Research Article

Vision-Related Quality of Life in Keratoconus: A KORQ-Based Cross-Sectional Study

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Abstract

Background: Keratoconus is a progressive corneal ectatic disorder that leads to irregular astigmatism, higher-order aberrations, and significant visual disturbances. Although clinical management focuses on corneal stability and visual acuity, these measures often fail to capture the functional and symptomatic burden experienced by patients in daily life. Disease-specific patient-reported outcome measures are therefore essential for comprehensive assessment of vision-related quality of life in keratoconus.

Aim: To evaluate the impact of keratoconus on vision-related quality of life using the Keratoconus Outcomes Research Questionnaire (KORQ) and to analyse the association of quality-of-life outcomes with demographic and functional variables.

Methods: A cross-sectional observational study was conducted among patients diagnosed with keratoconus attending a tertiary eye care centre. Vision-related quality of life was assessed using the KORQ, which includes Activity Limitation and Symptoms domains. Demographic data, including age, gender, and occupational status, were collected. Data were analysed using Jamovi statistical software. Descriptive statistics, independent samples tests, correlation analysis, and one-way analysis of variance were employed as appropriate, with statistical significance set at $p < 0.05$. As sensitivity analyses, non-parametric equivalents (Mann–Whitney U test, Spearman's correlation, Kruskal–Wallis test) were additionally applied given non-normality of activity limitation scores, and multivariate linear regression was performed to identify independent predictors of activity limitation while adjusting for age, gender, and occupation. Internal consistency of the KORQ domains was assessed using Cronbach's alpha.

Results: A total of 164 participants were included in the analysis. No statistically significant gender-based differences were observed in activity limitation or symptom scores. Age demonstrated a moderate positive correlation with activity limitation and a weaker but significant association with symptom severity. A significant positive relationship was observed between symptom burden and activity limitation. Occupational differences in activity limitation were statistically significant on non-parametric testing (Kruskal–Wallis, $p = 0.001$). However, multivariate regression adjusting for age and gender showed that occupation was not an independent predictor of activity limitation, whereas age remained significantly and independently associated with activity limitation ($p < 0.001$); this indicates the univariate occupational effect was substantially confounded by age, as students (the largest occupational group) were considerably younger than other groups. Symptom scores remained comparable across occupational groups.

Conclusion: Keratoconus significantly affects vision-related quality of life, primarily through functional limitations and symptom burden. Age was independently associated with greater functional impairment, whereas the apparent occupational effect appeared largely attributable to age differences between occupational groups rather than occupation itself; gender did not appear to be a major determinant. Given the cross-sectional design, these associations should not be interpreted as causal. The findings support the routine use of disease-specific quality-of-life measures, such as the KORQ, to complement clinical assessment and guide patient-centred keratoconus management.

Keywords: Keratoconus; Quality of life; KORQ; Activity limitation; Visual symptoms; Patient-reported outcomes.

1. Introduction

Keratoconus (KC) is a progressive, non-inflammatory corneal ectatic disorder characterized by localized stromal thinning and anterior protrusion of the cornea, resulting in irregular astigmatism, myopia, and higher-order optical aberrations.[1] The disease typically manifests during adolescence or early adulthood and may progress over several decades, coinciding with critical phases of educational attainment, occupational development, and social integration.[2] Owing to its chronic and progressive nature, keratoconus represents not only a clinical challenge but also a substantial functional and psychosocial burden for affected individuals.[3] From a visual optics perspective, keratoconus produces complex distortions that extend beyond simple reductions in visual acuity.[4] Patients

frequently experience symptoms such as monocular diplopia, ghosting of images, glare, halos, reduced contrast sensitivity, and fluctuating vision, particularly under low-illumination conditions.[5] These visual disturbances are primarily driven by irregular astigmatism and higher-order aberrations, notably vertical coma, which are inadequately captured by conventional high-contrast visual acuity testing.[6] Consequently, patients with apparently acceptable best-corrected visual acuity may continue to report significant visual dissatisfaction and functional impairment, a phenomenon often described in clinical practice as the "20/20 unhappy patient."[7] Advances in diagnostic modalities, including corneal topography and tomography, have improved early detection and monitoring of keratoconus progression.[8] Similarly, therapeutic interventions such as corneal collagen cross-linking, specialty contact lenses, intracorneal ring segments, and keratoplasty have expanded the management options available to clinicians.[9] While these interventions aim to stabilize the cornea or improve optical quality, their success is traditionally evaluated using objective clinical parameters such as keratometric indices, corneal thickness, and visual acuity.[10] However, these measures do not adequately reflect the patient's lived experience of the disease or the functional limitations encountered in daily life. In recent years, there has been a growing emphasis on patient-centred care in ophthalmology, recognizing that objective clinical outcomes alone are insufficient to fully characterize disease impact.[11] Patient-reported outcome measures (PROMs) have therefore emerged as essential tools for assessing the subjective consequences of visual disorders.[12] PROMs capture the patient's perception of functional ability, symptom burden, and visual comfort, thereby complementing clinical measurements and providing a more holistic assessment of treatment outcomes.[13] This shift is particularly relevant in keratoconus, where the discrepancy between clinical findings and patient-perceived disability is well documented.[14]

