Check for updates

OPEN ACCESS

DOI: 10.46903/gjms/23.3.1849

ORIGINAL ARTICLE

OCULAR MORBIDITY AND ASSOCIATED RISK FACTORS AMONG MARBLE MINEWORKERS

Muhammad Suliman, Mufarriq Shah, Shoaib Asmat, Shazia Noreen, Daud jan, Yumna Tariq

Pakistan Institute of Community Ophthalmology, Hayatabad Medical Complex, Peshawar

ABSTRACT

Background: The marble industry and stone quarries affect the health of workers in the industry and have a negative effect on those living in the area of the industry, the whole ecosystem, and public health as a whole. This study aimed to determine the ocular morbidities and associated risk factors in marble mineworkers.

Material & Methods: This cross-sectional study, conducted at different mining sectors in District Buner, Khyber Pakhtunkhwa province, Pakistan, included participants aged 18 and above. Participants underwent a comprehensive ocular examination, including a detailed history of the work category, work duration, ocular symptoms, and ocular morbidities such as conjunctivitis, cataracts, and pterygium. SPSS software was used for analysis. Chi-square tests and logistic regression were used to assess associations between occupational characteristics and ocular morbidity.

Results: Most of the total 88 participants were in the age group of 18 to 30 years (n =37; 42%). Three-fourths (n = 66; 75%) of the participants were educated. Factory workers contributed to 29.5% (n=26). Among the participants, 30.7% (n= 27) had work experience of less than 5 years at the site and 19.3 % (n=17) had 20 years or more work experience. There was a significant association of ocular symptoms with work experience (p = 0.00) but no significant association of ocular symptoms with working indoors, outdoors or both (p = 0.623). Corneal opacities were the most common anterior segment morbidities, found in 38.6% (n=34) of participants in the right eye and 22.7% (n=20) in the left eye, followed by pterygium (n=9; 10.2 %). None of the participants was using any protective eyewear.

Conclusion: Corneal opacities and pterygium were common in marble workers. Using personal protective equipment could have a preventing effect on ocular hazards to reduce ocular complications in marble mineworkers.

KEY WORDS: Cataract; Conjunctivitis; Corneal opacities; Ecosystem; Mine workers; pterygium.

Cite as: Suliman M, Shah M, Asmat S, Noreen S, Jan D, Tariq Y. Ocular morbidity and associated risk factors among marble mineworkers. Gomal J Med Sci 2025 Jul-Sep;23(3):292-7. https://doi.org/1046903/gjms/23.3.1849

INTRODUCTION

The marble industry and stone quarries affect the health of workers in the industry and have a negative effect on people living in the area of the industry, the whole ecosystem, and public health as a whole.[1] The possibility of industrial accidents is increased during the process of making large marble blocks portable such as cutting, loading and transporting.

Corresponding Author:

Dr. Mufarriq Shah
Associate Professor
Pakistan Institute of Community Ophthalmology
Hayatabad Medical Complex
Peshawar, Pakistan
E-mail: mufarriq1@hotmail.com

Date Submitted: 13-11-2024
Date Revised: 21-07-2025
Date Accepted: 05-08-2025

These accidents lead to serious outcomes, such as permanent disability, or death.[2] In several studies, mining and quarrying have been shown to be one of the most dangerous sectors because of the inherent characteristics, such as exposure to damp, dust, gas, smoke, noise, and mechanical vibration.[3,4]

Marble workers are more vulnerable to weather, sunshine, and the reflection of sunlight from marble floors and walls. Various instruments, including hand tools, power saws, and explosives, are used in quarry operations. The environment in which quarries operate is dry, dusty, and highly contaminated. These elements raise the possibility of foreign particles coming into contact with the eyes. Consequently, blindness and vision impairment can be seen as the most important occupational risks in these workers; and photokeratitis, dermatitis in the summer months.[5]

