



ORIGINAL RESEARCH PAPER

Ophthalmology

OCULAR EFFECTS OF CHRONIC SUNLIGHT EXPOSURE IN TEA ESTATE WORKERS OF SOUTHERN ASSAM

KEY WORDS: Ultraviolet radiation, occupational exposure, pterygium, cortical cataract, tea plantation, Assam

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ABSTRACT	Background: Occupational sunlight exposure is a significant cause of ocular morbidity, particularly in populations engaged in outdoor labor. Tea estate workers in Southern Assam experience prolonged ultraviolet (UV) exposure, yet region-specific epidemiological data are limited. Objectives: To determine the prevalence and spectrum of ocular changes associated with chronic sunlight exposure in tea estate workers of Southern Assam. Methods: A cross-sectional observational study was conducted in selected tea estates. Participants aged ≥18 years, with ≥5 years of outdoor occupational exposure, were included. Demographic details, exposure history, and protective practices were documented. Comprehensive ocular examinations were performed, including visual acuity assessment, slit-lamp biomicroscopy, and fundus evaluation. Diagnoses were based on standard clinical criteria. Data were analysed using descriptive statistics and Chi-square tests to evaluate associations between exposure duration and ocular findings. Results: Of 240 participants (108 males, 132 females; mean age 42.3 ± 9.6 years), the most common ocular conditions identified were pterygium (34.6%), pinguecula (29.2%), cortical cataract (24.1%), and chronic conjunctivitis (18.8%). Photokeratitis was present in 5% of participants, mostly during peak harvest seasons. Fundus changes suggestive of early age-related macular degeneration were observed in 7.5% of cases. Workers with ≥15 years of exposure had significantly higher prevalence of pterygium (p < 0.01) and cortical cataract (p < 0.05). Only 3.8% reported regular use of UV-protective eyewear. Conclusion: Tea estate workers in Southern Assam exhibit a high prevalence of UV-induced anterior segment disorders, particularly pterygium and cortical cataract. Prolonged occupational sunlight exposure without adequate protection is a major risk factor. Implementing preventive strategies—such as provision of affordable UV-protective eyewear, community-based education, and regular ocular screening—could reduce ocular morbidity in this vulnerable population.
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INTRODUCTION Occupational sunlight exposure is a recognized risk factor for several ocular diseases, primarily due to the harmful effects of ultraviolet (UV) radiation. Chronic exposure to UV-A (315–400 nm) and UV-B (280–315 nm) can lead to degenerative changes in the conjunctiva, cornea, lens, and retina through mechanisms involving oxidative stress, protein denaturation, and inflammatory cascades. [1,2] Tea estate workers, especially in tropical and subtropical regions, are continuously exposed to sunlight for prolonged hours without adequate eye protection. Studies from Australia,[3] Nepal,[4] and South India [5] have reported higher prevalence of pterygium, pinguecula, and cortical cataracts in outdoor workers. However, there is limited epidemiological data from tea-growing regions of North-East India, where socio-economic constraints and low health awareness exacerbate the risks. Southern Assam's tea estates employ thousands of workers, predominantly women, who spend 6–8 hours daily in direct sunlight during plucking seasons. Lack of UV-protective eyewear and inadequate occupational health measures place them at heightened risk for preventable ocular morbidity. This study aims to document the prevalence and spectrum of ocular changes associated with chronic sunlight exposure in tea estate workers of Southern Assam and to analyse their association with duration of occupational exposure. MATERIALS AND METHODS Study Design And Setting A cross-sectional observational study was conducted between January and June 2025 in three major tea estates of Cachar district, Southern Assam.	Study Population Inclusion Criteria - Workers aged ≥18 years - Minimum 5 years of continuous outdoor occupational exposure Exclusion Criteria - History of ocular trauma - History of previous ocular surgery - Presence of systemic conditions (e.g., diabetes mellitus) that could confound lens / retina changes Sample Size And Sampling Using an expected prevalence of pterygium of 30% from prior studies [4] and a 95% confidence level with 6% margin of error, the sample size was calculated as 240. Participants were selected using stratified random sampling from estate registers. Data Collection Demographic information, occupational history (years of exposure, daily working hours), and use of protective eyewear were recorded using a structured questionnaire. Ocular Examination All Participants Underwent: Visual acuity assessment using Snellen's chart. Slit-lamp examination for anterior segment evaluation. Fundus examination using direct and indirect ophthalmoscopy after mydriasis when indicated. - Lens opacities were graded according to the Lens Opacities Classification System III (LOCS III).[6] - Pterygium and pinguecula were diagnosed clinically based on standard morphological criteria.[7]
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Statistical Analysis

Data were entered into Microsoft Excel and analysed using SPSS version 26. Descriptive statistics (percentages, means ± SD) were used. Associations between ocular findings and exposure duration were tested using Chi-square tests, with p < 0.05 considered significant.

RESULTS

A total of 240 tea estate workers meeting the inclusion criteria were examined. Of these, 108 (45%) were male and 132 (55%) were female, reflecting the female predominance in the tea-picking workforce.