Generic vision-related quality of life instruments, such as commonly used visual function questionnaires, have been applied to keratoconus populations; however, they suffer from important limitations.[15] These tools were largely developed for age-related or generalized ocular conditions and often lack items addressing keratoconus-specific visual phenomena, including image distortion, glare sensitivity, and fluctuating vision.[16] As a result, ceiling effects are frequently observed, limiting their sensitivity in detecting functional impairment in mild to moderate disease and reducing their utility in monitoring disease progression or treatment response. To address these limitations, disease-specific instruments have been developed, among which the Keratoconus Outcomes Research Questionnaire (KORQ) is the most widely validated and clinically relevant. The KORQ was developed using rigorous qualitative methods and psychometric testing based on Rasch analysis, ensuring that the instrument provides interval-level measurement rather than simple ordinal scoring.[17] It comprises two distinct domains: Activity Limitation, which assesses difficulty in performing vision-dependent daily tasks, and Symptoms, which evaluates the frequency and severity of visual and ocular discomfort associated with keratoconus. By targeting the unique functional and symptomatic profile of keratoconus, the KORQ offers superior sensitivity and construct validity compared with generic questionnaires. Multiple validation studies across diverse populations have demonstrated that the KORQ exhibits high reliability, internal consistency, and construct validity. Importantly, KORQ scores have been shown to correlate more strongly with functional visual measures and real-world performance than with corneal topographic indices alone. This highlights a critical insight: the impact of keratoconus on quality of life is mediated not merely by corneal shape or disease stage, but by the success of visual rehabilitation and the individual's ability to perform daily activities comfortably and efficiently.

Despite its established psychometric robustness, there remains a relative paucity of data examining the quality-of-life impact of keratoconus in routine clinical settings.[18] Data on this topic specific to the Indian population remain particularly limited [AUTHOR: please cite a supporting India-specific reference here, if available]. Sociodemographic factors, occupational demands, access to advanced contact lens modalities, and environmental conditions may significantly influence how patients experience and adapt to keratoconus. Understanding these factors is essential for tailoring management strategies, optimizing patient counselling, and evaluating the real-world effectiveness of current treatment approaches. Therefore, the present study aims to evaluate the impact of keratoconus on patients' quality of life using the Keratoconus Outcomes Research Questionnaire (KORQ). By analysing activity limitation and symptom burden in individuals diagnosed with keratoconus, this study seeks to provide a patient-centred perspective on disease impact and to identify key factors associated with reduced vision-related quality of life. Such insights are expected to inform clinical decision-making, enhance outcome assessment, and reinforce the

importance of incorporating PROMs into the routine management of keratoconus.

2. Methodology

This study employed a hospital-based cross-sectional observational design to assess the impact of keratoconus on vision-related quality of life among affected individuals. The research was conducted in a tertiary eye care and optometry clinical setting, where patients diagnosed with keratoconus routinely present for visual assessment and rehabilitation. Ethical approval for the study was obtained from the Institutional Ethics Committee, and all procedures adhered to the tenets of the Declaration of Helsinki. Prior to participation, all eligible subjects were informed about the purpose and nature of the study, and written informed consent was obtained. Participants were recruited using a consecutive sampling method and included individuals aged 18 years and above with a confirmed clinical diagnosis of keratoconus based on corneal topography or tomography findings. Patients using spectacles or contact lenses for visual correction were eligible for inclusion. Individuals with a history of ocular conditions other than keratoconus that could independently influence visual function, such as advanced cataract, glaucoma, retinal disorders, or neurological conditions affecting vision, were excluded from the study. Patients with incomplete questionnaire responses or those unwilling to participate were also excluded from the final analysis. Vision-related quality of life was assessed using the Keratoconus Outcomes Research Questionnaire (KORQ), a disease-specific, patient-reported outcome measure developed to capture the unique functional limitations and symptom burden associated with keratoconus. The questionnaire comprises two domains, namely activity limitation and symptoms, and responses are recorded on a Likert-type scale, with higher scores indicating greater perceived difficulty or symptom severity. In addition to the KORQ, demographic and clinical information was collected using a structured data collection form, including age, gender, duration since diagnosis of keratoconus, type of visual correction used, duration of contact lens use, average daily wearing time, and source of prescription. The questionnaire was administered either through supervised self-completion or interviewer assistance to ensure clarity and completeness of responses. Participants were instructed to respond based on their typical visual experience during daily activities rather than isolated clinical circumstances. Completed questionnaires were reviewed for completeness prior to data entry.