Injuries to the anterior segment of the eye and ocular

surface are frequent in the marble industry and stone quarries. The most common cause of eye injuries in low- and middle-income nations is at work. The lifetime prevalence of these injuries is 4.4%, and the age-specific prevalence ranges from 2% to 6%.[6] An estimated 1.6 million people become blind because of 55 million ocular injuries annually.[7] Eye fatigue, corneal, lens, and ocular surface degeneration, exposure to foreign objects, and severe perforating injuries resulting in blindness are among the most frequent ocular conditions.[8,9] A study reported pterygium the most common (22.03%) ocular morbidity followed by cataract (11.86%) and conjunctival melanosis (8.47%) in workers in mines.[4] The use of protective eyewear has a critical role in the prevention of eye injuries, however, a study reported that only 2% of workers used protective glasses in stone-cutting factories.[10] Preventing vision loss in people with eye disorders through optimal care of ocular disease is crucial. It is lessened when these patients receive the proper care that addresses their eye health issues.[11] Existing general services and resources are linked to the establishment of an eye care delivery system for the treatment of eye illnesses and the prevention of blindness.[12]

Ocular injury is a major global public health concern and a major preventable cause of blindness. Factors such as un-organized working conditions; a lack of execution of regulations, a lack of awareness, availability, or frequent usage of protective equipment such as safety goggles, and delays in obtaining proper treatment lead to a high burden of ocular trauma.[13-15] Marble miners are at a higher risk of acquiring ocular morbidities due to a variety of occupational dangers, including dust, UV rays, and mechanical accidents. The prevalence and risk factors of these disorders are not well documented, and eye health in this population is frequently ignored. In addition to examining risk factors like age, length of work, and absence of protective gear, this study attempted to determine the types and prevalence of eye problems among marble mineworkers. The results will guide preventive measures, enhance occupational safety, and support laws that safeguard the eye health of marble mineworkers.

MATERIAL AND METHODS

This cross-sectional study was conducted from the 12th of March to the 21st of April 2024 at different mining sectors in District Buner, Khyber Pakhtunkhwa province, Pakistan. Ethical approval was taken from the ethical committee of the Pakistan Institute of Community Ophthalmology, Hayatabad Medical Complex, Peshawar (No. 003/UGS/PICO/2024 dated 01/01/2024). Approval was taken from the president of the marble mining association in Malakand division and signed informed consent was obtained from each participant of the study. Participants were assured that their data would be kept confidential during the procedure. This study followed the Declaration of Helsinki. The study comprised participants who had worked at marble mining sites for at least a year and were at least 18 years old. Individuals with a history of ocular surgery or systemic diseases affecting vision and those who declined to participate were excluded.

A self-made pre-tested validated questionnaire was used in face-to-face interviews for data collection. Participants were examined in a spacious, well-lit room. Before eye examination, a detailed history of each participant about the work category, work duration and level of education was recorded.

Participants underwent a comprehensive ocular examination including visual acuity assessment using a Snellen chart at a distance of 6 meters. Anterior segment examination was performed using a Binomag Loupe to evaluate the anterior segment for common ocular conditions such as conjunctivitis, cataracts, and pterygium. Fundoscopy, to assess the posterior segment, was performed through a direct ophthalmoscope. All findings were meticulously documented in the questionnaire for each participant, including any ocular conditions identified and recommendations for further management or referral to an ophthalmologist if necessary.

Statistical Program for Social Sciences software was used for analysis. The prevalence of ocular morbidity and demographic factors were subjected to descriptive statistics. Chi-square tests and logistic regression analyses were used to assess associations between occupational characteristics (such as job role and exposure length) and ocular morbidity while controlling for relevant confounders.

RESULTS

All of the eighty-eight male participants working in marble industries in the district took part in this study. Most of the participants (n =37; 42%) were in the age group of 18 to 30 years, and three participants were above 60 years. Of the total 88 participants, 34% (n = 30) were educated till a secondary level, and 10% (n = 9) were higher secondary level. Factory workers contributed to 29.5% (n = 26) (Table 1).

