between groups using Pearson chi-square, Fisher exact and Fisher-Freeman-Halton tests. Bonferroni test, one of the multiple comparison tests, was used.

3. Results

A total of 400 voluntary, 351 male (87.8%) and 49 females (12.2%), were included in the study. The mean age of the participants was 36.92±10.27 years, and the average working time in the sector was 8.87±8.06 years. Of the 400 people in the study, 153 (38.3%) had a foreign ocular body exposure history. When the educational status was evaluated, the incidence of foreign bodies in the eye was statistically significantly higher in those who did not have formal education ($p<0.05$). As the level of education increases, the frequency of foreign bodies in the eye decreases.

According to the sector they work, the prevalence of foreign bodies in the eye was 80% in the construction workers and 36.1% in the manufacturing sector ($p<0.05$). The demographic data of the participants included in the study are shown in Table 1.

Table 1. Prevalence of Foreign Body Injuries in the Eye in the Workplace and sociodemographic factors

	History of Foreign Body Injury in the Eye						Statistics p
	Yes		No		Total		
	n	%	n	%	n	%	
Gender							
Male	140	39.9	211	60.1	351	100.0	$\chi^2=3.25$; $p>0.05$
Female	13	26.5	36	73.5	49	100.0	
Last school graduated							
Not graduated	18	100.0	0	0	8	100.0	
Primary school	36	50.0	36	50.0	72	100.0	
Middle school	31	47.7	34	52.3	65	100.0	$\chi^2=31.19$; $p>0.05$
High school	65	34.6	123	65.4	188	100.0	
University	11	18.0	50	82.0	61	100.0	
Working sector							
Construction sector	16	80.0	4	20.0	20	100.0	$\chi^2=15.54$; $p<0.05$
Manufacturing sector	137	36.1	243	63.9	380	100.0	
Job							
Welder	47	85.5	8	14.5	55	100.0	
Smelter/carpenter/iron joiner	4	66.7	2	33.3	6	100.0	
Grinding operation	14	58.3	10	41.7	24	100.0	
Other	53	38.1	86	61.9	139	100.0	$\chi^2=83.45$; $p<0.05$
Machining machine operator (lathe/mill/drill operator)	20	21.7	72	78.3	92	100.0	
Machine Operator (press, laser machine, plasma machine, sheet metal cutting machine, etc.)	15	17.9	69	82.1	84	100.0	

Considering the work, foreign body exposure to the eye was most common in welders (85.5%), casters/carpenters/iron joiners (66.7%), and grinding operators 58.3%, respectively. The most frequently exposed foreign body feature was metal burrs, with a rate of 83.7%.

At the time of the incident, 56.6% of those who had foreign object exposure to their eyes were wearing protective glasses. In 58.8% of the cases, the doctor intervened in the foreign body, and in %19.6 of them, the foreign body was removed by themselves. When questioned about how they removed the foreign body themselves, they stated that 11.8% were blown and rubbed, and 23.7% were removed with paper or napkins. The frequency of employees who received a medical leave of absence was 18.3%, and 64.3% received a one-day rest report. 0.7% of those exposed to foreign bodies were hospitalized. The frequency of those whose eye complaints continued after the event was 17.0%. The most common complaints were burning at 85.2% and blurring of vision at 11.1%. The frequency of those with visual loss is 3.7%. When questioned about protective goggles usage, 48.7% said they sometimes use them, while 42.1% said they use them constantly. The frequency of those who have never

used it is 9.2%. When questioned about the reason for not using it, 29.6% blamed fogging, 23.9% said it causes blurring in vision, and 21.1% mentioned that it slows down their work. The frequency of those who received training on personal protective equipment was 85%, and those who received first aid training was 74.5%. The frequency of those who answered "Yes" to whether they had any work accident other than this incident was 23.5%. The characteristics of those exposed to ocular foreign bodies are summarized in Table 2.

Table 2. Distribution of workers who have a foreign object in their eyes, according to their characteristics regarding the foreign body and how the incident occurred.

	n	***%***
What was the nature of the foreign body? (n=153)		
Metal burr	128	83.7
Dust	14	9.2
Wood	7	4.6
Other	3	2.0
Plastic	one	0.7
Were you wearing protective goggles when exposed to foreign body? (n=152)		
Yes	86	56.6
No	66	43.4
Who removed the foreign body? (n=153)		
Ophthalmologist	90	58.8
Myself	30	19.6
My colleague	19	12.4
Health officer/nurse	11th	7.2
Occupational physician	2	1.3
Physicians in other branches	one	0.7
How was the foreign body removed? (n=152)		
By blowing, rubbing	18	11.8
Paper or napkin	36	23.7
Needle tip		
Have you had a medical absence report? (n=153)		
Yes	28	18.3
No	125	81.7
Do you still have eye complaints? (n=153)		
Yes	26	17.0
No	127	83.0
If yes, please state your complaint (n=27)		
Burning-sting	23	85.2
Blurred vision	3	11.1
Vision loss	one	3.7

