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Keratoconus in Northern Tanzania: A hospital-based prevalence and clinical profile study

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Background: Keratoconus (KC), a progressive, corneal, ectatic disease varies in prevalence globally. Differences and similarities in KC prevalence have been observed, and despite clinicians anecdotally reporting many KC cases, no empirical evidence of KC prevalence in Tanzania exists.

Aim: This study aimed to determine the KC prevalence and demographic and clinical profiles of patients attending a tertiary hospital.

Setting: The study was conducted at the Kilimanjaro Christian Medical Centre in Tanzania.

Methods: The study applied a quantitative, retrospective study design whereby identified data were extracted from clinical records of patients aged 12 years – 45 years, presenting with corneal abnormalities, between the years 2016 and 2020. Statistical Package for Social Sciences was used for data analysis.

Results: Of the 140 523 presenting patients, 1089 (0.77%) had corneal abnormalities, among whom KC prevalence was 10.0%. Patients were more likely to be men (odds ratio [OR]:1.5; $P = 0.033$) referred from lower-level clinics (OR:2.4; $P \leq 0.001$) and residing in the Arusha region (OR:1.8; $P = 0.012$). Clinically, KC patients were more likely than non-KC to have vernal keratoconjunctivitis (VKC) (OR:3.8; $P \leq 0.001$) and ocular allergies (OR:1.6; $P = 0.028$); be astigmatic (OR:6.5; $P = 0.001$) and myopic (OR:2.5; $P = 0.001$).

Conclusion: The prevalence of KC among patients with corneal abnormalities is high, with significant predominance in patients with myopia, astigmatism and VKC. Data quality revealed a need for KC clinical guidelines, improved record keeping.

Contribution: First study providing empirical KC data to guide improved patient care planning in Kilimanjaro.

Keywords: keratoconus; corneal abnormalities; autokeratometry; autorefractometry; Tanzania; Kilimanjaro Christian Medical Centre; eye department.

Introduction

Keratoconus (KC), a term originating from the Greek words *Keras* [cornea] and *Konos* [cones], refers to a corneal disorder in which the cornea becomes thinner and bulges forward in a cone-shaped fashion, resulting in high myopia, irregular astigmatism and eventually visual impairment.[1,2] The onset of the disease usually occurs during puberty, while in some cases it may develop in early adulthood and progress until the third to fourth decade of life, when it usually self-arrests. In the early stage of the disease, the patient is typically asymptomatic, after which, visual acuity decreases as the disease progresses, causing the patient to experience visual distortion with significant visual loss, which may also result from corneal scarring.[1]

The reported prevalence of KC varies with geographic location and the criteria used for diagnosis. Globally, in the general population, the prevalence of KC is reported to be in the range of 0.2% – 2.3%,[3] with some countries like Japan, the UK and Russia reporting prevalence figures as low as 1/2000.[4] Higher prevalence of KC among the general population has been reported as four patients per 100 000 in Saudi Arabia, which the authors state may be because of hereditary or associated environmental factors.[5,6] There is a paucity of population-based KC prevalence studies in Africa, with most prevalence studies being hospital-based.[7,8] The few population-based studies have reported a prevalence of 1.7% in Kenya[9] and 0.17% in Egypt.[10]

Differences and similarities in gender distribution and age at diagnosis of KC across different populations and regions have been observed. Keratoconus is confirmed to affect both men and women; however, it still remains unclear whether men or women have a higher global prevalence.[11] Some studies have reported a significant predominance of male KC patients, while others report predominance of female patients, with recent studies demonstrating no significant gender difference.

The disease is more prevalent in younger populations, as shown in studies conducted in Jordan, Iran and India, reporting the majority of patients in the age groups 20–24 years, 20–30 years and 21–30 years,[12] respectively. The mean age of diagnosis of KC patients varies between 19 and 25 years, with studies reporting means of 21.1 (±9.5) in Ghana, 21.03 (±6.17) in Iran, 24.7 (±7.94) in South Africa, 25.9 (±6.9) in Jordan and 19.01 (±6.64) years in India.[13] Possible reasons for the variation could be attributed to the slower progression of changes in the structure of the collagen organisation of the corneal layers in some,[14] unilateral onset and differences in access to early diagnostic eye health services.

