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# EVALUATION OF VISUAL ACUITY IN WORKERS OF TEXTILE INDUSTRY

*Original Research*

**Hamna Sarmad[1], Huma Murtaz[2], Saima Ghufran[3]*,**
[1]Optometrist, Optometry, Mehtab Medical Complex, Chakwal, Pakistan.
[2]Senior Lecturer, Riphah International University, Pakistan.
[3]Assistant Professor & HOD, Vision Sciences Department, Pakistan Institute of Rehabilitation Sciences, ISRA University, Islamabad Campus, Pakistan.
**Corresponding Author:** Saima Ghufran, Assistant Professor & HOD, Vision Sciences Department, Pakistan Institute of Rehabilitation Sciences, ISRA University, Islamabad campus, Pakistan. Saimaghufran@pirs.edu.pk
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## ABSTRACT

**Background:** Workers in the textile industry are exposed to occupational hazards that can adversely affect visual functions. Prolonged exposure to bright light, mechanical strain, and hazardous chemicals may contribute to visual impairments, including refractive errors, glare sensitivity, and ocular injuries. Limited research has comprehensively assessed multiple visual functions among textile workers, particularly in Pakistan. This study aims to evaluate visual acuity, contrast sensitivity, glare sensitivity, color vision, and visual field integrity in textile industry workers, identifying potential occupational risks affecting their ocular health.

**Objective:** To assess visual functions and determine the magnitude of work-related visual problems among textile industry workers in Lahore.

**Methods:** A cross-sectional survey was conducted among 93 textile workers aged 15–45 years. Visual acuity was measured using the LogMAR chart, color vision using Ishihara plates, visual field by confrontation testing, contrast sensitivity using Lea number plates, and glare sensitivity by targeted light exposure. Participants provided informed consent before data collection, and a structured questionnaire recorded demographic details, ocular complaints, and work-related risk factors. Data were analyzed using SPSS 20.0, applying descriptive statistics and comparative analyses where appropriate.

**Results:** Among 93 participants, 10% were male and 90% female. Normal visual acuity was recorded in 56 (61%) workers, while myopia was found in 43 (46.2%). Glare sensitivity was detected in 22 (24%), contrast sensitivity was deficient in 14 (15.2%), and color vision deficiency was observed in 4 (4.3%). Bright light exposure was reported by 88 (94.6%) workers. Five (5.4%) workers had vision-threatening ocular diseases, including cataract (3.2%) and diabetic retinopathy (2.2%). Protective devices were provided to all workers, contributing to a lower rate of ocular injuries.

**Conclusion:** This study highlights that textile workers are at significant risk of refractive errors, with myopia being the most prevalent. While color vision and contrast sensitivity impairments were less frequent, glare sensitivity was notable. Cataract and diabetic retinopathy were detected in older workers. Protective eyewear contributed to a reduced incidence of ocular injuries, underscoring the importance of workplace safety measures and routine ophthalmic screening.

**Keywords:** Cataract, contrast sensitivity, diabetic retinopathy, glare sensitivity, ocular injuries, refractive errors, visual acuity.

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## INTRODUCTION

The textile industry employs over 60 million people worldwide, making it one of the largest industrial sectors. Workers in this industry face numerous occupational hazards, including exposure to airborne pollutants, chemicals, and physical strain, which have long-term health implications. Chronic lung diseases, such as asthma and chronic obstructive pulmonary disease (COPD), are particularly prevalent due to prolonged exposure to textile dust and cotton hemp. Studies indicate that a significant proportion of non-smokers, ranging from 25% to 45%, develop obstructive lung disease due to occupational exposure. Additionally, workplace dust exposure has been reported as a major risk factor, with a documented incidence of 9% (1). Beyond respiratory health, workers in the textile industry are routinely exposed to a variety of carcinogenic dyes and solvents, which are linked to an increased risk of malignancies. The presence of genotoxic agents in textile and iron industries has been associated with cancer-related deaths. Chemicals such as solvents, dyes, finishing agents, and synthetic fiber dust pose significant health risks, with studies indicating higher rates of bladder cancer among workers involved in dyeing and bleaching processes (2). The combination of prolonged working hours, high physical demands, and inadequate occupational safeguards further predisposes workers to musculoskeletal disorders, cardiovascular diseases, gastrointestinal ailments, and neurological issues. Ocular problems, including photophobia, asthenopia, dry eye syndrome, and uncorrected refractive errors, are commonly reported among textile workers, highlighting the need for comprehensive occupational health interventions (3).

