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Physical and Mental Burden of Ocular Surface Squamous Neoplasia on Health-Related Quality of Life

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Abstract

Patients diagnosed with ocular surface squamous neoplasia (OSSN) often experience a significant decline in health-related quality of life (HRQoL) due to its potential for visual impairment. This study aimed to investigate the association between OSSN and HRQoL by considering various determinants. A case-control study was conducted at Dr. Moewardi General Hospital, Indonesia, from May to December 2024. A total of 324 respondents, 162 in each group, were sampled consecutively and enrolled in this study. The OSSN patients group and the control group consisted of 97 males (59.9%) and 65 females (40.1%). The HRQoL was evaluated using the RAND Short Form Health Survey (SF-36), focusing on physical health composite (PHC) and mental health composite (MHC) scores. All procedures adhered to the established ethical guidelines. Data were analyzed using multivariate regressions in IBM SPSS version 26. Result showed that OSSN significantly impacted HRQoL. Low PHC scores were prevalent in 48.1% of OSSN patients, compared to 50.6% in controls, with an odd ratio [OR] of 2.68 and p<0.05. The MHC scores showed a similar trend, with 49.0% of OSSN patients reporting low scores (OR: 2.56, p<0.05). Furthermore, the stratified analysis showed that younger males were particularly affected, with lower HRQoL scores across all domains. Overall, OSSN imposes physical and mental burdens, significantly reducing HRQoL. Thus, a holistic treatment method that integrates both the physical and psychological health supports for OSSN patients is needed. Awareness raising and early detection initiatives may further mitigate the adverse effects of OSSN on life quality.

Keywords: Mental health, physical health, quality of life, RAND SF-36, ocular surface squamous neoplasia

Introduction

Conjunctival tumors are characterized by abnormal tissue growth withinconjunctival area, with ocular surface squamous neoplasia (OSSN) being the most prevalent type.[1] In high-income countries, the annual of OSSN cases ranges from 0.03 to 1.9 per 100,000 individuals, whereas in sub-Saharan Africa, the rate is significant higher, ranging from1.6 to 3.4 cases per 100,000.[2] The risk factors for OSSN include ultraviolet (UV) radiation exposure, human immunodeficiency virus (HIV) seropositivity, human papillomavirus (HPV) infection, tobacco use, genetic predispositions, inadequate ocular sun protection, and advancing age.[2,3] The incidence rates of OSSN are higher in older populations, with a significant number of cases diagnosed in individuals over 50 years of age.[4]

Understanding the impact of conjunctival tumors on health-related quality of life (HRQoL) is essential, as HRQoL encompasses both physical health and emotional dimensions of health.[5] The RAND Short Form Health Survey (SF-36) is a validated instrument used to evaluate HRQoL by measuring physical health composite (PHC) and mental health composite (MHC) scores across eight domains.[6] Factors influencing HRQoL include treatment satisfaction and overall physical, and psychological well-being.[7] Traditionally, population health has been measured by mortality rates and life expectancy;[8] however, chronic physical symptoms and reduced social interaction significantly impair quality of life.[9]

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Previous research on OSSN has primarily focused on diagnosing techniques,[10] patient characteristics, and treatment outcomes.[10-12] The report of Mercado et al. contradicted quality of life (QoL) between patients with OSSN allocated to either surgical excision or topical interferon alfa 2b therapy treatment. The result indicated that various factors related to QoL before, during, and after OSSN treatment were significant. However, these factors were not thoroughly investigated.[13] This study addresses this gap by investigating the connections between OSSN and all domains of HRQoL. The study aims to provide a comprehensive understanding of how OSSN impacts patients' lives, thereby informing integrated care strategies that enhance patient well-being and satisfaction. By focusing on these critical areas, this research seeks to contribute valuable insights that can guide clinical practices and improve patient management strategies specifically related to conjunctival tumors.