It is widely accepted that the aetiology of KC is multifactorial, combining systemic, environmental and genetic factors,[15] and that environmental factors may be essential to trigger the condition in genetically predisposed individuals.[16] Identified environmental factors include ultraviolet (UV) exposure, eye rubbing, geographical location and atopy. Geographical locations with plenty of sunshine and hot weather, such as in India and the Middle East, have a higher prevalence than locations with cooler climates and less sunshine, like Finland, Denmark, Japan and Russia.[17]

Patients with KC generally do not become totally blind but, when uncorrected, the disease can lead to a lifetime of low vision, which imposes physical, emotional, psychosocial and economic implications on the affected individual and society in general,[18] making KC a significant public health concern.[19]

Despite clinicians anecdotally reporting high numbers of KC patients presenting at their respective hospitals, there is currently no empirical information available on the proportion of the population that has KC in Tanzania. In the absence of these data, little attention is given to the condition when eye health care is planned for the country.[20]

Therefore, the purpose of the study was to determine the prevalence as well as the demographic and clinical profiles of KC patients attending a tertiary eye hospital in the northern part of Tanzania, Kilimanjaro.

The Tanzanian health system

The Tanzanian health system is a hierarchical health system, which is in tandem with the political-administrative hierarchy.[21] At the lowest level of health care service delivery are dispensaries and health centres. Whereas dispensaries are found in every village, health centres are found at ward level and provide services to patients referred from the dispensary level.[22] At the secondary level are district hospitals. Most of these hospitals are public (owned by the government), although private hospitals, faith-based organisations (FBO) or non-governmental organisations' (NGO) hospitals may also be the designated district hospitals in a few areas. In each region, there is a regional referral hospital, which offers additional services to those at district level, including specialist services.[23] Tertiary or zonal hospitals offer specialist care at regional or national levels. The national referral hospital has the highest level of inpatient and outpatient services. Additionally, there are also some specialised hospitals that do not fit into this hierarchy and are therefore linked directly to the Ministry of Health.[24]

The Kilimanjaro Christian Medical Centre (KCMC) in the Kilimanjaro region, northern Tanzania, is a prominent referral and consultant hospital, serving a catchment area of over 11 million individuals. As a recognised leading facility in the region for eye care services, KCMC boasts a robust eye department, employing more than 15 ophthalmologists and 8 optometrists.[25] The facility serves as a referral centre for patients requiring specialised medical attention beyond the capabilities of the district and regional referral hospitals. The well-established referral system between KCMC and the surrounding district and regional referral hospitals facilitates the seamless transfer of patients in need of advanced care, ensuring timely access to specialised services and expertise available at KCMC.[26]

Research methods and design

This cross-sectional, retrospective, descriptive study was carried out at KCMC. The average number of patients visiting the eye department is approximately 33 962 per annum (hospital records, 2020). Data were extracted from files of patients who attended the eye clinic during the period 2016 to 2020. Data from all files for both male patients and female patients aged 12–45 years, who were examined and found to have corneal abnormalities, that is, patients diagnosed with KC, corneal ulcer, Cogan's syndrome, Herpes simplex keratitis, Herpes zoster ophthalmicus, interstitial keratitis and keratoconjunctivitis sicca, were included in this study. Patients younger than 12 years and older than 45 years were excluded.

Extracted data included demographic data, vision screening and clinical diagnosis information. Keratoconus was diagnosed based on the results of the slit-lamp examination, auto kerato-refractometer, retinoscopy and pachymetry. However, it is worth noting that the readings of pachymetry and keratometry for most KC patients were lacking, and also, the diagnosis of KC with less advanced equipment could affect the results of this study. The refractive errors were classified by the spherical equivalent (SE) as myopia

(SE ≤ –0.5 D), hyperopia (SE ≥ 0.5 D) and emmetropia (–0.5 > SE < 0.5D). Data were analysed using Statistical Package for Social Sciences (SPSS) version 23.0. Categorical data underwent descriptive analysis, and associations were tested using the Chi-square test. Multivariate analysis was performed using binary logistic regression and odds ratios (OR), with a 95% confidence interval (CI) applied and tests conducted at 5% level of significance.