Visual function plays a fundamental role in occupational efficiency, with visual acuity being a key parameter in assessing ocular health. Visual acuity refers to the eye's ability to resolve spatial details and is assessed using standardized tests such as the Snellen chart, LogMAR, Lea symbols, and E charts. Among these, the Snellen chart remains the most widely used due to its accessibility in multiple languages (4,5). Impaired vision, particularly due to uncorrected refractive errors, is a leading cause of occupational visual disability, affecting work performance and quality of life (6). Refractive errors arise due to changes in corneal shape, lens flexibility, or eyeball morphology, leading to conditions such as myopia and hyperopia. These errors can be managed through corrective measures, including prescription glasses, contact lenses, and refractive surgeries. Age-related decline in lens elasticity, known as presbyopia, further contributes to visual difficulties, particularly in tasks requiring near vision (7). Visual acuity assessments should ideally be performed under both high- and low-contrast conditions to ensure a comprehensive evaluation of functional vision, especially in work environments where contrast sensitivity plays a crucial role (8). In addition to visual acuity, contrast sensitivity is an essential component of visual function, allowing individuals to distinguish objects from their background under varying lighting conditions. This ability is particularly relevant for workers who operate machinery or perform tasks requiring fine detail discrimination. Contrast sensitivity deficits are often associated with retinal and optic nerve pathologies and are considered an early indicator in conditions such as glaucoma (9). Moreover, color vision plays a vital role in occupational safety and efficiency. Normal color perception enables workers to distinguish between various materials, signals, and safety indicators. However, color vision deficiencies, whether congenital or acquired, can interfere with task performance. Inherited color vision defects, often X-linked, affect approximately 8% of males and 0.5% of females, while acquired deficiencies are frequently linked to systemic diseases, solvent exposure, or drug toxicity (10-13).

Glare sensitivity, another crucial aspect of visual function, is defined as difficulty in visual perception under intense light exposure. Glare is particularly problematic in conditions involving reflective surfaces or bright industrial lighting and is a common complaint among individuals with cataracts. Workers exposed to high-glare environments may experience discomfort and visual fatigue, leading to decreased efficiency and increased risk of occupational accidents (14-16). The visual field, which represents the spatial extent of vision, is another essential component of ocular health. A normal visual field encompasses approximately 50 degrees superiorly, 60 degrees nasally, 70 degrees inferiorly, and 90 degrees temporally. Various techniques, such as Amsler grids and perimetry tests, are employed to assess visual field integrity, particularly in detecting conditions affecting the optic nerve and retina (17,18). The textile industry is a cornerstone of Pakistan's economy, contributing 8.5% to the Gross Domestic Product (GDP) and accounting for approximately 60% of the country's exports. Despite its economic significance, the industry poses substantial occupational health risks. Ophthalmic disorders among industrial workers lead to a decline in manpower productivity and, in severe cases, irreversible vision loss. Prolonged near work contributes to convergence insufficiency, while exposure to hazardous chemicals increases the likelihood of ocular injuries and degenerative eye conditions. Many of these visual impairments are preventable through the implementation of protective measures, including safety goggles and regular ophthalmic screenings (19-21).

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Globally, industrial ocular injuries account for over 1.6 million cases of blindness and 3 million cases of low vision. Additionally, more than 10 million disabilities result from workplace-related eye injuries each year (22-24). Despite these alarming statistics, many workers remain unaware of occupational hazards due to a lack of education and training. Insufficient access to protective equipment further exacerbates the prevalence of work-related ocular disorders. Given the critical role of vision in occupational efficiency and worker safety, it is imperative to evaluate the visual acuity and ocular health status of textile industry workers. This study aims to assess visual acuity and associated ocular health parameters among textile industry workers to identify risk factors contributing to occupational visual impairments. By addressing the gap in existing literature, the findings will contribute to the development of preventive strategies and workplace interventions to safeguard the ocular health of industrial workers.

## METHODS

A cross-sectional survey was conducted to evaluate visual acuity and other ocular health parameters among textile industry workers. Data collection was performed using a self-designed questionnaire and a structured clinical examination proforma. The questionnaire documented demographic details, occupational history, ocular complaints, and history of ocular injuries. The clinical examination assessed visual acuity, color sensitivity, contrast sensitivity, glare sensitivity, and visual field abnormalities using standardized ophthalmic charts and instruments. Informed consent was obtained from all participants before enrollment. Ethical approval was secured from the Institutional Review Board (IRB) of the College of Ophthalmology and Allied Vision Sciences (COAVS), King Edward Medical University (KEMU), Lahore. The study was conducted at the Department of Ophthalmology, COAVS, KEMU, between October and December 2019. Participants were selected using a non-probability convenience sampling technique. Inclusion criteria included workers aged 18 years and above who had been employed in the textile industry for at least one year and were willing to participate in the study. Individuals with pre-existing diagnosed ocular pathologies unrelated to occupational exposure, a history of ocular surgery, or systemic diseases known to affect vision, such as uncontrolled diabetes or advanced neurological disorders, were excluded.