Methods

Case-control research was conducted at Dr. Moewardi Hospital,Indonesia, from May to December 2024. The sample size was determined using a 1:1 ratio of cases to controls. Based assumed prior research linking age to OSSN risk, with a prevalence of 0.1% in the veteran population at the South Florida VA Hospital.[14] In determining the sample size, a standard deviation of 8 was used for age in OSSN, aiming for a power of 80% ($Z\beta$ = 0.84) and an alpha level of 5% ($Z\alpha/2$ = 1.96). The minimum sample size calculated was 136 respondents per group with a control-to-case rate of 1. Adjusting for an estimated 19% non-response rate, the final target was 162 respondents per group, totaling 324 participants[15]

The study population includes individuals at the ophthalmology polyclinic who met the eligibility criteria. The inclusion criteria comprised patients, visitors, , and employees aged 18 to 79 who were fluent in Indonesian and possessed the mental capacity to complete the SF-36 questionnaire. Individualswith severe cognitive impairments or those undergoing specific exclusionary treatments were omitted. Cases consisted of patients with histopathologically confirmed OSSN, while controls included individuals without OSSN or major comorbidities such as diabetes mellitus and hypertension, matched for age and gender through consecutive sampling.

Data were collected structured interviews and google form after explaining the research aims and questionnaire process. Three trained researchers with expertise in public health and qualitative methods conducted the interviews to ensure ethical and professional data collection. Informed consent was obtained both orally and in writing.

The diagnosis OSSN was based on histopathological examination of tissue biopsies

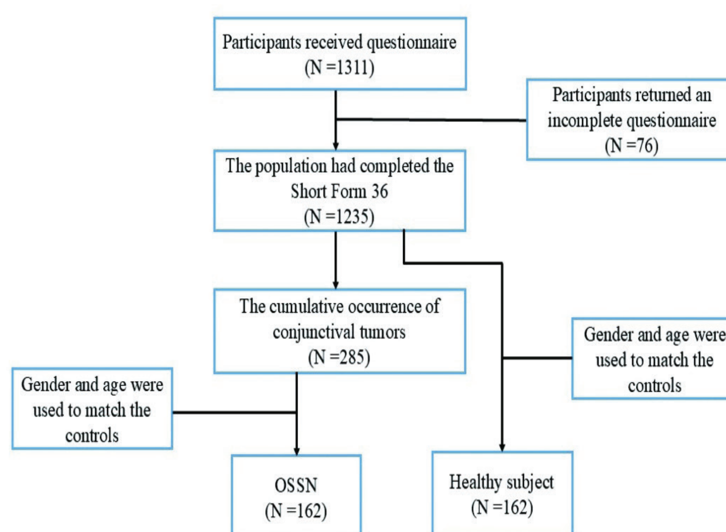

Figure 1 Flow Diagram of the Sampling Process for OSSN Patients and Healthy Subjects

documented in medical records. Findings were classified as benign (e.g., squamous papilloma), pre-invasive (varying degrees of dysplasia or carcinoma in situ), or invasive (squamous cell carcinoma).[16]

HRQoL was measured using the Indonesian version of the SF-36, which scores quality of life from 0 to 100.[17]165 participants (19–94 yrs, 59.2% female Scores below the median for PHC and MHC were defined as diminished quality of life. The SF-36 evaluates eight domains: physical functioning, role physical, bodily pain, general health, vitality, social functioning, role emotional, and mental health. This methodology effectively delineates PHC and MHC, comprehensively understanding the health status of an individual. In the physical functioning domain of the SF-36, one item inquires, “Does your health now limit you in these activities? (walking or climbing stairs),” with respondents given three response options: “yes, limited a lot,” “yes, limited a little,” or “no, not limited at all.” The SF-36 has demonstrated good internal consistency, with Cronbach’s alpha coefficients typically ranging from 0.938 to 0.942 for its various scales.[18]