Among the participants, 30.7% (n = 27) had work experience of less than 5 years at the site and 19.3 % (n = 17) had 20 years or more of work experience. Of the total participants, 86.4% (n = 76) experienced at least one or more than one ocular symptom while 13.6% (n=12) participants did not experience any ocular symptoms. More than one-fourth (n=24; 27.3%) of participants who had work experience of less than 5 years at the site reported ocular symptoms. All of the 17 participants with work experience of more than 20 years had some ocular symptoms (Table 2). There was a significant association of work experience with ocular symptoms (p = 0.00).

Table 1: Demographics profile of participants.

Characteristics	Category	Frequency n (%)
Age in years	18-30	37 (42)
	31-45	30 (34.1)
	46-60	18 (20.5)
	>60	3 (3.4)
	Total	88 (100)
Education	Illiterate	22 (25)
	Primary	17 (19.3)
	Middle	10 (11.4)
	Secondary	30 (34.1)
	Higher secondary	9 (10.2)
	Total	88 (100)
Work category	Quarry worker	18 (20.5)
	Factory worker	26 (29.5)
	Crush plant worker	12 (13.6)
	Owner and others	32 (36.4
	Total	88

Symptoms of dry eyes were more common in crush plant workers. The association of dry eyes with the work category is shown in Table 3.

Table 2: Work experience and ocular symptoms

Work Experience in Years	Ocular symptoms		
	Yes n (%)	No n(%)	Total n(%)
<5	24(27.3%)	3(3.4%)	27(30.7%)
6 to 10	20(22.7%)	4(4.5%)	24(27.3%)
11 to 15	8(9.1%)	3(3.4%)	11(12.5%)
16 to 19	17(20.4%)	3(2.3%)	20(22.7%)
≥20	17(19.3%)	0(0.0%)	17(19.3%)
Total	76(86.4%)	12(13.6%)	88(100.0%)

Amongst the 61 (69.3 %) participants who were working outdoors, 54 had some ocular symptoms. Nine (10.2 %) of the participants were working indoors and seven of them were experiencing ocular symptoms, while among the 18 participants who were working both outdoors and indoors, 15 had ocular symptoms. There was no significant difference in ocular symptoms among participants working indoors, outdoors or both ($p = 0.623$).

Out of 88 participants, 51 (58%) had refractive errors. Astigmatism was more common (n = 26, 29.5 %) followed by myopia (n = 12, 13.6 %). Ten participants had hypermetropia. By examination, corneal opacities (59.6%) were the most prevalent finding (38.6 % in right eyes and 22.7 % in left eyes).

Ocular morbidities of the anterior segment of the right eyes and left eyes of participants working in different categories are shown in Table 3 and Table 4 respectively.

Table3. Association of work category of participants with dry eye

Work category of participant	Symptoms of dry eyes			P value
	Yes n (%)	No n(%)	Total n(%)	
Quarry worker	10(11.4%)	8(9.1%)	18(20.5%)	0.043
Factory worker	10(11.4%)	16(18.2%)	26(29.5%)	
Crush plant worker	6(6.8%)	6(6.8%)	12(13.6%)	
Owner and others	6(6.8%)	26(29.5%)	32(36.4%)	
Total	32(36.4%)	56(63.6%)	88(100.0%)	

Table 3: work category and ocular morbidity of the anterior segment of the right eyes of participants