Visual functions were assessed using validated ophthalmic tests and instruments. Visual acuity was measured using the Snellen and LogMAR charts at a standardized distance of six meters for distance vision and 40 cm for near vision. Contrast sensitivity was evaluated using the Pelli-Robson contrast sensitivity chart and the Mars Letter Contrast Sensitivity test. Color vision was examined using the Ishihara test for red-green deficiencies and the Farnsworth D-15 test to detect other color vision anomalies. Glare sensitivity was assessed using the Brightness Acuity Test (BAT), which measures visual function under high-intensity light exposure. Visual field testing was conducted using the Amsler grid for central vision defects and confrontation visual field testing for peripheral vision screening. In cases where detailed visual field analysis was required, a Humphrey Field Analyzer or Goldmann perimetry was used. Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 20.0. Descriptive statistics, including mean and standard deviation, were used to summarize quantitative variables such as age, visual acuity, contrast sensitivity, color vision, glare sensitivity, and visual field assessments. Categorical variables, such as gender, were analyzed using the chi-square test or Fisher's exact test, as appropriate. Continuous variables were compared using analysis of variance (ANOVA) for multiple group comparisons. Statistical significance was set at a p-value of $<0.05$. This study provides a comprehensive assessment of visual functions in textile industry workers, utilizing standardized ophthalmic tools and rigorous statistical methods to ensure the accuracy and reliability of findings.

## RESULTS

A total of 93 textile industry workers were included in the study, comprising 10% males and 90% females. Visual acuity assessment revealed that 56 participants (61%) had normal vision, while myopia was identified as the most common refractive error, affecting 23 participants (24.7%). Hyperopia was observed in 14 participants (14.3%). Among those with refractive errors, prescription spectacles were recommended. Glare sensitivity was present in 22 participants (24%), indicating significant discomfort under bright lighting conditions. Color vision assessment showed that 4 participants (4.3%) had severe color vision deficiency. Contrast sensitivity was impaired in 14 participants (15.2%). Work environment assessment revealed that 88 workers (94.6%) were exposed to bright light conditions, while 4 (4.3%) worked under normal lighting and only 1 (1.1%) in dim lighting. Prolonged exposure to bright light was reported as a contributing factor to eye strain, photophobia, and asthenopia.

Ocular health assessment identified cases of cataract and diabetic retinopathy among workers aged over 35 years, who were subsequently referred to Mayo Hospital for further ophthalmic evaluation. Dry eye symptoms were reported by all participants, with a notable number experiencing ocular injuries due to occupational hazards. Workers with ocular injuries were advised to seek medical attention. Protective

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eyewear was provided by the industry to all workers, though compliance with usage was not assessed in this study. The analysis considered visual functions, ocular diseases, and injuries as dependent variables, while gender, nature of work, and occupational hazards were treated as independent variables.

Visual field assessment revealed that 13 participants (14%) had some degree of visual field impairment. Peripheral visual field defects were detected in 10 participants (10.8%), while 3 participants (3.2%) exhibited central visual field defects. These impairments were more commonly observed in older workers and those with a history of prolonged exposure to hazardous workplace conditions. Additionally, analysis of refractive error severity indicated that mild to moderate myopia was the most prevalent, affecting 18.3% of participants, while high myopia was recorded in 6.4% of cases. Hyperopia severity varied, with most cases being mild. The impact of ocular deficiencies on work productivity was also evident, as workers with significant visual impairments reported increased difficulty in performing tasks requiring precision, such as handling textile machinery and identifying color variations.

**Table 1: Visual Acuity Status of Participants**

| Visual Acuity Status | Number of Participants | Percentage (%) |
|---|---|---|
| Normal | 56 | 61.0 |
| Myopia | 23 | 24.7 |
| Hyperopia | 14 | 14.3 |

**Table 2: Other Visual Function Deficiencies**

| Visual Function | Number of Participants | Percentage (%) |
|---|---|---|
| Glare Sensitivity | 22 | 24.0 |
| Color Vision Deficiency | 4 | 4.3 |
| Contrast Sensitivity Deficiency | 14 | 15.2 |
| Bright Light Working Conditions | 88 | 94.6 |

