

Original Research Article

Role of conjunctival ultraviolet autofluorescence device, as an indicator of ocular ultraviolet radiation exposure in pterygium and pinguecula among outdoor workers in Southern India

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ABSTRACT

Background: Objective of the study was to evaluate conjunctival ultraviolet autofluorescence (CUVAF) device, as an indicator of ocular ultraviolet (UV) radiation exposure in pterygium and pinguecula among outdoor workers.

Methods: Subjects above 21 years of age engaged in outdoor work were enrolled based on inclusion criteria. A standardized questionnaire was administered to assess the lifetime UV exposure and erythematous UV dose were noted from the tropospheric emission monitoring internet service (TEMIS). Autofluorescence photographs of the nasal and temporal conjunctiva were taken using CUVAF tool and were assessed for presence of damage with exposure to UV radiation. Logistic regression was done to estimate the risk.

Results: A total of 229 participants, among them 205 (89.5%) were males and 24 (10.4%) were females. This included 75 (32.7%) with pterygium in one or both eyes, 69 (30.3%) with pinguecula and 85 (37.1%) normal. Median conjunctival damage in pterygium was 45.3 mm² (IQR 35.1), in pinguecula was 17.9 mm² (IQR 16.0) and in normal was 11.1 mm² (IQR 25.2) demonstrating significant difference between the groups ($p < 0.001$). The conjunctival damage was positively associated with pterygium OR: 1.12 (95% CI: 1.05-1.71, $p < 0.001$) and pinguecula OR: 1.10 (95% CI: 1.07-1.49, $p = 0.01$). Rural location, literacy status were the significant risk factors for development of pterygium with odds of 2.97 (95% CI: 1.46-6.05, $p = 0.003$) and 4.84 (95% CI: 1.86-12.73, $p = 0.001$) respectively.

Conclusions: Increasing conjunctival damage was found to be associated with prevalent pterygium.

Keywords: Pterygium, Conjunctival ultraviolet autofluorescence, Solar radiation, Lifetime ultraviolet exposure

INTRODUCTION

Ultraviolet radiation exposure (UVR) is a significant public health problem and the World Health Organization (WHO) estimates that ultraviolet exposure is responsible for significant loss of quality of life and increased premature death rates.¹ The ozone layer acts as a physical barrier against UVR and prevents all short wavelengths (<290 nm, and including all of UVC) as well as 85% of UVB (wavelength 280–315 nm) reaching the ground surface. Thinning of the protective ozone layer increases

the amount of solar UVB and UVA (black light) reaching the earth's surface which is a major environmental risk factor that leads to adverse effects on human health including the ocular health causing eye disorders.² There are supportive evidences suggesting that acute high dose exposure of these radiations can cause photokeratitis and photoconjunctivitis, whereas the low dose chronic exposure is a risk factor for the development of cataract, pterygium, pseudoexfoliation, climatic droplet keratopathy, squamous cell carcinoma of the cornea and conjunctiva.³⁻⁵ Pinguecula is a yellowish, benign,