Work Category	Ocular morbidity								Total n(%)
	No morbidity n(%)	corneal opacities n(%)	corneal aberasion n(%)	Cataract n(%)	Pterygium n(%)	Pinguculae n(%)	Ptosis n(%)	Pseduphakic n(%)	
Quarry worker	4(4.5%)	5(5.7%)	0(0.0%)	2(2.3%)	3(3.4%)	1(1.1%)	1(1.1%)	2(2.3%)	18(20.5%)
Factory worker	4(4.5%)	18(20.5%)	0(0.0%)	2(2.3%)	2(2.3%)	0(0.0%)	0(0.0%)	0(0.0%)	26(29.5%)
Crush plant worker	1(1.1%)	4(4.5%)	6(6.8%)	0(0.0%)	1(1.1%)	0(0.0%)	0(0.0%)	0(0.0%)	12(13.6%)
Owner and others	17(19.3%)	7(8.0%)	0(0.0%)	3(3.4%)	3(3.4%)	1(1.1%)	0(0.0%)	1(1.1%)	32(36.4%)
Total	26(29.5%)	34(38.6%)	6(6.8%)	7(8.0%)	9(10.2%)	2(2.3%)	1(1.1%)	3(3.4%)	88(100.0%)

Table 4: work category and ocular morbidity of the anterior segment of the left eyes of participants

Work Category	Anterior segment of left eye							Total n(%)
	No morbidity n(%)	corneal opacities n(%)	corneal aber-asion n(%)	Cataract n(%)	Pterygium n(%)	Pinguculae n(%)	Pseduphakic n(%)	
Quarry worker	3(3.4%)	8(9.1%)	0(0.0%)	4(4.5%)	1(1.1%)	1(1.1%)	1(1.1%)	18(20.5%)
Factory worker	16(18.2%)	8(9.1%)	0(0.0%)	0(0.0%)	1(1.1%)	0(0.0%)	1(1.1%)	26(29.5%)
Crush plant worker	3(3.4%)	3(3.4%)	5(5.7%)	0(0.0%)	1(1.1%)	0(0.0%)	0(0.0%)	12(13.6%)
Owner and others	25(28.4%)	1(1.1%)	0(0.0%)	2(2.3%)	3(3.4%)	1(1.1%)	2(2.3%)	32(36.4%)
Total	47(53.4%)	20(22.7%)	5(5.7%)	6(6.8%)	6(6.8%)	2(2.3%)	4(4.5%)	88(100.0%)

DISCUSSIONS

The higher prevalence of refractive errors, Pterigium, corneal opacities and dry eye is mostly caused by the occupational environment of marble mineworkers, which is marked by UV exposure, and a lack of protective gear. Lack of knowledge about eye protection and socioeconomic barriers to healthcare access exacerbate these diseases even further.[13, 14] Findings from this study show that all 88 male workers were working in three different sectors, including quarries, marble factories, and crushing plants. Three-fourths of the participants were educated, and one-fourth of the participants worked in marble mining for at least 20 years. Work experience was significantly associated with ocular symptoms (p=0.00). The association of ocular symptoms was not significant with working indoors, outdoors, or both (p = 0.623). Dry eyes were the most common symptom. Corneal opacities were the most common anterior segment morbidities and were found more in the right eyes of participants than the left eyes (34 vs. 20). The second leading ocular morbidity was pterygium.

All of the workers were males. The lack of female participation in the marble industry in District Buner can be attributed to a combination of factors. There is a lot of physical labor involved in the marble sector, especially in the quarrying and processing stages. Women are perceived as being unfit or unsafe for jobs like moving large stones or operating machinery. There may be a stigma attached to women working in some fields, particularly those that are perceived as better suited for men, like mining or construction. Furthermore, a large number of marble quarries and processing facilities are situated in isolated or rural regions, where cultural attitudes towards women working outside the home are even more restrictive. According to comparable studies, conducted in India and Egypt, mine workers who operate on the sites are usually male.[10,16]

Findings from this study show that the majority of workers were either young or middle-aged. These results align with those of similar studies conducted in Ghana and India.[17,18] Among the 88 workers, 80.7% had fewer than 20 years of job experience, which is in line with a study conducted in Egypt, which reported 78.4% had less than 20 years of work experience.[16] A similar result has been reported by researchers in Ghana, who found that 37.4% of workers had more than 10 years of work experience.[19] In contrast, a study conducted in Nigeria reported that workers had just 5 years or less of work experience.[20] Employees with several years of experience are less likely to have work-related injuries because they are more seasoned, mature, and knowledgeable of workplace dangers. Unfortunately, in our study, all of the workers with experience of 20 years or more have ocular symptoms. These are primarily because an exposure to industrial environment for several years increases the risk of ocular symptoms, and secondly, none of the participants in our study were wearing protective eyewear which increases the risk of ocular hazards.[20]