All respondents completed the initial questionnaire and were asked about various types of disturbances during the interview or while filling out Google Form. These disturbances, including random interruptions, cognitive and behavioral issues, environmental factors, and emotional states, can be addressed to enhance the accuracy and meaningfulness of research outcomes. Respondents were asked to report any other current or past diseases. Meanwhile, OSSN is a complex condition influenced by various confounding factors that may obscure its relationship with potential risk exposures. Key comorbidities include skin diseases, such as actinic keratosis and squamous cell carcinoma, which can show a history of sun damage.[19] Ocular conditions, such as pterygium, along with systemic diseases, including immunosuppressive diseases, systemic lupus erythematosus, rheumatoid arthritis, and diabetes, may elevate the risk of OSSN by impacting immune responses and health in general.[20] Environmental factors, particularly excessive sun exposure and carcinogen exposure, are significant due to the association with UV radiation, a known risk factor.[19] Chronic inflammation from psoriasis and HPV infections also increases susceptibility to neoplastic changes.[21] Demographic factors including age, gender, race/ethnicity, BMI (body mass index), educational level, and protective behaviors, such as sunscreen and sunglasses contribute to OSSN risk. Additionally, income variables, which were controlled for in the analyses, also play a role in OSSN risk.

Descriptive statistics were used to summarize demographic features, with continuous variables reported as mean and standard deviation. The distribution of SF-36 scores was evaluated using skewness and multivariate regressions. The relationship between OSSN and low HRQoL was investigated using multivariate regression, adjusted for age, gender, BMI, and socioeconomic factors. Furthermore, the mean score of OSSN was compared across eight domains with those of matched controls in a 1:1 ratio, using the Chi-square test for group comparisons. Odds ratio (OR) for the likelihood of low HRQoL associated with OSSN was calculated. The primary analysis was repeated, stratifying by gender and age ranges, namely under 50, 50 to 59, and >60 years. The impact of age, gender, and diagnosis on OSSN and HRQoL relationships was evaluated by testing interaction terms for age, gender, BMI, education level, and income in multivariable models.

The lowest HRQoL scores (PHC and MHC) were used as the result indicator, adopting a cross-sectional design for sensitivity analysis. A significance level of 0.05 was considered meaningful and data analysis was performed using IBM SPSS version 26. This research was approved by the Health Research Ethics Committee of Dr. Moewardi Hospital (number ID 1.157/V/HREC/2024).

Results

From the initial screening of 1,073 respondents, 162 cases with histopathologically confirmed OSSN and 162 age- and gender-matched healthy controls were selected for in-depth case-control analysis. The demographic and clinical characteristics of the study population are summarized in Table 1.

The distribution of age and gender was identical between groups due to matching . A greater percentage of cases possess non-university education compared to controls. No statistically significant differences were observed in education, BMI, or income level between cases and controls (p>0.05), confirming, confirming the effectiveness of the matching process The median scores for PHC and MHC were established at 62 and 68, respectively, with scores below these medians categorized as low HRQoL (Table 2).

Table 1 Characteristics of Respondents

Variables	Case (n=162)	Control (n=162)	p-value
Age in years, n (%)			1.00^{0}#
<50	87 (53.7)	87 (53.7)	
50–59	26 (16.0)	26 (16.0)	
≥60	49 (30.2)	49 (30.2)	
Gender, n (%)			1.000#
Female	65 (40.1)	65 (40.1)	
Male	97 (59.9)	97 (59.9)	
Education			0.147#
Non-university	128 (79.0)	138 (85.2)	
University	34 (21.0)	24 (14.8)	
Body mass index, mean (SD)			0.392#
Underweight (<18.5 kg/m^2)	24 (14.8)	19 (11.7)	
Normal (18.5–24.9 kg/m^2)	100 (61.7)	95 (58.6)	
Overweight (>25.0 kg/m^2)	38 (23.5)	48 (29.6)	
Monthly Income (IDR), n (%)			0.216#
<1,500,000	99 (61.1)	88 (54.3)	
≥1,500,000	63 (38.9)	74 (45.7)	

Notes: Data presented as n (%), #Chi-square test. Threshold for income established based on participant median