degenerative growth on the nasal or bulbar conjunctiva which could be a precursor for pterygium. It is pictured by an avascular central elevation surrounded by capillaries mainly occurring due to the influence of UV rays.⁶ Pterygium (surfer's eye) is an ocular surface disease that is characterized by a wing-shaped growth of limbal and conjunctival tissue over the adjacent cornea. In pterygium there is an observed alteration in the ocular surface homeostasis leading to proliferative clusters of limbal stem cells (LSCs), epithelial metaplasia, active fibrovascular tissue, inflammation, and disruption of Bowman's layer along the invading apex of the pterygium.⁷ Pterygium is considered as a benign condition with overall pooled prevalence around 10% worldwide as reported in meta-analytic study.⁹ Major risk factors of pterygium are age, male gender and outdoor occupation with increase in exposure to UVR, rural residence and smoking.^{10,11} In the year 2000, it was estimated that over 200 million people presented with pterygium globally. This contributed to almost 47,000 disability adjusted life years (DALYs), of which about 20,000 to 35,000 with presenting pterygium were associated with UVR exposure. Moreover, the association between development of pterygium and UV radiation is established from numerous epidemiological studies¹² wherein the tropical regions near the equator has high intensity of UV exposure presenting with increased prevalence of pterygium naming it "Pterygium belt zone".¹³ The UVR induces the development of pterygium through damaging limbal stem cells (p-53 mutation), altering the stromal fibroblast, up-regulation of inflammatory cytokines and production of growth factors and matrix metalloproteinase (MMPs).¹⁴ Both UVA and UVB reaching the ocular surface and mainly involved in triggering the reactive oxygen species causing DNA damage and activation of transcription factors, which regulate the expression of multiple genes involved in extracellular matrix changes leading to solar related eye disorders such as pterygium and cataract.¹⁵ The whole body assessment of UV radiation is done with Melbourne visual impairment questionnaire using a model comprising a comprehensive occupational history as well as laboratory and field measurements of UVB exposure, but simple questionnaires documenting history of sun exposure are prone to significant recall bias.^{16,17} Thus development of more precise methods to measure ocular UV exposure has allowed researchers to quantify this relationship between the body exposure levels with the ocular exposure level by an objective method utilizing conjunctival autofluorescence photography tool. This is based on Wood's lamp principle used to measure the actinic damage on the skin visible as fluorescence under ultraviolet light.¹⁵ Similarly, the UV damaged elastin and collagen present in the conjunctival cells have molecules that fluoresce when excited by UV radiation of appropriate wavelength. A change in the intracellular content of proteins including cytokines and matrix metalloproteinases may also contribute to the CUVAF damage.¹⁸ Ooi et al explored the autofluorescence damage on pterygium and established that 80% of pterygia showed autofluorescence damage representing the cellular activity and the remaining 20% of

pterygia had burnt out cells.¹⁷ India being a tropical country with high UV exposure, conjunctival damage could be a preclinical sign for pterygium development and the extent of damage identified with CUVAF would remain a better scope for intervention and prevention of UV spectrum disorders in eye especially pterygium.¹⁹ Therefore, the aim of this study was to evaluate the adjunctive role of CUVAF, as an indicator of ocular ultraviolet radiation exposure, and its association with the development of pterygium and pinguecula among south Indian outdoor workers.

METHODS

Study design and participants

A hospital-based observational study was conducted at Sankara Nethralaya Eye Hospital, Medical Research Foundation, Chennai with approval from the institutional ethics committee and in strict adherence to the tenets of the Declaration of Helsinki. Written informed consent was obtained and participants aged above 21 years engaged in outdoor work such as farming, driving (auto, truck and bus), quarry working, welding, road-side vendor, security personnel exposed to solar radiations as a part of occupation from October 2020 to March 2022 were included into the study.

Subjects with any history of injury and those with more than 10 number of migrations were excluded. All the participants underwent a comprehensive eye examination, questionnaire-based assessment of lifetime ocular UV exposure assessment and conjunctival ultraviolet autofluorescence photography.

Conjunctival ultraviolet autofluorescence (CUVAF) photography

Fluorescence of tissue occurs when light of shorter wavelengths around 340–400 nm, emitted by Wood's light, is absorbed and radiation of longer wavelengths, is emitted. Autofluorescence in the tissue occurs when the epidermal and dermal melanin absorbs the waveband, where the collagen in these layers fluoresces upon an excitation light source.¹⁵ CUVAF photography derived from Wood's lamp is a novel imaging technique developed to capture and quantitatively measure the area of UV-induced conjunctival damage.¹⁷ Images were captured using a custom made attachment mounted to an iPhone camera fitted with light emitting diode (LED) UV transmission filter light source positioned at 3 cm away from the eye that produced non-collimated, highly divergent light of 365 (peak) nm wavelength, (transmittance range 300 to 400 nm) as shown in Figure 1. The camera was set at an exposure time (time when the film or digital sensor of the camera is exposed to light with shutter open) of "1/8 sec" for a better quality of images in desired lighting level and an optimum setting of 400 International Organization for Standardization (ISO) is set which is the required speed of the sensitivity to light. The

conjunctival ultraviolet autofluorescence images were obtained in a dark room on temporal and nasal regions of each eye for all the study subject.²⁰ A minimum of three images were captured and the photograph with highest quality was chosen for analysis and those hindered by lid position or defocus were rejected.