It has been noted that ocular health is adversely affected by marble quarries since eye injuries rank third in frequency after injuries to the hands and feet.[21] Among the mine workers, corneal opacities were the most common anterior segment morbidity (38.6 %) followed by pterygium (10.2%). Pterygium was found to be the second leading ocular morbidity among mine workers in Türkiye, contributing (8.7%).[3] Pterigium is reported to be the most common followed by pingueculae, in a study conducted in Ghana.[17] Exposure to high UV radiation from sunshine, dust, and environmental fumes may result in pterygium.[22] Another study reported cataracts and pterygium as the most prevalent ocular problems among the quarry workers.[4] These differences might be due to the different nature of work in marble mining sites.

Finding from this study shows that 58% of workers had refractive errors. These findings align with a study reporting myopia as common in quarry workers in Tamil Nadu.[23] A similar result was documented in a study conducted in Turkiye, reporting refractive error as the most common ocular morbidity in marble workers. [3]Contrary to that, a study from Ghana reported that the majority of the workers among participants in that study had normal visual acuities.[15] One reason for this difference may be that corneal opacities, causing refractive errors, were more common in our study. Not using protective eyewear by participants in our study could be the reason for the greater number of corneal opacities.

CONCLUSION

The study highlights a considerable burden of ocular morbidity among marble mineworkers with a significant association of ocular symptoms with work experience (p = 0.00). Conditions such as corneal opacities were the most common anterior segment morbidities, found in 38.6% (n=34) of participants in the right eye and 22.7% (n=20) in the left eye, followed by pterygium (n=9; 10.2 %).

Recommendatiions: The following recommendations aim to improve the quality of life and occupational safety for marble mineworkers to reduce the risk of preventable vision loss.

- Frequent eye screenings: To identify and treat eye disorders early, provide routine eye exams at mining sites.
- Use of protective eyewear: To avoid dust and UV-related eye damage, make it essential to use safety goggles.
- Health education: Teach mineworkers the value of eye protection, proper cleanliness, and how to prevent eye diseases.
- Available eye treatment Services: Make sure that eye treatment is both reasonably priced and easily available by using insurance coverage or mobile clinics.
- Policy and research support: Encourage further research for eye health in occupational safety regulations.