Table 2. Continued

	n	***%***
Do you constantly wear protective goggles during the process at work? (n=152)		
I do not use	14	9.2
I sometimes use	74	48.7
I always use	64	42.1
Why don't you use it? (n=71)		
It causes me to see blurry	17	23.9
It's misting	21	29.6
My work is slowing down	15	21.1
Other	18	25.4

4. Discussion

The annual incidence of patients admitted to hospital and emergency services diagnosed with ocular injury is 13-423/100.000 [9,10]. In the Helsinki Ocular Trauma Study, where hospital admissions were examined, the incidence of ocular trauma was found to be 88/100,000. They said that ocular traumas occur most frequently with superficial foreign bodies, in men between the ages of 17-45 and for work-related reasons [11]. In the survey by Glynn et al, the annual incidence was 980/100,000 in the whole population [12].They showed that more than half of the injuries were occupational accidents, and men were 5.5 times more exposed than women. Gordon conducted a phone interview survey of eye injuries in a population of all Canadians over the age of 18 years. They determined that the incidence of all eye injuries was 2090/100,000 per year. 35.5% of these injuries were work-related [13].

Ocular trauma data obtained based on hospital data give lower rates than general population studies. The fact that the annual incidences obtained by survey studies are higher than the studies conducted with hospital admissions indicates that there are ocular traumas that do not apply to the hospital. It supports that the most common eye trauma observed in all studies is an occupational accident, and men are more exposed to it. When we look at the lifetime ocular injury prevalence studies, it was found to be 14.4% in the Baltimore Eye Survey [14], 21.1% in Australia [15], and 19.8% in Beaver Dam [3]. In prevalence studies, it was determined that the most common injuries were in the workplace.

In the literature, the most common reason for hospital admissions due to ocular injuries is occupational accidents, and the leading cause of eye injuries is superficial foreign bodies. For this reason, in this study, in which we included the high-risk group, unlike the general population studies, we found a history of foreign body exposure to the eye in a part of their working life in 38.3% of the workers working in Çalı Industrial Zone. This rate was considerably higher than the data found in the literature. Our entire study population consists of workers in the industrial zone, and 87.8% of the participants are male. In a Canadian public health study, men aged 20 years and older had a 1.35 times greater risk than women, and Glynn et al reported that men are 5.5 times more likely to be exposed to ocular trauma than women [11, 12]. Foreign body exposure was observed in 40% of men and 25% of women included in this study. The fact that men work in risky jobs such as welding, joinery, and casting causes these results.

In the current study, 58.8% of those exposed to the foreign body were examined by a doctor, while others said that the foreign body was removed by themselves or their friends. Corneal perforation and foreign body penetration into the eye are risks when removing foreign bodies. In addition, careless handling when removing foreign bodies from the central cornea may result in decreased vision due to scarring. Even if a metallic foreign body is removed from the cornea, the rust ring remaining in the deep

stroma may result in scarring and corneal irregularity. Especially the rust ring located in the corneal center can cause visual complaints. Foreign bodies not removed within 24 hours cause reactive inflammation such as iritis. Foreign bodies in the deep corneal stroma may cause corneal endothelial cell damage and corneal thickening [14, 15]. For this reason, a specialist should remove corneal foreign bodies and prescribe proper medications.

Studies have stated that corneal injuries are more common in the construction and metal industries. A study examined hospital admissions from Türkiye and noted that 87% of the patients presenting with a corneal foreign body were metal cutting and welding workers [16]. Another study from Germany reported this rate as 73% [17]. Welders (85.5%), smelters/carpenters/iron joiners (66.7%), and grinding operators (58.3%) were the most exposed occupations in our study. 56.6% of workers with a foreign body in the eye said they used protective goggles during the injury. Especially 74.5% of the welders were using protective goggles during injury. In the study of Ozkurt et al, 43% of those exposed to foreign bodies wore protective goggles, and in the study of Kızıltaş et al, the rate was 49.1% [16, 18]. In the Australian prevalence study, 18% of those exposed to ocular injury at work were wearing protective goggles [19]. In the study reported from Germany, 6.9% of the employees exposed to trauma wore protective goggles [17]. We think that the different results observed in the literature and our study are due to the inadequate use of protective goggles, insufficient protection, and insufficient training. In the Çalı Industrial Zone where we conducted the research, training should be given to the welding, carpenter, iron, and joinery workers in the high-risk group, especially in the construction sector, and personal protective equipment should be reviewed and made more sheltered.

5. Conclusion

All new strategies to prevent ocular injury will significantly reduce the rates of ocular trauma we have identified. It is necessary to increase the frequency and effectiveness of employee training, to increase the use of protective equipment, and to make it more effective. Ocular injuries, especially the penetration of foreign bodies into the densely innervated corneal tissue, cause severe pain in people. With each preventable eye injury, the person will be prevented from suffering, and the decrease in hospital admissions and the prevention of loss of workforce will reduce the burden on the health system and the economy.