**Table 3: Visual Field Assessment of Participants**

| Visual Field Deficiency | Number of Participants | Percentage (%) |
|---|---|---|
| Normal | 80 | 86.0 |
| Peripheral Field Defect | 10 | 10.8 |
| Central Field Defect | 3 | 3.2 |

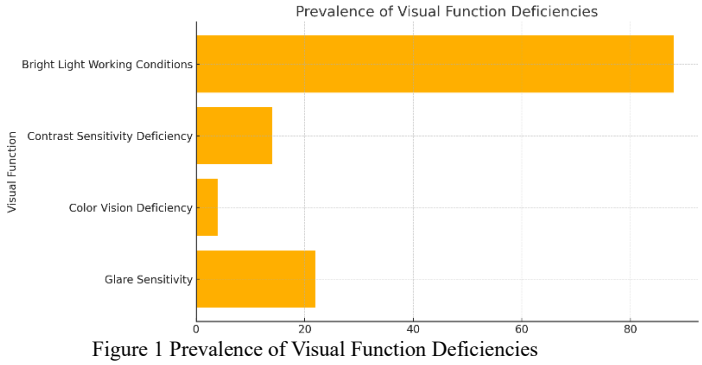

Figure 1 Prevalence of Visual Function Deficiencies

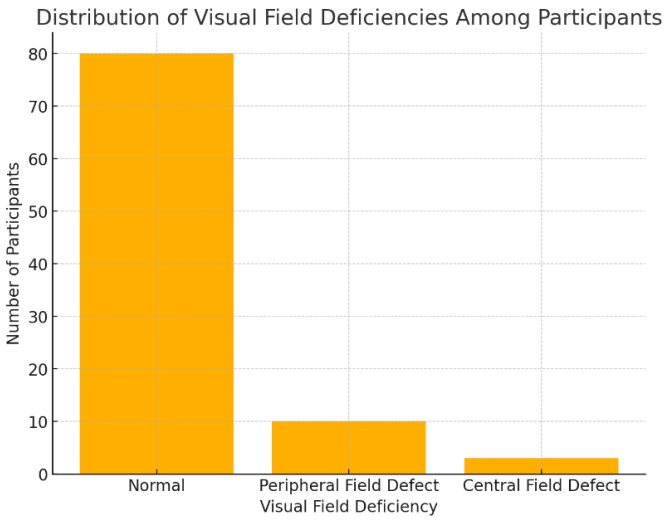


Figure 3 Distribution of Visual Field Deficiencies Among Participants

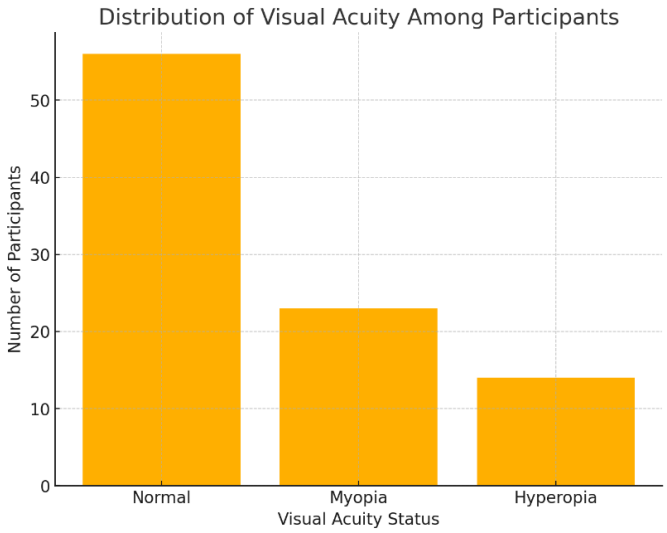


Figure 2 Distribution of Visual Acuity Among Participants

## DISCUSSION

This study comprehensively evaluated visual functions among textile industry workers in Pakistan, marking one of the first attempts to assess all major visual parameters in this occupational group. Previous studies have primarily focused on isolated aspects of visual function, such as refractive errors or ocular injuries, whereas this study examined multiple parameters, including visual acuity, contrast sensitivity, glare sensitivity, color vision, and visual field integrity. The findings contribute to the growing body of evidence on occupational visual health, particularly among industrial workers who are continuously exposed to hazardous working conditions (25). The results demonstrated a high prevalence of refractive errors, with myopia being the most common visual impairment, affecting nearly half of the workers assessed. This aligns with previous research on industrial workers, which has also reported a high burden of myopia due to prolonged near work exposure. Hypermetropia and presbyopia were less prevalent, though their presence underscores the need for vision correction strategies tailored to the needs of aging workers. Contrast sensitivity and color vision deficiencies were observed at lower frequencies compared to studies conducted in petrochemical and automobile repair industries, where chemical solvent exposure has been linked to a greater impact on visual function. The relatively lower prevalence of contrast sensitivity and color vision impairments in textile workers suggests that other occupational factors, such as lighting conditions and mechanical strain, may play a more prominent role in affecting visual health. However, the study identified significant glare sensitivity among workers, with nearly a quarter of participants experiencing difficulty adapting to bright light conditions. This finding is particularly relevant given that over 94% of workers were exposed to bright light environments, which can exacerbate symptoms such as eye strain, photophobia, and asthenopia (12).