The primary analysis revealed a significant relationship between OSSN and diminished HRQoL. The frequency of low PHC scores in subjects with OSSN was 48.1%, compared to 50.6% in subjects without OSSN. This leads to OR of 2.68 (95% CI: 2.61–2.75, p<0.05) when

Table 2 Association Between OSSN and Low HRQoL (Below Median)

SF-36 Domain	Control (n=162)	OSSN (n=162)	OSSN			
			Corrected for gender and age only		Corrected for all#	
			OR (95% CI)	P-value	OR (95% CI)	p-value
PHC	50.6%	48.1%	2.68 (2.61-2.75)	<0.001	1.78 (1.72-1.84)	<0.001
MHC	50.6%	49.0%	2.56 (2.42-2.66)	<0.001	1.71 (1.65-1.77)	<0.001
Physical Functioning (PF)	48.8%	45.1%	2.70 (2.36-2.83)	<0.001	1.80 (1.72-1.87)	<0.001
Role Physical (RP)	31.5%	29.0%	2.71 (2.40-2.98)	<0.001	1.67 (1.59-1.75)	0.013
Bodily Pain (BP)	52.6%	46.7%	2.25 (1.94-2.53)	<0.001	1.50 (1.44-1.56)	<0.001
General Health (GH)	40.7%	27.8%	2.92 (2.51-3.32)	0.010	1.95 (1.89-2.03)	0.021
Vitality (VT)	46.3%	36.4%	2.54 (2.93-2.15)	<0.001	1.69 (1.66-1.72)	0.001
Social Functioning (SF)	64.3%	54.8%	2.34 (2.28-2.40)	<0.001	1.56 (1,47-1.65)	<0.001
Role Emotional (RE)	65.9%	55.6%	2.37 (2.65-2.75)	0.001	1.58 (1.52-1.67)	<0.016
Mental Health (MH)	58.9%	45.1%	2.61 (2.42-2.80)	0.001	1.74 (1.66-1.82)	<0.001

Notes: OR: Odds ratio, CI: Confidence interval. #Adjusted for age, gender, BMI, education, and income

Table 3 Comparison of Mean HRQoL Domain Scores

SF-36 Domain	Control Mean (SD)	OSSN Mean (SD)	p-value
PHC	78.6 (9.3)	49.9 (13.9)	<0.001*
MHC	70.4 (11.9)	43.0 (14.0)	<0.001*
Physical Functioning (PF)	78.7 (13.9)	46.9 (14.2)	0.023*
Role Physical (RP)	67.9 (21.4)	38.6 (35.4)	<0.001*
Bodily Pain (BP)	75.9 (18.7)	53.7 (12.0)	<0.001*
General Health (GH)	71.3 (12.0)	50.6 (10.4)	<0.001*
Vitality (VT)	63.5 (14.2)	41.4 (14.4)	<0.001*
Social Functioning (SF)	62.4 (18.6)	41.7 (16.7)	<0.001*
Role Emotional (RE)	76.5(16.0)	48.6 (39.0)	0.010*
Mental Health (MH)	79.3 (18.9)	40.4 (8.2)	<0.001*

PHC: Physical Health Composite (Averages of PF, RP, BP, GH), MHC: Mental Physical Health Composite (Averages of VT, SF, RE, MH), SF-36: Short Form 36, SD: standard deviation, *significantly lower than controls (p< 0.05)

adjusted for gender and age, and 1.78 (95% CI: 1.72–1.84, p<0.05) when regulating for all confounding factors, as shown in Table 2. MHC scores showed a similar trend, with a prevalence of 49.0% in OSSN patients compared to 50.6% in the control group, resulting in OR of 2.56 (95% CI: 2.42–2.66, p<0.05) and 1.71 (95% CI: 1.65–1.77, p<0.05) after comprehensive adjustments.

The comparison of mean scores across all eight domains of HRQoL demonstrated that subjects with OSSN reported significantly lower scores than healthy controls.