CUVAF image analysis

The images were saved in tagged imaged format (TIF) for better resolution and to retain standard color information. The images are then exported to “ImageJ” software version 1.52a; Java 1.8.0-112 [64 bit] available in www.imagej.nih.gov/ij for analysis of the defective area. Images captured were calibrated for known horizontal visible distance of about 12 cm and unit of length is set in millimeters for conversion from pixels to mm². The areas of nasal and temporal regions were measured separately using the polygon selection to outline the area of autofluorescence in a semi-darkened room using a single computer monitor (Figure 2) for improved contrast detection and accuracy of image tracing on conjunctiva. In the eyes with more than single damage, multiple areas were marked and the average area of damage was obtained. Cumulative conjunctival damage of nasal and temporal areas of each of the eyes were summed and weighted damage was obtained for analysis.

Questionnaire-based assessment of lifetime ocular UV exposure

All subjects were assessed for cumulative UV exposure by standardized Melbourne visual impairment questionnaire which collected details on the frequency and duration of sun exposure that varied over an individual's lifetime, and the residential history as the erythemal UV dose varies by each geographic location. The task/job performed over a period of time related to outdoor activity was noted and the number of hours spent outdoor with the use of protective aids like hats/turbans and glass were graded depending on the use as 1 – never, 2 – less than half of the time, 3 – half of the time, 4 – more than half of the time, 5 – always and scaled for analysis as never = 0, seldom = 0.25, half time = 0.50, usually = 0.75, and always = 1.00 (18). The lifetime ocular UV exposure estimation was calculated using the formulae as below where; OE eff=lifetime effective ocular exposure; years s=number of school years in period s; LFs=location factor, constant value for s location; years p=number of years in life period p; hrsday p=number of hours spent outside in weekday, period p; LF p=location factor, constant value for p location; hatday p=% of time that the person worn hat in weekday, period p; sungday p=% of time that the person worn sunglasses in weekday, period p; glsday p=% of time that the person worn glasses in weekday, period p; hrsleis p=number of hours spent outside in leisure time, period p; hatleis p=% of time that the person worn hat in leisure time, period p; sungleis p=% of time that the person worn sunglass in leisure time, period p; and glsleis p=% of time that the person worn glasses in leisure time, period.

$$\begin{aligned}
 OE\ eff = s &= 1 \sum years\ s \times LF\ s + p \\
 &= 1 \sum years\ p \{ [hrsday\ p \times 5/7 \\
 &\times LF\ p] \times [hatday\ p \times 0.53 + (1 \\
 &- hatday)]\ p \} \times [sungday\ p \times 0.07 \\
 &+ (1 - sungday)]\ p \} \times [glsday\ p \\
 &\times 0.21 + (1 \\
 &- glsday)]\ p \} \{ [hrsleis\ p \times 2/7 \\
 &\times LF\ p] \times [hatleis\ p \times 0.53 + (1 \\
 &- hatleis)]\ p \} \times [sungleis\ p \times 0.07 \\
 &+ (1 - sungleis)]\ p \} \times [glsleis\ p \\
 &\times 0.21 + (1 - glsleis)]\ p \} \} 19
 \end{aligned}$$

Statistical analysis

Statistical tests were performed using statistical package for the social sciences (SPSS) IBM, version 20a with statistical significance set at p value <0.05. The CUVAF data and lifetime ocular UV exposure levels did not follow a normal Gaussian distribution and were analysed with non-parametric test. Continuous variables were described using means and standard deviations if normally distributed or by medians and interquartile ranges if skewed. The categorical variables were presented using percentages. Binary logistic regression was done to analyse the odds of associated risk factors with conjunctival UV damage.

RESULTS

Totally 229 participants were included in the study of which 85 (37.2%) were normal, 75 (32.7%) had pterygium in at least one eye and 69 (30.1%) had pinguecula. There were 205 (89.5%) males and 24 (10.5%) females with median age of 45 years (IQR–11) and 49 years (IQR–15) respectively. We evaluated 458 (nasal and temporal) CUVAF images of 229 participants. Total CUVAF damage and UV dose exposure levels were non-normally distributed, and median conjunctival damages were 11.1 mm² (IQR–25.2), 45.3 mm² (IQR–35.1) and 17.9 mm² (IQR–16) in normal, pterygium and pinguecula respectively. Median UV dose exposure was 2.4 J/cm² (IQR–1.99) in normal, 2.1 J/cm² (IQR–1.92) in those with pinguecula, 2.2 J/cm² (IQR–2.02) in those with pterygium that did not demonstrate any significant difference among the groups which can be accounted to the nature of the occupation as outdoor workers.