Ocular injuries were reported in nearly one-fifth of participants, with physical injuries being the most common type, followed by chemical and electrical injuries. Despite the provision of protective eyewear, a notable proportion of workers experienced vision-related complaints post-injury, including diplopia and blurred vision. The study also identified cases of cataract and diabetic retinopathy among workers over the age of 35, highlighting the importance of early ophthalmic screening and referral mechanisms for timely intervention. While the majority of workers were provided with protective eyewear, compliance and effectiveness of these safety measures were not assessed, leaving a gap in understanding the actual impact of preventive strategies in this occupational setting (13,26). Comparing these findings with prior research, studies in automobile repair industries have shown that professional hazards significantly increase the risk of ocular disorders, with many workers lacking awareness of safety protocols. Occupational exposure to pollutants, chemicals, and mechanical hazards has been identified as a major contributor to visual health deterioration in industrial settings. Previous research has also indicated that a considerable proportion of workers either do not receive protective equipment or fail to use it consistently, which aligns with findings in the current study, where a significant percentage of workers still experienced ocular injuries despite the availability of safety gear. Moreover, literature suggests that occupational visual impairments are often underreported due to limited access to regular ophthalmic assessments, emphasizing the need for structured eye care programs within industrial sectors (8,27).

The strengths of this study lie in its comprehensive assessment of multiple visual functions using standardized ophthalmic tools, ensuring objective evaluation of occupational visual health. The inclusion of a broad range of parameters provides a holistic understanding of the impact of textile work on vision. However, certain limitations must be acknowledged. The cross-sectional design of the study prevents causal inferences regarding the long-term impact of occupational exposure on visual health. The reliance on self-reported questionnaires for ocular complaints may have introduced response bias, and the absence of detailed compliance data on protective eyewear use limits the ability to assess the effectiveness of safety interventions. Additionally, while visual field testing was conducted, the results indicated no abnormalities, which raises the possibility of underreporting due to the limitations of the assessment methods used. More advanced perimetric analysis may be required for detecting subtle visual field defects in industrial workers exposed to prolonged visual strain (17). Future studies should adopt longitudinal designs to evaluate the progression of visual impairments in textile workers over time. Incorporating objective assessments of workplace lighting conditions, ergonomic factors, and compliance with protective measures would further enhance the understanding of occupational risk factors. Expanding the study to include a larger and more diverse sample of industrial workers across different regions would improve generalizability. Establishing routine ophthalmic screening and awareness programs within textile industries is essential to mitigate the long-term effects of occupational exposure on visual health and ensure early detection and management of visual impairments.

## CONCLUSION

This study evaluated the visual functions of textile industry workers in Lahore, highlighting the impact of occupational exposure on ocular health. The findings indicate that visual acuity was the most commonly affected parameter, with workers being prone to refractive errors such as myopia, presbyopia, and hyperopia. While contrast sensitivity and color vision remained largely unaffected, glare sensitivity was observed in a portion of the workforce, particularly among those exposed to intense lighting conditions. Machine operators and maintenance workers were at a higher risk of ocular injuries due to prolonged exposure to mechanical and environmental hazards. Cases of vision-threatening ocular diseases were identified, emphasizing the need for early detection and intervention. The study underscores the importance of regular ophthalmic screenings, workplace safety measures, and the consistent use of protective eyewear to minimize occupational eye injuries and preserve visual health in industrial settings.

### AUTHOR CONTRIBUTIONS

| Author | Contribution |
|---|---|
| Hamna Sarmad | Substantial Contribution to study design, analysis, acquisition of Data<br>Manuscript Writing<br>Has given Final Approval of the version to be published |
| Huma Murtaza | Substantial Contribution to study design, acquisition and interpretation of Data<br>Critical Review and Manuscript Writing<br>Has given Final Approval of the version to be published |
| Saima Ghufran* | Substantial Contribution to acquisition and interpretation of Data<br>Has given Final Approval of the version to be published |

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