The mean age of participants was 42.3 ± 9.6 years, with an age range of 21 to 65 years. The average duration of outdoor occupational exposure was 18.6 ± 6.2 years. On a typical working day, participants reported spending an average of 7.1 ± 1.3 hours under direct sunlight, particularly during peak harvesting periods.

Table 1: Demographic Characteristics Of Study Participants

Variable	Value
Total participants	240
Gender	Male: 108 (45%) Female: 132 (55%)
Age (years)	Mean ± SD: 42.3 ± 9.6 (range 21–65)
Duration of outdoor work (years)	Mean ± SD: 18.6 ± 6.2
Average hours/day under sunlight	Mean ± SD: 7.1 ± 1.3

The most common ocular abnormality detected was pterygium, present in 83 participants (34.6%). Pinguecula was observed in 70 individuals (29.2%), while cortical cataract was identified in 58 participants (24.1%). Chronic conjunctivitis was documented in 45 workers (18.8%), predominantly among those with prolonged exposure to dust and wind in addition to sunlight. Photokeratitis was detected in 12 participants (5%), occurring more frequently during the high-intensity summer months.

Fundus examination revealed early signs of age-related macular degeneration (AMD) in 18 participants (7.5%), with drusen and pigmentary changes predominantly in those over 50 years of age.

Table 2: Prevalence Of Ocular Findings

Ocular Finding	n (%)
Pterygium	83 (34.6%)
Pinguecula	70 (29.2%)
Cortical cataract	58 (24.1%)
Chronic conjunctivitis	45 (18.8%)
Photokeratitis	12 (5%)
Early AMD	18 (7.5%)

Analysis revealed a statistically significant association between prolonged occupational exposure and the prevalence of certain ocular conditions. Workers with ≥15 years of exposure had markedly higher rates of pterygium (p < 0.01) and cortical cataract (p < 0.05) compared to those with shorter exposure histories.

The occurrence of photokeratitis also showed a seasonal trend, with most cases reported during the summer harvest period when UV intensity was at its peak.

Table 3: Association Of Ocular Findings With Duration Of Exposure

Condition	< 15 years exposure	≥ 15 years exposure	p-value
Pterygium	21 (20.8%)	62 (44.6%)	< 0.01*
Cortical cataract	15 (14.9%)	43 (30.9%)	< 0.05*
Photokeratitis	3 (3.0%)	9 (6.5%)	NS

*Significant at p < 0.05; NS – Not significant

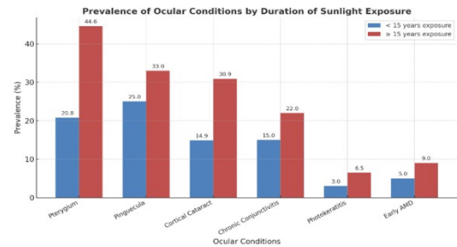


Figure 1: Distribution of Ocular Conditions Among Study Participants

Use of UV-protective eyewear was strikingly low in the study population. Only 9 participants (3.8%) reported consistent use of sunglasses or other protective devices during work. The majority of workers cited lack of awareness, cost constraints, and the perception that protective eyewear hindered work efficiency as reasons for non-use.

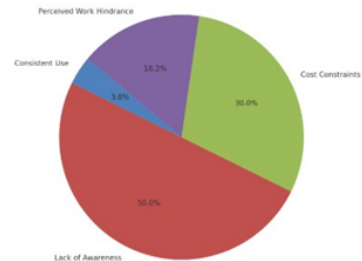


Figure 2: Barriers to the use of protective gear

DISCUSSION

This study highlights the substantial burden of UV-related ocular disorders among tea estate workers in Southern Assam, with pterygium and cortical cataract being the most common. The prevalence of pterygium (34.6%) aligns with findings from rural South India (33.1%) [5] and exceeds reports from temperate climates such as Spain (12.1%).[8] The significantly higher prevalence in workers with ≥15 years of exposure supports the cumulative UV damage hypothesis.[2]

Pinguecula prevalence (29.2%) is consistent with occupational exposure studies in agricultural workers from Nepal (28.4%).[4] Cortical cataract rates (24.1%) reflect UV-B induced protein denaturation in the lens,[1] similar to findings in Australian outdoor workers (22%).[3]

Notably, only 3.8% of workers used any protective eyewear, underscoring the need for affordable and culturally acceptable interventions. The observed early AMD prevalence (7.5%) suggests possible UV contribution to retinal oxidative stress,[9] although confounding factors like smoking could not be excluded in this study.

Limitations

- Cross-sectional design limits causal inference.
- Potential recall bias in estimating exposure duration.
- Lack of UV index measurements at worksites.

Despite these, the study provides valuable region-specific data on an occupational group often overlooked in public health planning.

CONCLUSION

Chronic occupational sunlight exposure among tea estate workers of Southern Assam is associated with high prevalence of anterior segment disorders, especially pterygium and cortical cataract. Prolonged exposure without protection is a significant modifiable risk factor. Preventive strategies should include regular ocular screening, provision of affordable UV-protective eyewear, and worker education programs.

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