Systemic disorders and personal habits of the participants were documented and did not show a significant difference among the groups. The complete demographic details of the participants are given in Table 1.

Features of pinguecula and pterygium

A total of 69 subjects had pinguecula in either eye and presence of pinguecula was high in males 65 (94.2%) compared to females 4 (5.7%). The median age group of the participants with pinguecula was 45 years (IQR–9). About 75% of the participants with pinguecula were

employed as drivers in this study. Prevalence of pterygium in males were 56 (74.6%) and in females were 19 (25.3%). The median age group of the participants with pterygium was 51 years (IQR–13). Fifty-four (72%) participants had bilateral pterygium and the other 21 (28%) had unilateral pterygium. In majority of the cases, we observed nasal pterygium 71 (94.6%) and only 4 (5.3%) had temporal pterygium. In those who had pterygium most were employed as drivers 27 (36%) and farmers 24 (32%). Total hours exposure to solar radiation at work did not show any significant difference in distribution of pterygium and pinguecula occurrence.

Association of conjunctival damage and UV exposure with pterygium and pinguecula

Irrespective of the study group, the median value of CUVAF scoring across 458 images of 229 eyes was 23.11 mm² (IQR–32.1). Around 12 (5.2%) participants in study had no minimum detectable conjunctival damage, and the highest total CUVAF measurement was 102.4 mm². There was no difference in median CUVAF between right eyes and left eyes (19.8 mm² versus 18.3 mm², $p=0.088$).

The CUVAF damage in pterygium, pinguecula and normal were plotted in a graph (Figure 3) that showed a significant difference among the normal 11.1 mm² (IQR–25.2), pinguecula 17.9 mm² (IQR–16.2) and pterygium 45.3 mm² (IQR–35.1) with $p<0.001$.

Age was significantly associated with development of pterygium with 8 times risk in age group of participants more than 60 years ($p\leq0.001$) whereas development of pinguecula did not show any association with age. Development of pterygium was significantly associated with male gender with 22 times risk ($p=0.003$) and rural residence with 2.9 times risk ($p=0.003$). Median conjunctival damage was represented in four quartiles based on the area of damage in the conjunctiva, where the increasing quartile was significantly associated with pterygium. The conjunctival damage showed 13 times risk ($p=0.004$) for those in 2nd quartile (9.50–23.00 mm²), 21 times risk ($p=0.001$) for those in 3rd quartile (24.00–41.00 mm²) and 224 times risk ($p\leq0.001$) for those in 4th quartile (>42 mm²) for development of pterygium. Similarly conjunctival damage in the 2nd quartile showed 3.49 times risk ($p=0.003$) with pinguecula. Not spectacle was but hat/turban use at outdoor work was found to be protective factor for pinguecula 0.18 (95% CI: 0.07–0.48, $p=0.001$). In contrast the use of turban or hat in those with pterygium was found to be a risk factor with odds of 2.19 (95% CI: 1.07–4.48, $p=0.032$). Body mass index (BMI), spectacle usage, total hours of exposure solar radiation at work and lifetime ocular UV exposure levels did not show any association in both pterygium and pinguecula patients. Complete details on risk factor assessment are illustrated in Table 2.

Table 1: Details on complete demographic data of participants.