The physical health composite (PHC) score averaged 49.9±13.9 in patients with OSSN compared to 78.6±9.3 in controls (p<0.05). Similarly, MHC scores were 43.0±14.0 for OSSN patients versus 70.4±11.9for controls group (p<0.05). Each individual domain consistently

Table 4 Association Between OSSN and Low HRQoL Stratified by Age and Gender

Sub group	OSSN (Case, n=162)			Subject without OSSN (Control, n=162)			Comparison of OSSN subjects to subjects without OSSN	
Age (years)	n	Prevalence of low PHC	Prevalence of low MHC	n	Prevalence of low PHC	Prevalence of low MHC	OR or low PHC (CI, pp-value)	OR or low MHC (CI, p-value)
<50	87	54.0%	54.0%	87	42.5%	36.8%	1.46 (1.39-1.53), p<0.001	1.27 (1.22-1.32), p<0.001
50-59	26	63.1%	69.2%	26	38.5%	42.3%	1.63 (1.55-1.71), p<0.001	1.49 (1.15-1.91), p<0.001
≥60	49	53.1%	65.3%	49	42.9%	46.9%	1.39 (1.16-1.81), p<0.001	1.23 (1.15-1.30), p<0.001
Sex								
Male	97	54.6%	55.5%	97	49.5%	50.5%	3.30 (2.98-3.62), p<0.001	2.74 (2.17-3.31), p<0.001
Female	65	52.3%	50.8%	65	38.5%	49.2%	2.71 (2.37-3.05), p=0.001	2.58 (2.01-3.15), p=0.007

PHC: Physical health composite; MHC: Mental health composite; OR: Odds ratio; CI: Confidence interval

showed a significant reductions in QoL for those affected by OSSN, highlighting the detrimental impact of the condition on overall well-being. Sensitivity analyses using the lowest quartile of HRQoL scores as the outcome variable yielded consistent results, reinforcing the primary findings

Subgroup analysis categorized by age and gender revealed significant differences in the impact of OSSN on HRQoL. Among respondents under 50 years of age, the prevalence of low PHC was 54.0% for those with OSSN compared to 42.5% for controls (OR: 1.46; p<0.05). Within the 50–59 age bracket, the prevalence was 63.1% in the OSSN group versus 38.5% in controls (OR: 1.63; p<0.05). For respondents aged 60 and older, the prevalence of low PHC was 53.1% in OSSN group compared to 42.9% in controls (OR: 1.39; p<0.05). Regarding gender, male patients with OSSN demonstrated a low PHC prevelance at 54.6% compared to 49.5% in controls (OR: 3.30; p<0.05), while for females, the prevalence was52.3% versus 38.5% (OR: 2.71; p<0.001) (Table 4).

Discussion

The findings of this study offer essential insights into the demographic and socio-economic characteristics of individuals evaluated for OSSN. The age distribution, in which 53.7% of respondents were under 50 years of age, indicates a younger demographic prevalence. This is consistent with prior literature suggesting that OSSN can occur more frequently in younger individuals, particularly in regions with high levels of ultraviolet (UV) radiation exposure.[19,22] The gender distribution observed where males comprised 59.9% of participants, is also consistent with existing reports. This imbalance supports earlier documentation of a higher incidence of OSSN in males, which may be associated with increased ultraviolet (UV) exposure resulting from occupational hazards or lifestyle choices.[23] Futhermore, a higher percentage of cases possessed a non-university education (79.0%) compared to the control group (85.2%). Research conducted by Wernly et al. on various types of cancers, including colorectal neoplasia, indicates that higher educational attainment is associated with improved health outcomes and lower risk of advanced disease. This pattern may also apply to OSSN, where lower educational attainment could correlate with higher risk due to less awareness and preventive measures.[24] These factors include socio-economic disadvantages that limit access to health education and protective measures, such as UV protection.[25] The analysis of BMI showing most participants categorized as normal weight. However, the control group has a higher percentage of overweight respondents (29.6%) compared to the cases (23.5%).