Ethical considerations

Ethical clearance was obtained from the Tumaini University Kilimanjaro Christian Medical College Ethical Clearance Committee (certificate number 2401) and the University of KwaZulu-Natal Biomedical Research Ethics Committee (reference number BE436/18).

Results

Demographic characteristics of study patients

A total of 1089 records of patients presenting with corneal abnormalities between the years 2016 and 2020 were analysed. The mean age of patients was 23.5 years (±9.9, 12–45), with female patients (51.9%) and those aged 12–24 years (60.8%) being in the majority of the 198 referred patients, and nearly half (46.5%) were referred from district hospitals. Further analysis revealed a prevalence of KC among all patients aged 12–45 years, presenting with any eye condition during the study period as 0.08% (109/140 523), and 10.0% (109/1089) among those with corneal abnormalities.

Demographic characteristics of keratoconus patients

There was a higher proportion of male KC patients compared to female patients (57.8% vs. 42.2%). The mean age of patients was 21.6 years (±9.0, 12–45), with male patients (20.2 ± 8.6 years) being younger than female patients (23.6 ± 9.4 years). There was a preponderance of male KC patients in the age group of 12–24 years, while the opposite was the case in the older age groups (Figure 1).

As shown in Figure 2, more than half of the KC patients (51.4%) were residents of the Kilimanjaro region, followed by Arusha (28.4%).

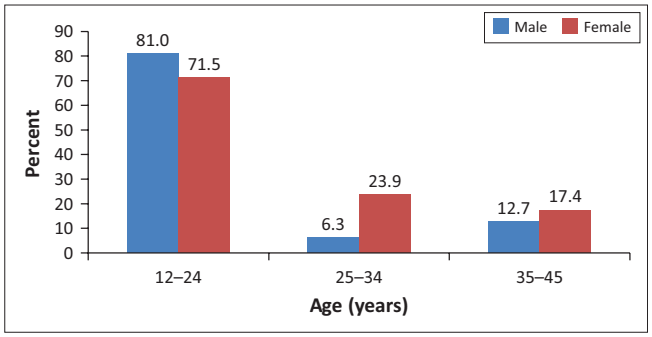

FIGURE 1: Age-gender distribution of keratoconus patients (n = 109).

Clinical profile of keratoconus patients

It was noted that the majority of patient record cards did not contain information on case history and clinical signs, mostly recording refractive data, which did not include pachymetry and keratometry readings in most KC patient records.

Signs

Among the 23 KC patients whose data on clinical signs were recorded, the majority (52.2%) had Munson's sign (Figure 3).

There was no significant difference between the better and worse eye regarding unaided visual acuity, refractive error as measured by SE, astigmatism and mean-K reading. The mean values of symmetry indicate that the majority of KC patients had moderate visual acuity and myopia with high astigmatism.

Among the 109 KC patients, pachymetry was performed on only 4.6% and B-scans on 5.5%. Applying the K-readings < 45D (mild), 45D–52D (moderate), 52D – 62D (advanced) and > 62D (severe), on the worse eye[19] to classify KC for the 13 patients who had keratometry performed and recorded, 71.4% had moderate or worse stages of KC (Figure 4).