Variables	Normal (n=85) N (%)	Pterygium (n=75) N (%)	Pinguecula (n=69) N (%)	P value
Age in years (median±IQR)	44 (9)	51 (13)	45 (9)	<0.001
Gender				
Male	84 (98.8)	56 (74.6)	65 (94.2)	0.001
Female	1 (1.2)	19 (25.3)	4 (5.7)	
Residence				
Urban	65 (76.7)	39 (52)	50 (72.5)	0.002
Rural	20 (23.5)	36 (48)	19 (27.5)	
Total hours of work				
<5	11 (12.9)	13 (17.3)	6 (8.7)	0.053
5–8	29 (34.1)	33 (44.1)	26 (37.7)	
>8	45 (40)	28 (37.3)	37 (53.6)	
Type of occupation				
Drivers	66 (77.6)	27 (36)	52 (75.4)	0.001
Farmers	3 (3.5)	24 (32)	3 (4.3)	
Construction workers	2 (2.4)	0	4 (5.7)	
Street vendors	1 (1.1)	3 (4)	4 (5.7)	
Others	13 (15.3)	21 (28)	6 (8.7)	
Literacy status				
Literate	78 (91.7)	48 (64)	60 (86.9)	0.001
Illiterate	7 (8.2)	27 (36)	9 (13.1)	
Body mass index				
Underweight	4 (4.7)	4 (5.3)	0	0.242
Normal weight	29 (34.1)	35 (46.6)	31 (44.9)	
Obese	47 (55.2)	35 (46.6)	38 (55.1)	

Continued.

Variables	Normal (n=85) N (%)	Pterygium (n=75) N (%)	Pinguecula (n=69) N (%)	P value
KSES score				
Upper-class	0	0	0	0.001
Upper-middle	0	0	1 (1.4)	
Lower-middle	15 (17.6)	5 (6.6)	3 (4.3)	
Upper-lower-class	68 (80)	57 (76)	65 (94.2)	
Lower-class	1 (1.2)	13 (17.3)	0	
Spectacle usage				
Yes: no	30 (35.2): 55 (64.7)	33 (44): 42 (56)	25 (36.2): 44 (63.7)	0.478
Hat/turban usage				
Yes: no	28 (32.9): 57 (61.2)	45 (60): 30 (40)	6 (8.7): 63 (91.3)	0.005
Systemic conditions				
Hypertension - yes: no	8 (9.4): 77 (90.5)	11 (14.6): 64 (85.3)	9 (13.1): 60 (86.9)	0.588
Diabetes mellitus - yes: no	14 (16.4): 71 (83.5)	15 (20): 60 (80)	12 (17.4): 57 (82.6)	0.837
Personal habits				
Smoking - yes: no	19 (22.3): 66 (77.6)	11 (14.6): 63 (84.2)	18 (26.1): 51 (73.9)	0.225
Alcohol - yes: no	33 (38.8): 52 (61.2)	16 (21.3): 59 (78.6)	28 (40.6): 41 (59.4)	0.222
Lens status				
Phakia	85 (100)	75 (100)	67 (97.1)	0.307
Pseudophakia	0	0	2 (2.8)	
Conjunctival damage (mm ²) median (IQR)	11.1 (25.2)	45.3 (35.1)	17.9 (16)	<0.001
UVD exposure (J/cm ²) median (IQR)	2.4 (1.99)	2.1 (1.92)	2.2 (2.02)	0.425

IOP - Intraocular pressure, IQR - inter quartile range, KSES – Kuppaswamy socioeconomic status, UVD - ultraviolet dosage

Table 2: Risk assessment of the diseases with various factors.

Variables	No of subjects (n)	Pterygium OR (95% CI)	P value	No of subjects (n)	Pinguecula OR (95% CI)	P value
Age (years)						
<49	94	1		112	1	
50–59	44	2.09 (0.98–4.44)	0.056	35	0.91 (0.42–1.96)	0.812
>60	22	8.41 (2.56–27.59)	<0.001	7	0.92 (0.19–4.32)	0.918
Location						
Urban	102	1		115	1	
Rural	54	2.97 (1.46–6.05)	0.003	39	1.26 (0.59–2.54)	0.586
Gender						
Female	20	1		39	1	
Male	140	22.96 (2.87–183.42)	0.003	115	5.03 (0.54–6.33)	0.154
Literacy status						
Literate	126	1		138	1	
Illiterate	34	4.84 (1.86–12.73)	0.001	16	1.62 (0.58–4.74)	0.373
Lifetime ocular UV exposure (J/cm ²)	160	0.88 (0.69–1.15)	0.343	154	0.98 (0.69–1.17)	0.440
Cumulative CUVAF damage (mm²)						
1 st quartile (<9.50)	42	1		54	1	
2 nd quartile (9.60–23.00)	30	13.14 (2.24–76.97)	0.004	47	3.49 (1.15–8.05)	0.003
3 rd quartile (24.00–41.00)	36	21.01 (3.54–124.54)	0.001	34	2.03 (0.81–5.08)	0.131
4 th quartile (>42.00)	51	224.47 (34.31–1468.3)	<0.001	12	3.78 (1.01–14.28)	0.051
Cumulative CUVAF damage (mm ²)	160	1.10 (1.05–1.11)	<0.001	154	1.03 (1.01–1.07)	0.009
Spectacle usage						
No	97	1		99	1	
Yes	63	1.13 (0.55–2.28)	0.745	55	1.03 (0.53–2.03)	0.926