The primary results of this research elucidate the significant physical and mental burdens associated with OSSN, demonstrating a detrimental impact on HRQoL. Approximately half of the patients with OSSN experienced low PHC scores was 48.1% in OSSN group. Odds ratios adjusted for age and gender indicated that individuals with OSSN possess a 2.68 times higher likelihood of low PHC and a 2.56 times higher likelihood of low MHC compared to those without the condition.. These results echo findings from various studies highlightingthe psychological burden associated with chronic ophthalmic and dermatologic conditions, which can expose patients to distress and anxiety. [26]

Consequently, there is a clear necessity for healthcare providers to adopt a holistic treatment methodology that considers both physical and mental health dimensions in the management of OSSN.

The stratified analysis revealedsignificant variations in HRQoL based on age and gender. Patients under the age of 50 reported a prevalence of low PHC scores at 54.0%, while those in the 50–59 age group, reached 63.1%. These results suggest that younger individuals may be disproportionately affected by the health impacts of OSSN, necessitating designed interventions that target this vulnerable demographic. Furthermore, the data showed a pronounced association between low HRQoL and male patients was observed (54.6% for low PHC). This gender disparity reinforces the relevance of implementing gender-sensitive health strategies to meet the unique challenges of male patients with conjunctival tumors, including malignancies, including squamous cell carcinoma (SCC) and conjunctival melanoma.[27]

Comprehensive evaluation using SF-36 questionnaire shows that patients with OSSN consistently report inferior scores across all eight domains compared to healthy controls. The stark differences in mean PHC (49.9±13.9 vs. 78.6±9.3) and MHC scores (43.0±14.0 vs. 70.4±11.9) illustratethe extensive toll that OSSN exerts on physical and emotional well-being. Chronic conditions, such as eye cancer, do not only hinder physical capabilities but also

contribute to increased psychological distress. In this regard, a cycle that can diminish social interaction and QoL is created.[28] The relationship between chronic disease and mental health is critical, suggesting that interventions must address both physical and psychological aspects to improve patient outcomes.

The interplay of confounding factors, including dermatological comorbidities, systemic diseases, and environmental factors like smoking and alcohol consumption, further complicates the clinical picture.[29] Addressing these variables is essential for accurately assessing the impact of OSSN on HRQoL and designing effective preventive strategies.

This research has limitations, including a potentially skewed sample that may affect perspectives on occupational impacts.[30] While educational levels were similar between groups, the results may not be generalizable to all populations or different ocular conditions. Additionally, the cross-sectional nature of the HRQoL assessment limits the ability to draw longitudinal conclusions.

In conclusion, OSSN imposes significant physical and mental burdens on HRQoL, with about half of patients reporting low PHC and MHC scores. Younger patients and males appear to be disproportionately affected, indicating a need for targeted interventions. Increased awareness of the psychosocial implications of OSSN can guide integrated care models that balances physical treatment with mental health support, such as counseling, support groups, and rehabilitation programs. Public health initiatives promoting awareness of OSSN risk factors, and the importance of early detection are crucial for mitigating the impact of the disease on patient quality of life.