REFERENCES

1. Salem HS. Evaluation of the stone and marble industry in Palestine: environmental, geological, health, socioeconomic, cultural, and legal perspectives, in view of sustainable development. Environ Sci Pollut Res Int. 2021;28:28058–80. https://doi.org/10.1007/s11356-021-12526-4
2. Gyekye SA, Salminen S. Causal attributions of Ghanaian industrial workers for accident occurrence. J Safety Res. 2004;34:2324–40. https://doi.org/10.1016/j.jsr.2003.03.002
3. Ay İE, Yavaş SP, Baysan C. A cross-sectional study on marble workers: occupational eye health problems and risk factors. J Ist Faculty Med. 2022;85:548–56. https://doi.org/10.26650/IUITFD.1134346
4. Azuamah Y, Nwazunku A, Amadi A, Esenwah E, Ikoro N, Megwas A. Major ocular problems found among quarry workers and residents of quarrying communities in Abakaliki, Southeastern Nigeria. Int J Res. 2019;6:129–36. https://doi.org/10.1007/s11356-021-18410-5
5. Angotzi G, Bramanti L, Tavarini D, Gragnani M, Cassiodoro L, Moriconi L, et al. World at work: marble quarrying in Tuscany. Occup Environ Med. 2005;62:417–21. https://doi.org/10.1136/oem.2004.018721
6. Forrest KY, Cali JM. Epidemiology of lifetime work-related eye injuries in the US population associated with one or more lost days of work. Ophthalmic Epidemiol. 2009;16:156–62. https://doi.org/10.1080/09286580902738175
7. Négrel AD, Thylefors B. The global impact of eye injuries. Ophthalmic Epidemiol. 1998;5:143–69. https://doi.org/10.1076/opep.5.3.143.8364
8. Ngo C, Leo S. Industrial accident-related ocular emergencies in a tertiary hospital in Singapore. Singapore Med J. 2008;49:280.
9. Okoye O, Umeh R. Eye health of industrial workers in Southeastern Nigeria. West Afr J Med. 2002;21:132–7.
10. Mohan A, Gajraj M, Vishnoi I. Love your eyes at work: a survey on awareness of eye protection among workers of a granite stone-cutting factory. J Clin Ophthalmol Res. 2024;12:74–5. https://doi.org/10.4103/jcor.jcor_137_23
11. Able RS, Able AD. Ocular diseases. In: Avery's Drug Treatment. 4th ed. Auckland: Adis International; 1997. p. 581–605.
12. Sihota R, Tandon R. Parson's Diseases of the Eye. 20th ed. New Delhi: Elsevier; 2007. p. 523–9.
13. Lipscomb HJ. Effectiveness of interventions to prevent work-related eye injuries. Am J Prev Med. 2000;18:27–32. https://doi.org/10.1016/S0749-3797(00)00138-0
14. Yu TSI, Liu H, Hui K. A case-control study of eye injuries in the workplace in Hong Kong. Ophthalmology. 2004;111:70–4. https://doi.org/10.1016/j.ophtha.2003.05.018
15. 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;113:1159–64. https://doi.org/10.1016/j.ophtha.2006.02.020
16. Khorshed EA, El-Naggar SA, El-Gohary SS, Awad AM, Ahmed AS. Occupational ocular health problems among marble workers at Shaq El Tho'ban industrial area in Egypt. Environ Sci Pollut Res Int. 2022;29:37445–57. https://doi.org/10.1007/s11356-021-18410-5
17. Koffuor GA, Kyei S, Gyanfosu L, Afari C. Effect of the working environment on oculo-visual health of some sand and stone miners in Ghana. J Environ Occup Sci. 2012;1:83–90. https://doi.org/10.5455/jeos.20120719050427
18. Dagli RJ, Kumar S, Dhanni C, Duraiswamy P, Kulkarni S. Dental health among green marble mine laborers, India. J Oral Health Community Dent. 2008;2:1–7. https://doi.org/10.5005/johcd-2-1-1
19. Kwaku Tetteh KK, Owusu R, Axame WK. Prevalence and factors influencing eye injuries among welders in Accra, Ghana. Adv Prev Med. 2020;2020:2170247. https://doi.org/10.1155/2020/2170247
20. Ezisi C, Eze B, Okoye O, Arinze O. Correlates of stone quarry workers' awareness of work-related ocular health hazards and utilization of protective eye devices: findings in Southeastern Nigeria. Indian J Occup Environ Med. 2017;21:51–5. https://doi.org/10.4103/ijoem.IJOEM_171_16
21. Mir M, Jehan A, Qadri S, Wani R, Bashir H, Shafi T. An epidemiological study on prevalence and pattern of ocular injuries in Kashmir Valley—a conflict zone. Int J Med Sci Public Health. 2014;3:3–6.
22. Taylor HR. Pterygium. Amsterdam: Kugler Publications; 2000. p. 4.
23. Taluka CW. Morbidity and mortality among quarry and stone workers. Nat Environ Pollut Technol. 2002;50:217–20.

CONFLICT OF INTEREST
Authors declare no conflict of interest.
GRANT SUPPORT AND FINANCIAL DISCLOSURE
None declared.

AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	MS, MS
Acquisition, Analysis or Interpretation of Data:	MS, MS, SA, SN, DJ
Manuscript Writing & Approval:	MS, MS, SA, SN, YT

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.