All collected data were entered into Microsoft Excel and analysed using Jamovi statistical software. Descriptive statistics were used to summarize demographic and clinical characteristics, with continuous variables expressed as mean and standard deviation and categorical variables presented as frequencies and percentages. Linear regression analysis was performed to identify factors associated with quality-of-life outcomes, with total KORQ scores serving as the dependent variable. Independent variables included duration of contact lens use, daily wearing time, and source of prescription. Model fit was evaluated using the coefficient of determination, and statistical significance was set at a p-value of less than 0.05.

To account for the non-normal distribution of activity limitation scores, non-parametric equivalents (Mann–Whitney U test, Spearman's rank correlation, Kruskal–Wallis test) were additionally performed as sensitivity analyses. Multivariable linear regression was used to identify independent predictors of activity limitation scores, with age, gender, and occupation entered as covariates. Internal consistency of the KORQ Activity Limitation and Symptoms domains was evaluated using Cronbach's alpha. For scoring, each KORQ item response (not at all, a little, quite a bit, a lot) was coded numerically from 1 to 4; items marked "not applicable" were treated as missing and excluded from that participant's domain mean, which was calculated as the average of all completed items within the domain. Free-text occupation entries were independently reviewed and grouped into seven categories (Student, Homemaker, Businessman, Private service, Government service, Teaching, Healthcare professional); entries that could not be reliably classified (e.g., numeric entries suggestive of data-entry error, n = 3) were excluded from occupation-based analyses. Formal keratoconus severity staging (e.g., Amsler–Krumeich or ABCD classification) was not performed in this cohort and could therefore not be included as a covariate; this is addressed further in the Limitations section.

3. Results

A total of 164 participants diagnosed with keratoconus were included in the final analysis, comprising 80 females (48.8%) and 84 males (51.2%), indicating an almost equal gender distribution within the study population. The mean age of female participants was 30.7 ± 10.2 years, while male participants had a mean age of 32.0 ± 10.6 years. Age ranged from 13 to 56 years among females and from 10 to 56 years among males. Shapiro–Wilk testing indicated a deviation from normality for age distribution (W = 0.976, p = 0.007); however, the large and comparable group sizes supported further parametric analysis. The mean symptoms score, as measured using the Keratoconus Outcomes Research Questionnaire, was 2.64 ± 0.49 for females and 2.57 ± 0.41 for males. Median values were 2.62 for females and 2.55 for males, with symptom scores ranging from 1.73 to 3.83 in females and from 1.64 to 3.63 in males. Shapiro–Wilk analysis demonstrated that symptom scores followed an approximately normal distribution in both females (p = 0.344) and males (p = 0.736). As activity limitation scores were non-normally distributed, they are more appropriately summarised by median (IQR): 2.59 (IQR 1.94–2.82) for females and 2.44 (IQR 1.76–2.73) for males. For comparison with parametric analyses reported below, the mean ± SD was 2.40 ± 0.62 for females and 2.27 ± 0.61 for males. Activity limitation scores ranged from 1.13 to 3.44 in females and from 1.00 to 3.28 in males. In contrast to symptom scores, activity limitation scores showed significant deviation from normality in both females (p < 0.001) and males (p = 0.001), indicating greater variability and skewness in functional limitation outcomes. Gender-wise occupational distribution revealed notable variation across occupational categories. Students constituted a comparable proportion of females (n = 27) and males (n = 26). Homemakers were predominantly female (n = 25), with limited male representation (n = 5). The businessman category was largely male-dominated, comprising 30 males and only 5 females. Participants engaged in private service included 21 males and 15 females. Government service and teaching professions accounted for smaller proportions of the sample, with slightly higher male representation in both categories. Healthcare professionals were exclusively female in the present study (n = 5). This distribution reflected a non-uniform occupational profile across genders within the study population.