Continued.

Variables	No of subjects (n)	Pterygium OR (95% CI)	P value	No of subjects (n)	Pinguecula OR (95% CI)	P value
Hat/turban usage						
No	87	1		120	1	
Yes	73	2.88 (1.07–4.48)	0.032	34	0.18 (0.07–0.48)	0.001
Body mass index						
Normal weight	67	1		63	1	
Under weight	8	1.36 (0.27–6.96)	0.712	4	-	0.999
Obese	82	1.21 (0.23–6.29)	0.816	85	-	0.999
Total hours of work						
<5	14	1		11	1	
5-8	73	0.84 (0.29–2.37)	0.743	61	1.49 (0.39–5.60)	0.560
>8	73	0.62 (0.22–1.70)	0.347	82	1.44 (0.39–5.29)	0.584

CUVAF–Conjunctival ultraviolet autofluorescence damage, odds risk (OR) adjusted for age and rural residence, CI–confidence interval (logistic regression)



Figure 1: Novel iPhone fitted conjunctival ultraviolet autofluorescence photography system used to measure the conjunctival damage.

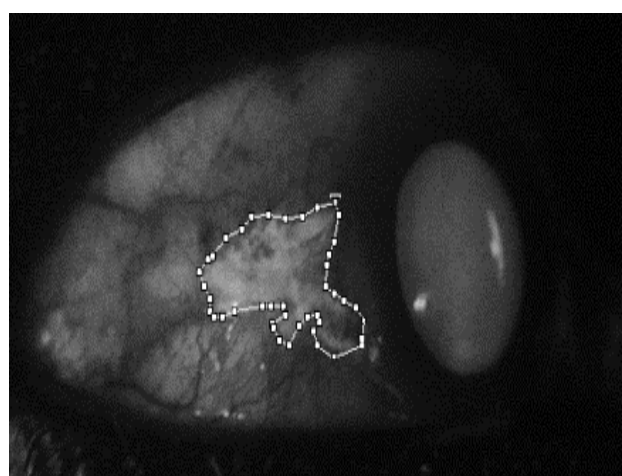


Figure 2: Representative damage in conjunctiva seen in CUVAF image marked subjectively by polygonal section for analysis in “ImageJ” software.

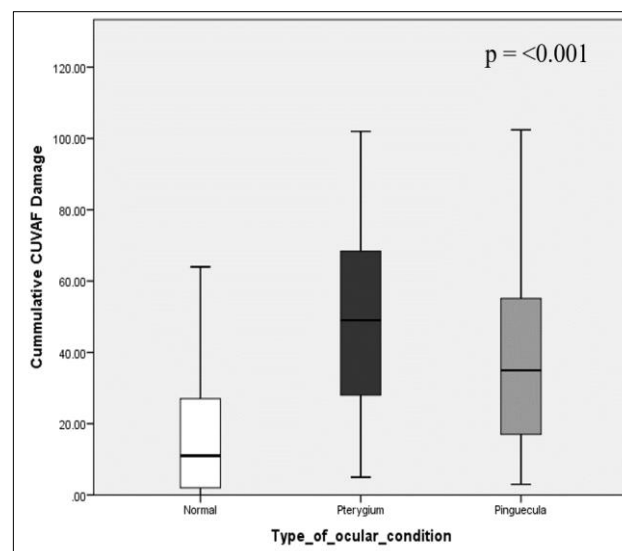


Figure 3. Box plot depicting difference in conjunctival damage among normal, pterygium and pinguecula participants