References

1. Nayak S. A Rare Case of bilateral ocular surface squamous neoplasia in an immunocompetent patient. J Clinical Ophthalmol Res. 2022;2(2):219–21. doi:10.52768/2833-5465/1060
2. Höllhumer R, Michelow P, Williams S. Demographics, clinical presentation and risk factors of ocular surface squamous neoplasia at a tertiary hospital, South Africa. Eye (Basingstoke). 2023;37(17):3602–8. doi:10.1038/s41433-023-02565-1
3. Hollhumer R, Williams S, Michelow P. Ocular surface squamous neoplasia: Population demographics, pathogenesis and risk factors. African Vision and Eye Health. 2020;79(1):1–8. doi:10.4102/aveh.v79i1.553
4. Meide EVH, Ferguson TJ, Karp CL, Lum F, Terveen DC. US Incidence and Demographics of Ocular Surface Squamous Neoplasia in the IRIS® Registry 2014–2021. Ophthalmology. 2025;132(9):988–94. doi:10.1016/j.ophtha.2025.04.014
5. Flor-Alemany M, Sandborg J, Migueles JH, Söderström E, Henström M, Marín-Jiménez N, et al. Mediterranean diet adherence and health-related quality of life during pregnancy: Is the mediterranean diet beneficial in non-mediterranean countries?. Nutrients. 2024;16(5):1–11. doi:10.3390/nu16050718
6. Philip KEJ, Buttery SC, Bowen S, Lewis A, Jeffery E, Alghamdi SM, et al. Singing for lung health in COPD: a multicentre randomised controlled trial of online delivery. BMJ Open Respiratory Research. 2024;11(1):1–12. doi:10.1136/bmjresp-2024-002365
7. Lins-Kusterer L, Aguiar I, Santos-Lins LS, Lins-Rocha M, Aguiar CVN, Menezes MS, et al. Validation of the RAND 36-item health survey questionnaire in Brazil. Arquivos de Gastroenterologia. 2022;59(2):193–97. doi:10.1590/s0004-2803.202202000-36
8. Wratsangka R, Putri RANH. The importance of anemia and health-related quality of life in the elderly. Universa Medicina. 2020;39(2):135–49. doi:10.18051/univmed.2020.v39.135-149
9. Clinton SK, Giovannucci EL, Hursting SD. The world cancer research fund/American institute for cancer research third expert report on diet, nutrition, physical activity, and cancer: Impact and future directions. Journal of Nutrition. 2020;150(4):663–71. doi:10.1093/jn/nxz268
10. Höllhumer R, Michelow P, Williams S. Comparison of non-invasive diagnostic modalities for ocular surface squamous neoplasia at a tertiary hospital, South Africa. Eye (Basingstoke). 2024;38(6):1118–24. doi:10.1038/s41433-023-02833-0
11. Zhang KY, Aurit S, Silberstein P. Racial and socioeconomic disparities in ocular surface squamous neoplasia: a National Cancer Database analysis. Ophthalmic Epidemiol. 2022;29(3):319–27. doi:10.1080/09286586.2021.1925307
12. Nakai H, Ueda K, Kitazawa K, Fukuoka H, Inatomi T, Yokoi N, et al. Excision combined with ocular surface reconstruction followed