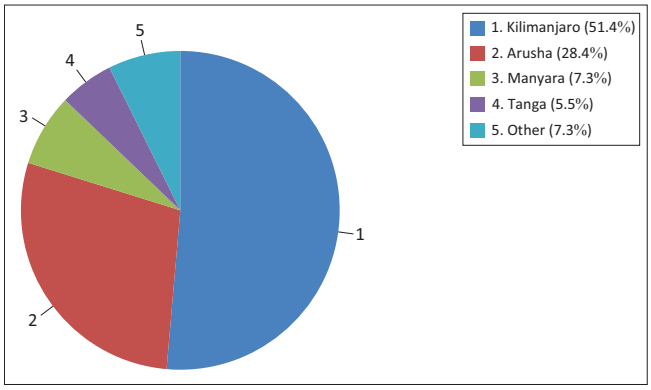

FIGURE 2: Region of residence of keratoconic patients (n = 109).

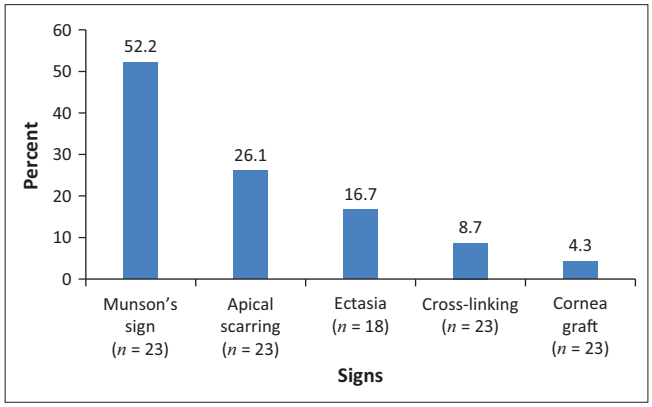

FIGURE 3: Signs of keratoconus (n = 23).

Factors associated with keratoconus

Male patients with corneal abnormalities and those aged < 25 years were significantly more likely to present with KC than female patients ($P = 0.033$) and older patients ($P = 0.015$). Myopia, astigmatism, refractive errors, ocular allergies and vernal keratoconjunctivitis (VKC) were significantly associated with KC ($P < 0.05$) as shown in Table 1.

Predictors of keratoconus

Binary logistic regression indicates that *myopia, astigmatism,* VKC and *ocular allergies* are significant predictors of *KC* (Chi-Square = 94.0, $P < 0.001$). The other predictors, viz., gender, *age*, *region of residence,* and *refractive error* are not significant. All eight predictors describe 18.6% (Nagelkerke $R = 0.186$) of the variability of *KC*. *Myopia, astigmatism, VKC and ocular allergies* are significant at the 5% level (*myopia:* Wald = 9.1, $P = 0.003$; *astigmatism:* Wald = 31.4, $P < 0.001$; VKC: Wald = 8.8, $P = 0.003$; ocular allergies: Wald 12.7, $P < 0.001$). As shown in Table 2, the adjusted odds ratio for astigmatism (aOR = 5.66;95% CI: 3.09–10.39) and *VKC (aOR = 2.68;95% CI: 1.40–5.15) were the highest.*

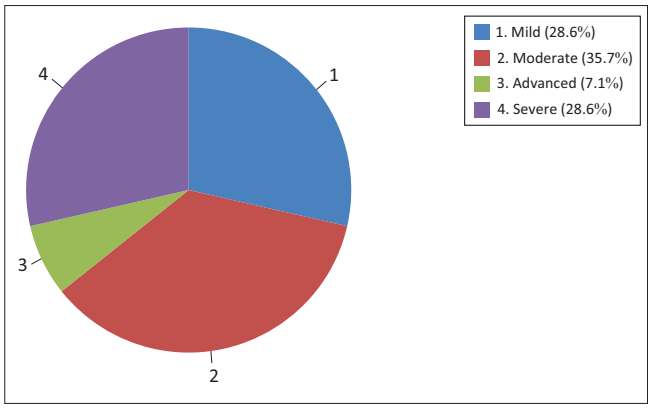

FIGURE 4: Severity of keratoconus according to keratometry readings ($n = 14$).

Discussion

The purpose of the study was to determine the prevalence as well as the demographic and clinical profiles of KC patients who attended a tertiary eye hospital in the northern part of Tanzania, Kilimanjaro.