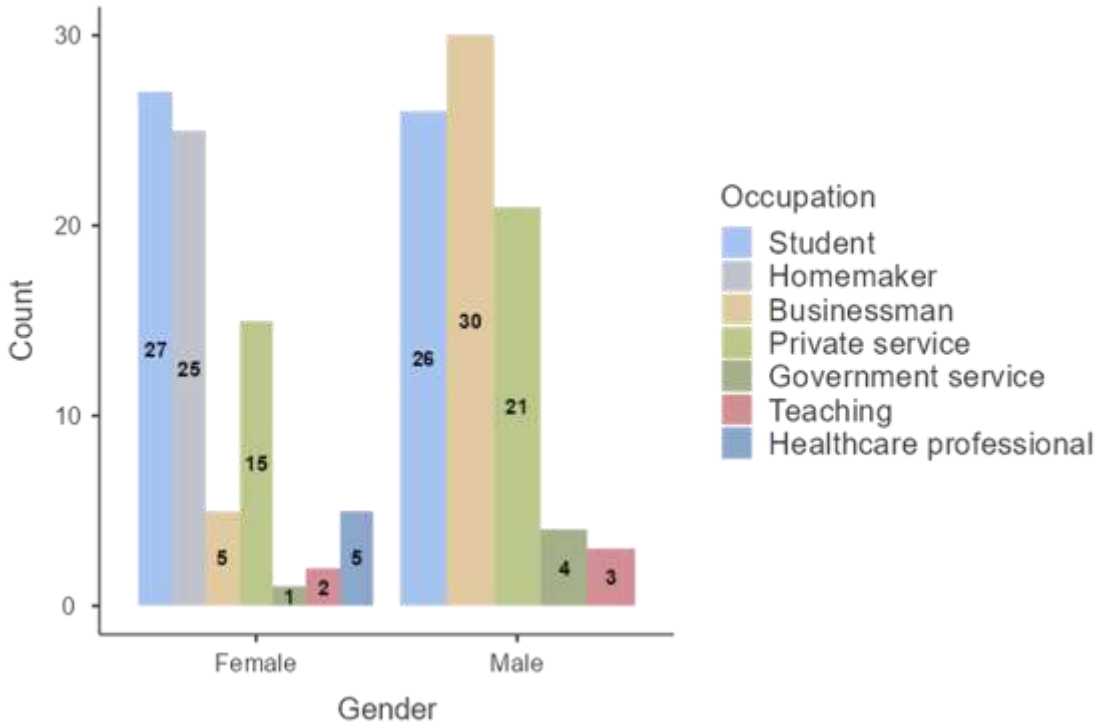

Figure 1: Gender-wise distribution of occupations among participants with keratoconus

An independent samples t-test was conducted to compare age between female and male participants. No statistically significant difference was observed between the two groups (t(162) = −0.845, p = 0.399). The mean difference was −1.37 years with a standard error of 1.62. The effect size was small (Cohen's d = −0.13), indicating a negligible practical difference in age between genders.

Table 1: Comparison of Age Between Female and Male Participants Using Independent Samples t-Test								
		Statistic	**df**	**p**	**Mean difference**	**SE difference**		**Effect Size**
Age	**Student's t**	-0.845	162	0.399	-1.37	1.62	Cohen's d	-0.132
Note. H_a $\mu_{Female} \neq \mu_{Male}$								

Comparison of mean symptoms scores between genders using an independent samples t-test demonstrated no statistically significant difference between females and males (t(162) = 0.90, p = 0.369). The mean difference was 0.06 with a standard error of 0.07, indicating comparable symptom severity across genders.

Table 2: Comparison of Mean Symptoms Score Between Female and Male Participants						
		Statistic	**df**	**p**	**Mean difference**	**SE difference**
Mean Symptoms score	**Student's t**	0.9	162	0.369	0.0633	0.0703
Note. H_a $\mu_{Female} \neq \mu_{Male}$						

Similarly, comparison of mean activity limitation scores between genders revealed no statistically significant difference (t(162) = 1.27, p = 0.207). The mean difference was 0.12 with a standard error of 0.10, indicating comparable levels of activity limitation among female and male participants.

Table 3: Comparison of Mean Activity Limitation Scores Between Female and Male Participants						
		Statistic	**df**	**p**	**Mean difference**	**SE difference**
Mean Activity Limitation score	**Student's t**	1.27	162	0.207	0.122	0.0959
Note. H_a $\mu_{Female} \neq \mu_{Male}$						

Pearson's correlation analysis was performed to examine the relationships among age, mean activity limitation score, and mean symptoms score. A moderate positive correlation was observed between age and mean activity limitation score (r = 0.418, p < 0.001), indicating that higher age was associated with greater activity limitation. A

weak but statistically significant positive correlation was also observed between age and mean symptoms score (r = 0.211, p = 0.007), suggesting an increase in symptom severity with advancing age. Additionally, mean activity limitation score demonstrated a moderate positive correlation with mean symptoms score (r = 0.515, p < 0.001), indicating that greater symptom burden was associated with higher levels of functional limitation.