Ethical statement

The study was approved by the ethics committee of Health Sciences University, Bursa Yüksek İhtisas Training and Research Hospital. (Protocol number and date:2011-KAEK; 25 2022/02-02). The principles of the Declaration of Helsinki were adhered to throughout the study.

Funding

No financial support has been received for this study.

Conflict of Interest

The authors report no conflict of interest.

Author’s contributions

H.G.U: Conceptualization, Methodology, Formal analysis, Writing - Original draft preparation.
L.Ö: Conceptualization, Methodology, Control/supervision, Review.
N. A.H: Methodology, Resources, Literature review.
D.D: Conceptualization, Methodology, Literature review.
Y:D: Data collection and processing, Methodology.

All authors read and approved the final manuscript.

References

[1] Chaudhary A, Singh R, Singh SP, "Prognostic value of Ocular Trauma Score and pediatric Penetrating Ocular Trauma Score in predicting the visual prognosis following ocular injury" , *Rom J Ophthalmol*, 66(2), 146-152, 2022.

[2] Heath Jeffery RC, Dobes J, Chen FK, "Eye injuries: Understanding ocular trauma", *Aust J Gen Pract*, 51(7), 476-482,2022.

[3] Wong TY, Klein BE, Klein R, "The prevalence and 5-year incidence of ocular trauma. The Beaver Dam Eye Study", *Ophthalmology*, 107(12), 2196-2202,2000.

[4] Yiğit O, Yürüktümen A, Arslan S, "Foreign body traumas of the eye managed in an emergency department of a single-institution", *Ulusal Travma Acil Cerrahi Dergisi*, 18(1), 75-79, 2012.

[5] Akdur O, Özkan S, Erkılıç K, Durukan P, Duman A, İkizceli İ, "Evaluation of ocular trauma cases presentıng to the emergency department", *Journal of Academic Emergency Medicine*, 8, 47-50,2009.

[6] İrfan U, Adem G, "Yüzeyel korneal yabancı cisimlerde tedaviye kadar geçen süre ile ilişkili faktörlerin değerlendirilmesi", *Cumhuriyet Medical Journal*, 35(2), 239-243,2013.

[7] Alıkma MS, Unsal E, "Kornea yaralanması ile başvuran hastalarımızın demografik ve klinik özellikleri", *SDÜ Tıp Fakültesi Dergisi*, 26(4), 390-395, 2019.

[8] Bağış, M, Kryeziu, L, Akbaba, Y, Ramadani V, Karaguzel E S, & Krasniqi, B, "The micro-foundations of a dynamic technological capability in the automotive industry", *Technology in Society*, 70, 102060,2022.

[9] Klopfer J, Tielsch JM, Vitale S, See LC, Canner JK, "Ocular trauma in the United States. Eye injuries resulting in hospitalization, 1984 through 1987", *Arch Ophthalmol*, 110(6), 838-842,1992.

[10] Karlson TA, Klein BE, "The incidence of acute hospital-treated eye injuries", *Arch Ophthalmol*, 104(10):1473-1476,1986.

[11] Sahraravand A, Haavisto AK, Holopainen JM, Leivo T, "Ocular traumas in working age adults in Finland - Helsinki Ocular Trauma Study", *Acta Ophthalmol*, 95(3), 288-294,2017.

[12] Glynn RJ, Seddon JM, Berlin BM, "The incidence of eye injuries in New England adults", *Arch Ophthalmol*, 106(6), 785-789,1988.

[13] Gordon KD, "The incidence of eye injuries in Canada", *Can J Ophthalmol*, 47(4), 351-353,2012.

[14] Bhargava M, Bhambhani V, Paul RS, "Anterior segment optical coherence tomography characteristics and management of a unique spectrum of foreign bodies in the cornea and anterior chamber", *Indian J Ophthalmol*, 70(12), 4284-4292,2022.

[15] Camodeca AJ, Anderson EP, "Corneal Foreign Body", In: StatPearls. edn. Treasure Island (FL): StatPearls, 2022.

[16] Ozkurt ZG, Yuksel H, Saka G, Guclu H, Evsen S, Balsak S, "Metallic corneal foreign bodies: an occupational health hazard", *Arq Bras Oftalmol*, 77(2), 81-83,2014.

[17] Nepp J, Rainer G, Krepler K, Stolba U, Wedrich A, "Etiology of non-penetrating corneal injuries", Klin Monbl Augenheilkd, 215(6), 334-337,1999.

[18] Kızıltas B, Duman R, KAaygısız M, Cankurtaran V, Kızıltaş Ö, Başkan C, Balcı M, "Yüzeyel Korneal Yabancı Cisimlerde Epidemiyoloji ve Dominant Göz Değerlendirilmesi", *MN Oftalmoloji*, 23(3), 131-133,2016.

[19] McCarty CA, Fu CL, Taylor HR, "Epidemiology of ocular trauma in Australia", *Ophthalmology*, 106(9), 1847-1852,1999.