by topical chemotherapy for ocular surface squamous neoplasia. Japanese J Ophthalmol. 2024;68(10):731–40. doi:10.1007/s10384-024-01111-0
13. Mercado CL, Pole C, Wong J, Batlle JF, Roque F, Shaikh N, et al. Surgical versus medical treatment for ocular surface squamous neoplasia: a quality of life comparison. The Ocular Surface. 2019;17(1):60–3. doi:10.1016/j.jtos.2018.09.001
14. Mcclellan AJ, Mcclellan AL, Pezon CF, Carol L, Feuer W, Galor A, et al. Veterans affairs population. Cornea. 2015;32(10):1354–8. doi:10.1097/ICO.0b013e31829e3c80.The
15. Onunkwor OF, Al-Dubai SAR, George PP, Arokiasamy J, Yadav H, Barua A, et al. A cross-sectional study on quality of life among the elderly in non-governmental organizations' elderly homes in Kuala Lumpur. Health Qual Life Outcomes. 2016;14(1):1–10. doi:10.1186/s12955-016-0408-8
16. Mishra DK, Taneja S, Singh V, Veena U, Kaliki S. Histopathological spectrum of ocular surface squamous neoplasia: A retrospective study of 776 lesions. Indian J Pathology Microbiol. 2022;65(1):3–7. doi:10.4103/IJPM.IJPM_1313_20
17. Morthen MK, Magno MS, Utheim TP, Snieder H, Hammond CJ, Vehof J. The physical and mental burden of dry eye disease: a large population-based study investigating the relationship with health-related quality of life and its determinants. The Ocular Surface. 2021;21(4):107–17. doi:10.1016/j.jtos.2021.05.006
18. Indrakila S, Soewoto W, Purnomo J, Malindha E, Prastawa RP. Reliability and construct validity of the short form 36 questionnaire for conjunctival tumor patients in Indonesia. Indonesian J Cancer. 2025;19(3):372–80. doi:10.33371/ijoc.v19i3.1320
19. Gleber-Netto FO, Nagarajan P, Sagiv O, Pickering CR, Gross N, Ning J, et al. Histologic and genomic analysis of conjunctival SCC in African and American Cohorts Reveal UV Light and HPV signatures and high tumor mutation burden. Invest Ophthalmol Vis Sci. 2024;65(4):24. doi:10.1167/iovs.65.4.24
20. Yang Y, Bachour K, Tong M, Khair D, Gaffar J, Robert MC, et al. Incidence of ocular surface squamous neoplasia in pterygium specimens. Canadian J Ophthalmology. 2024;59(2):79–82. doi:10.1016/j.jcjo.2022.12.004
21. Costache DO, Bejan H, Poenaru M, Costache RS. Skin cancer correlations in psoriatic patients. cancers. 2023;15(9):1–13. doi:10.3390/cancers15092451
22. Schmitt J, Haufe E, Trautmann F, Schulze HJ, Elsner P, Drexler H, et al. Is ultraviolet exposure acquired at work the most important risk factor for cutaneous squamous cell carcinoma? Results of the population-based case-control study FB-181. British J Dermatol. 2018;178(2):e161–e161. doi:10.1111/bjd.16286
23. Suleiman DE, Liman AA, Waziri GD, Iliyasu Y, Ahmed SA. Clinicopathological characteristics of ocular surface squamous neoplasia: a 10-year review form a referral tertiary centre in Nigeria. International Ophthalmology. 2022;42(12):3905–11. doi:10.1007/s10792-022-02411-5
24. Wernly S, Semmler G, Schaffler-Schaden D, Flamm M, Aigner E, Datz C, et al. The association between educational status and colorectal neoplasia: results from a screening cohort. International J Colorectal Disease. 2023;38(1):1–6. doi:10.1007/s00384-023-04383-z
25. Hossain RR, Oh JA, McLintock C, Murphy C, McKelvie J. Ocular surface squamous neoplasia: a 12-Month prospective evaluation of incidence in Waikato, New Zealand. Vision. 2022;6(3):10–5. doi:10.3390/vision6030050
26. Magalhães AM, Vieira RP, Fernandes TJ de M, Rocha C da S, Higino T, Ventura C V, et al. Analysis of ocular surface and quality of life in patients with corneal and conjunctival tumors. Arquivos Brasileiros de Oftalmologia. 2022;86(2):131–6. doi:10.5935/0004-2749.20230036
27. Mirzayev I, Gündüz AK, Gündüz ÖÖ, Özalp Ateş FS, Nalcı Baytaroğlu H. Demographic and clinical features of conjunctival tumours at a tertiary care centre. Clin Exp Optom. 2022;105(7):708–14. doi:10.1080/08164622.2021.1971048
28. Huang Y, Guo Y. Quality of life among people with eye cancer: a systematic review from 2012 to 2022. Health Qual Life Outcomes. 2024;22(1):1–13. doi:10.1186/s12955-023-02219-6
29. Kounatidou NE, Vitkos E, Palioura S. Ocular surface squamous neoplasia: Update on genetics, epigenetics and opportunities for targeted therapy. The Ocular Surface. 2025;35(11):1–14. doi:10.1016/j.jtos.2024.11.006
30. Alkandi IG, Khan MA, Fallatah M, Alabdulhadi A, Alanizan S, Alharbi J. The impact of incentive and reward systems on employee

performance in the saudi primary, secondary, and tertiary industrial sectors: a mediating influence of employee job satisfaction. Sustainability (Switzerland). 2023;15(4):1–22. doi:10.3390/su15043415