Table 4: Pearson's Correlation Matrix Showing Relationships Between Age, Activity Limitation, and Symptoms Scores

		Age	Mean Activity Limitation score	Mean Symptoms score
Age	**Pearson's r**	—		
	df	—		
	p-value	—		
Mean Activity Limitation score	**Pearson's r**	0.418	—	
	df	162	—	
	p-value	<.001	—	
Mean Symptoms score	**Pearson's r**	0.211	0.515	—
	df	162	162	—
	p-value	0.007	<.001	—

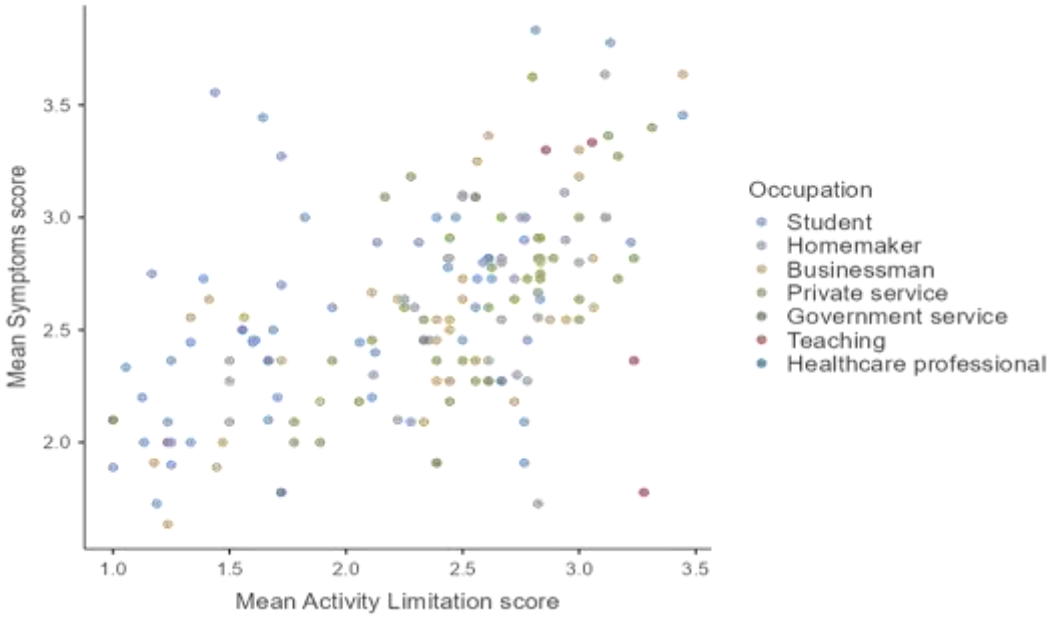

Figure 2: Scatter plot showing the relationship between mean activity limitation score and mean symptoms score across occupational groups in keratoconus patients

Differences in mean activity limitation and mean symptoms scores across occupational groups were analysed using Welch's one-way analysis of variance due to violations of normality and heterogeneity of variances. A borderline statistically significant difference was observed in mean activity limitation scores across occupational categories (Welch's $F(6, 21.1) = 2.57$, $p = 0.050$). Descriptively, higher mean activity limitation scores were observed among homemakers and participants engaged in private service, whereas students and healthcare professionals demonstrated lower mean scores. In contrast, no statistically significant difference was observed in mean symptoms scores across occupational groups (Welch's $F(6, 20.4) = 0.90$, $p = 0.514$), indicating relatively uniform symptom severity irrespective of occupation.

Cronbach's alpha indicated good-to-excellent internal consistency for both KORQ domains (Activity Limitation, $\alpha = 0.91$; Symptoms, $\alpha = 0.76$). As a sensitivity check on the parametric analyses above, non-parametric tests were performed given the non-normal distribution of activity limitation scores. Mann–Whitney U tests confirmed no significant gender difference in age, symptoms, or activity limitation (rank-biserial $r = 0.10$, -0.08, and -0.14 respectively; all $p > 0.11$), consistent with the t-test results. Spearman's correlations were consistent in direction and significance with the Pearson correlations reported above: age–activity limitation ($\rho = 0.435$, 95% CI 0.302–0.552, $p < 0.001$), age–symptoms ($\rho = 0.230$, 95% CI 0.079–0.370, $p = 0.003$), and activity limitation–symptoms ($\rho = 0.525$, 95% CI 0.404–0.627, $p < 0.001$). A Kruskal–Wallis test across occupational groups showed a statistically significant difference in activity limitation scores ($H = 22.07$, $p = 0.001$, $\varepsilon^2 = 0.10$, a small-to-moderate effect), a stronger result than the borderline Welch's ANOVA finding above; no significant difference was found for symptom scores ($H = 3.71$, $p = 0.715$, $\varepsilon^2 = -0.02$), consistent with the parametric result. To determine whether occupation was an independent predictor of activity limitation or reflected confounding by age, a multivariable linear regression was performed with activity limitation as the outcome and age, gender, and occupation (reference category: Student) as predictors ($n = 161$; $R^2 = 0.21$, adjusted $R^2 = 0.17$). Age remained a significant independent predictor ($\beta = 0.023$, 95% CI 0.011–0.035, $p < 0.001$), whereas none of the occupation categories reached significance after adjustment (all $p > 0.08$). This was consistent with the marked age difference across occupational groups (mean age 20.8 years for students versus 36–39 years for all other occupational categories), indicating that the univariate occupational association with activity limitation was substantially confounded by age rather than reflecting an independent effect of occupation.