DISCUSSION

We investigated the adjunctive role of CUVAF, as an indicator of ocular ultraviolet radiation exposure, and its association with occurrence of autofluorescence damage in pterygium and pinguecula among outdoor workers in southern India. The results from current study indicates that increasing conjunctival damage was associated with pterygium that is equivocal with previous studies as reported by McKnight et al, in the Raine study and Sherwin et al, in Norfolk Eye Study, where exposure to UV radiation led to elastin and collagen damage in the conjunctival tissue emitting fluorescence upon exposure to an excitatory light source.²⁰⁻²² Similarly the Norfolk Eye study looked at 641 participants and reported the distribution of CUVAF where the median damage was 21.2 mm², which is similar to that found in this study 23.11 mm² irrespective of the disease.²³ Similarly in participants with pinguecula the CUVAF damage was associated with it, extending evidence that UV radiation to be an important pathogenic risk factor in development of pterygium and pinguecula. This study reports that increasing conjunctival damage to be associated with both pinguecula and pterygium, indicating the influence of UV radiation on the pathogenesis of disease.

Prevalence of pterygium was more in males than in females in coherence with previous report by McKnight et al that can attributed due to the differences in the environmental exposure, with males spending higher proportion of time outdoor for occupational activities.²⁰ The current study indicated that increasing age and rural location were positively associated with development of pterygium in agreement with that reported by Asokan et al where rural residence and its association with pterygium could be due to difference in nature of the occupational activities in the study participants and high risk of pterygium among male participants can be attributed to exposure to UV radiation between genders.³ The studies have shown a higher prevalence of pterygium among those with lower levels of education and those belonging to lower socioeconomic status.²⁴ The current study also showed 6 times risk for development of pterygium in those with no education, but we did not find a significant association with literacy rate and pinguecula (Table 2). The causal association between pterygium and systemic condition like hypertension and diabetes is not clearly understood but a study in Singapore reported that risk of pterygium was high among people with hypertension.²³ In current study also we did not find any association with systemic conditions and pterygium. Similarly, alcohol consumption and smoking did not show any significant difference in distribution and association in case and control groups. Increasing age and rural location was not associated with development of pinguecula due to known fact that pinguecula can eventually develop into pterygium in later stages.²⁵

Lifetime ocular UV exposure was assessed with Melbourne visual impairment model where the median UV

dosage levels were not significantly different in normal and diseased group because all the participants engaged with outdoor work had a similar rate of exposure to solar radiations.¹³ The nasal conjunctiva had larger areas of CUVAF damage than the temporal area in pterygium patients, likely due to peripheral light focusing effect across the anterior part of the eye.²⁵ In current study utilization of ocular sun protective devices such as hat/turban at work was not found to be a protective factor against pterygium. This was in coherence as reported by Kearney et al that wearing hat was not a protective factor against conjunctival damage.²² This indicates that UV light could penetrate fabric and reach the surface. Ocular protective aids like spectacles are known to significantly reduce the amount of UV radiation reaching the eye, current study did not show any protective association with diseased in contrast with studies as reported in the past literatures. Task hours at work did not show any association with both pinguecula and pterygium, but it was found that number of people engaged in work were high in second (5-8 hours) and third category (>8 hours) which was should a significant difference in distribution among the groups. BMI did not show any significant difference in distribution and association in groups.

Limitations of the study were difficulty in assessing the damage in images with poor or low resolution, the recall bias associated with the questionnaire and in those subjects with dual occupations, only the occupation with maximum outdoor exposure was considered.

CONCLUSION

Exposure to sunlight is an important modifiable risk factors in outdoor workers to reduce the occurrence of ophthalmoheliosis and ocular surface damage. The use of ocular protective aids to avoid direct exposure from sunlight, while working outdoors may decrease the risk of ophthalmoheliosis. In this study, CUVAF tool was a clear indicator of conjunctival UV damage significantly associated with pterygium and pinguecula among outdoor workers. Early preclinical detection of UV spectrum disorders such as pterygium with detectable conjunctival damage can perhaps prevent further advancement of the condition by educating the patient in the use of protective eye wear, cut down the time of outdoor work in decreasing ocular UV exposure and treatment options to avoid surgery. This would eventually reduce the global burden of blindness due to pterygium that can progress to invasive carcinoma and the disability adjusted life years due to the presence of the disease.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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