Table 5: Multivariable Linear Regression Predicting Activity Limitation Score ($n = 161$; $R^2 = 0.21$, adjusted $R^2 = 0.17$; reference category for Occupation: Student)

Predictor	β	SE	95% CI	p
Intercept	1.499	0.166	1.171 to 1.827	<0.001
Age (years)	0.023	0.006	0.011 to 0.036	<0.001
Gender: Female (ref. Male)	0.187	0.108	−0.027 to 0.401	0.086
Occupation: Businessman	−0.011	0.161	−0.329 to 0.307	0.946
Occupation: Government service	−0.056	0.264	−0.578 to 0.465	0.831
Occupation: Healthcare professional	−0.302	0.276	−0.846 to 0.243	0.275
Occupation: Homemaker	0.013	0.184	−0.351 to 0.376	0.946
Occupation: Private service	0.165	0.159	−0.149 to 0.478	0.301
Occupation: Teaching	0.284	0.289	−0.287 to 0.854	0.327

β, unstandardised regression coefficient; SE, standard error; CI, confidence interval.

Overall, gender did not significantly influence age, symptom severity, or activity limitation. Age was independently associated with activity limitation even after adjustment for gender and occupation, whereas the univariate association between occupation and activity limitation appeared to be substantially confounded by age rather than an independent effect. Symptom severity and activity limitation remained significantly interrelated within the study population.

4. Discussion

The present study evaluated the impact of keratoconus on vision-related quality of life using the Keratoconus Outcomes Research Questionnaire, with particular emphasis on activity limitation and symptom burden across demographic and occupational variables. The findings demonstrate that keratoconus imposes a substantial functional and symptomatic burden on affected individuals, despite the absence of significant gender-based differences in overall quality-of-life scores. These results reinforce the concept that keratoconus-related disability is driven more by functional visual demands and disease chronicity than by demographic characteristics alone.

In the current cohort, no statistically significant differences were observed between male and female participants in either activity limitation or symptom scores. This finding is consistent with several validation and registry-based studies that report comparable functional impairment across genders when disease severity and correction status are similar. Although some international studies have reported higher symptom burden among female patients, particularly in relation to ocular discomfort and dry eye symptoms, the absence of such differences in the present study suggests that gender alone may not be a dominant determinant of vision-related quality of life in keratoconus. Instead, it is likely that optical quality and functional adaptation play a more central role in shaping patient-reported outcomes. Age demonstrated a significant positive correlation with activity limitation scores and a weaker but significant association with symptom scores, indicating that increasing age is associated with greater functional difficulty and symptom perception. This relationship may reflect cumulative disease burden, longer exposure to visual distortion, and age-related reductions in visual adaptability. Additionally, older individuals may experience compounding visual challenges such as reduced contrast sensitivity and early presbyopic changes, which can further exacerbate task-related difficulties in keratoconus. These findings align with previous literature suggesting that quality-of-life impairment in keratoconus is not solely dependent on corneal shape or severity indices, but rather on how visual disturbances interact with daily functional demands over time.[19] It should be noted that the correlation between symptom burden and activity limitation ($r = 0.515$) was numerically stronger than that between age and activity limitation ($r = 0.418$); as this study is cross-sectional, none of these correlations should be interpreted as evidence of a causal relationship. The moderate positive correlation observed between symptom scores and activity limitation scores highlights the interdependence between visual discomfort and functional ability. Patients experiencing greater glare, ghosting, ocular pain, or visual fatigue were more likely to report difficulty in performing everyday activities such as reading, screen use, or navigating in low-illumination environments. This relationship underscores the limitation of relying exclusively on high-contrast visual acuity as a marker of disease impact, as many keratoconus-related symptoms arise from higher-order aberrations and contrast loss rather than reduced Snellen acuity. The findings support the growing consensus that patient-reported outcome measures are essential for capturing the full burden of keratoconus, particularly in patients who may appear clinically stable yet experience significant visual dissatisfaction. On univariate analysis (Welch's ANOVA and the more conservative Kruskal–Wallis test), activity limitation scores differed significantly across occupational groups, with homemakers and participants in private service reporting higher scores than students and healthcare professionals. However, when age was accounted for in multivariable regression, occupation no longer significantly predicted activity limitation, whereas age remained an independent predictor. This is consistent with the marked age imbalance across occupational categories in this cohort (students, the largest group, were on average 15–18 years younger than participants in other occupations), and suggests that the apparent occupational differences largely reflect age rather than an independent effect of occupation-specific visual demands. Proposed mechanisms such as differential exposure to near work, variable lighting, or outdoor glare remain plausible but were not directly measured in this study and should be regarded as hypotheses for future research rather than established explanations. The absence of significant

occupational differences in symptom scores similarly suggests that symptom perception is more closely tied to disease characteristics than to occupational context.

Importantly, the findings of this study reinforce the conceptual framework that keratoconus-related quality of life is mediated by functional visual performance rather than by isolated clinical metrics. As highlighted in prior research, topographic severity and keratometric indices often demonstrate weak or inconsistent correlations with quality-of-life measures, whereas patient-centred assessments such as the KORQ provide a more accurate reflection of real-world disability. The present results are consistent with this paradigm, demonstrating that activity limitation and symptom burden vary independently of gender and are more strongly influenced by age, functional interaction between symptoms and tasks, and occupational context. From a clinical perspective, these findings emphasize the importance of integrating quality-of-life assessment into routine keratoconus management. Identification of patients with high activity limitation or symptom scores can guide individualized interventions, such as optimization of contact lens design, enhanced management of ocular surface disease, or targeted counselling regarding visual expectations. Furthermore, the use of disease-specific instruments such as the KORQ allows clinicians to detect the "functionally dissatisfied" patient who may otherwise be overlooked when relying solely on conventional clinical measures. Overall, the present study adds to the growing body of evidence supporting the use of keratoconus-specific patient-reported outcome measures to complement objective clinical assessment. By demonstrating meaningful associations between age, occupational factors, symptoms, and functional limitation, this study highlights the multifactorial nature of quality-of-life impairment in keratoconus and underscores the need for a holistic, patient-centred approach to disease management.

5. Limitations

This study has several limitations that should be considered when interpreting the findings. First, the cross-sectional design precludes causal inference; the observed associations between age, occupation, symptom burden, and activity limitation should be interpreted as correlational rather than causal. Second, the study was conducted at a single tertiary eye care centre using consecutive sampling, which may limit the generalisability of the findings to the broader keratoconus population and introduces the potential for selection bias. Third, disease severity was not formally staged using a validated classification system (e.g., Amsler–Krumeich or ABCD), and objective clinical measures such as corneal topographic indices, keratometry, or corneal thickness were not incorporated into the analysis; as severity is likely to influence both quality-of-life scores and the variables examined here, residual confounding by unmeasured disease severity cannot be excluded. Fourth, the type and duration of refractive correction (spectacles versus contact lenses) were recorded but not adjusted for as potential confounders. Fifth, the study relied exclusively on self-reported outcomes without corroborating objective visual function measures. Sixth, several occupational subgroups (Government service, Teaching, Healthcare professional) contained small numbers of participants (n = 5–6), limiting statistical power to detect true differences within these categories and the precision of the associated estimates. Finally, while the KORQ is a well-validated disease-specific instrument, this manuscript did not report whether a validated local-language version was administered, and psychometric properties beyond internal consistency were not re-evaluated in this population; future studies should consider formal local validation and adjustment for multiple comparisons across the range of associations tested.

6. Conclusion

This study demonstrates that keratoconus has a significant and measurable impact on vision-related quality of life, affecting both functional ability and symptom perception among affected individuals. Using the Keratoconus Outcomes Research Questionnaire, the present research highlights that activity limitation and symptom burden persist across demographic groups, underscoring the chronic and functionally disabling nature of the disease. The absence of significant gender-based differences suggests that the quality-of-life impact of keratoconus is largely independent of sex and is instead shaped by factors related to disease duration, functional demands, and individual adaptation.Age was independently and positively associated with activity limitation, even after adjustment for gender and occupation, which may reflect cumulative disease burden and longer-term exposure to visual distortion;

given the cross-sectional design, this association should not be interpreted as proof of causation. Additionally, the observed relationship between symptom severity and activity limitation emphasizes that visual discomfort and functional impairment are closely interlinked in keratoconus. These findings reinforce the limitations of relying solely on conventional clinical measures, such as visual acuity or corneal parameters, to evaluate disease impact. Although univariate analysis showed occupational variation in activity limitation, this association did not persist after adjusting for age, indicating that it was substantially confounded by the younger age of the student subgroup rather than reflecting an independent effect of occupational visual demands. This highlights the importance of accounting for age when interpreting occupation-related differences in keratoconus-related disability, and underscores the need for individualized, context-specific management strategies in keratoconus care. Overall, the findings support the routine incorporation of disease-specific patient-reported outcome measures, such as the KORQ, into clinical practice and research. Assessment of vision-related quality of life provides critical insight into patient-perceived disability, facilitates patient-centred decision-making, and enables more comprehensive evaluation of treatment outcomes. Future research with longitudinal designs and larger, diverse populations is warranted to further elucidate changes in quality of life over time and to evaluate the impact of emerging therapeutic interventions on patient-reported outcomes in keratoconus.

References

1. Singh RB, Koh S, Sharma N, Woreta FA, Hafezi F, Dua HS, Jhanji V. Keratoconus. Nature Reviews Disease Primers. 2024 Oct 24;10(1):81.
2. Dua HS, Darren SJ, Al-Aqaba TM, Said DG. Pathophysiology of keratoconus. InKeratoconus 2023 Jan 1 (pp. 51-64). Elsevier.
3. Ferdi AC, Nguyen V, Gore DM, Allan BD, Rozema JJ, Watson SL. Keratoconus natural progression: a systematic review and meta-analysis of 11 529 eyes. Ophthalmology. 2019 Jul 1;126(7):935-45.
4. Vazirani J, Basu S. Keratoconus: current perspectives. Clinical ophthalmology. 2013 Oct 14:2019-30.
5. Ramkissoon P. The effect of tinted lenses on colour discrimination and contrast sensitivity (Doctoral dissertation, University of Johannesburg).
6. Erdinest N, London N, Landau D, Barbara R, Barbara A, Naroo SA. Higher order aberrations in keratoconus. International Ophthalmology. 2024 Apr 10;44(1):172.
7. Ngare GG. A Cross-sectional Analysis of Vision Related Quality of Life in Adult Patients With Keratoconus in Nairobi (Doctoral dissertation, University of Nairobi).
8. Zhang X, Munir SZ, Sami Karim SA, Munir WM. A review of imaging modalities for detecting early keratoconus. Eye. 2021 Jan;35(1):173-87.
9. Espandar L, Meyer J. Keratoconus: overview and update on treatment. Middle East African journal of ophthalmology. 2010 Jan 1;17(1):15-20.
10. Bilen NB, Hepsen IF, Arce CG. Correlation between visual function and refractive, topographic, pachymetric and aberrometric data in eyes with keratoconus. International Journal of Ophthalmology. 2016 Aug 18;9(8):1127.
11. Nkoana PM, Mashige KP, Moodley VR. Strengthening keratoconus management systems in South African public sector facilities. African Vision and Eye Health. 2024;83(1):1-1.
12. Kandel H, Pesudovs K, Nguyen V, Chen JY, Poon A, Mills R, Watson SL. Patient-reported outcomes in keratoconus: a save sight keratoconus registry study. Cornea. 2023 May 1;42(5):590-7.
13. Ferrini E, Aleo D, Posarelli C, Figus M, Miccoli M, Gabbriellini G. Impact of corneal collagen cross-linking on vision-related quality of life measured with the keratoconus outcomes research questionnaire (KORQ) in patients with keratoconus. Contact Lens and Anterior Eye. 2023 Apr 1;46(2):101746.
14. Padmanabhan P, Elsheikh A. Keratoconus: a biomechanical perspective. Current Eye Research. 2023 Feb 1;48(2):121-9.
15. Saunier V, Mercier AE, Gaboriau T, Malet F, Colin J, Fournié P, Malecaze F, Touboul D. Vision-related quality of life and dependency in French keratoconus patients: impact study. Journal of Cataract & Refractive Surgery. 2017 Dec 1;43(12):1582-90.

16. Fan L, Kandel H, Watson SL. Impacts of keratoconus on quality of life: a qualitative study. Eye. 2024 Nov;38(16):3136-44.
17. Fournié P, Acquadro M, Touboul D, Cochener B, Chiambaretta F, Muraine M, Borderie V, Bourges JL, Benmedjahed K, Tugaut B, Bernheim D. Keratoconus and the impact of treatment on patients' quality of life: a qualitative study. Ophthalmology and Therapy. 2023 Aug;12(4):1939-56.
18. Nandzik M, Wylęgała A, Kijonka M, Szkodny D, Markuszewski B, Wylęgała E. Validation of the Polish Version of the Keratoconus Outcomes Research Questionnaire: Tool for Vision-Related Quality of Life in Patients with Keratoconus. Journal of Clinical Medicine. 2025 Apr 24;14(9):2959.
19. Kandel H, Pesudovs K, Watson SL. Measurement of quality of life in keratoconus. Cornea. 2020 Mar 1;39(3):386-93.