Prevalence of keratoconus

The overall KC prevalence revealed among patients attending the KCMC eye department during the study period (2016–2020) was 0.08%. However, this prevalence could be

TABLE 2: Multivariate analysis results.

Variables	cOR	95% CI	β	Wald	aOR	95% CI	P
Gender (male)	1.5	1.0–2.3	0.42	3.5	1.51	0.98–2.34	0.062
Age (12–24 years)	1.7	1.1–2.6	0.24	1.0	1.27	0.80–2.03	0.310
Region of residence (Arusha)	1.7	1.1–2.7	0.25	2.8	1.53	0.93–2.51	0.094
Myopia	2.5	1.6–3.8	0.23	9.1	2.02	1.28–3.19	0.003*
Astigmatism	6.5	3.6–11.9	0.31	31.4	5.66	3.09–10.39	< 0.001*
VKC	3.4	1.9–6.0	0.33	8.8	2.68	1.40–5.15	0.003*
Ocular allergies	1.6	1.0–2.3	0.23	12.7	2.30	1.45–3.63	< 0.001*
Refractive error	1.7	1.1–2.8	0.30	0.03	0.95	0.52–1.72	0.862

cOR, crude odds ratio; aOR, adjusted odds ratio; CI, confidence interval.
*, denotes statistical significance.

TABLE 1: Factors associated with keratoconus among patients with corneal abnormalities.

Variables	Total	Keratoconus (KC) status				OR	95% CI	*P*
		KC		No KC				
		n	%	*n*	%			
Gender	-	-	-	-	-	-	-	0.033*
Male	524	63	12.0	461	88.0	-	-	-
Female	565	46	8.1	519	91.9	1.5	1.0–2.3	-
Age (years)	-	-	-	-	-	-	-	0.015*
12–24	662	78	11.8	584	88.2	-	-	-
25–45	427	31	7.3	396	92.7	1.7	1.1–2.6	-
Region of residence	-	-	-	-	-	-	-	0.012*
Arusha	211	31	14.7	180	85.3	-	-	-
Other	878	78	8.9	800	91.1	1.8	1.1–2.7	-
Myopia ($n = 949$)	-	-	-	-	-	-	-	< 0.001*
Yes	470	73	15.5	397	84.5	-	-	-
No	479	33	6.9	446	93.1	2.5	1.6–3.8	-
Hyperopia ($n = 949$)	-	-	-	-	-	-	-	0.793
Yes	285	33	11.6	252	88.4	-	-	-
No	664	73	11.0	591	89.0	1.1	0.7–1.6	-
Astigmatism ($n = 949$)	-	-	-	-	-	-	-	< 0.001*
Yes	533	92	17.3	441	82.7	-	-	-
No	416	13	3.1	403	96.9	6.5	3.6–11.9	-
Risk factors	-	-	-	-	-	-	-	-
Refractive error	781	88	11.3	693	88.7	1.7	1.1–2.8	0.028*
Ocular Allergies	472	58	12.3	414	87.7	1.6	1.0–2.3	0.028*
VKC	76	19	25.0	57	75.0	3.4	1.9–6.0	< 0.001*

KC, keratoconus; OR, odds ratio; CI, confidence interval; VKC, vernal keratoconjunctivitis.
*, denotes statistical significance.

underestimated as the study revealed poor record keeping with relevant diagnostic tests not conducted or recorded. The notable lack of advanced diagnostic equipment, such as topographers and tomographers, has most likely resulted in patients being missed or misdiagnosed. Further, very few patients underwent keratometry, topography, pachymetry and B-scans. The prevalence is similar to another hospital-based study conducted at a tertiary hospital in Ghana (0.05%),[7] but much lower than that reported in other similar studies: 13.7% among patients presenting at a provincial eye hospital in South Africa,[8] 0.5% among children aged up to 15 years in Nigeria,[27] and 0.9% among patients diagnosed with allergic conjunctivitis of all ages in Gambia.[28]

The prevalence of KC among the 1089 patients diagnosed with corneal abnormalities aged 12–45 years was 10.0%, which is lower than that reported in a study in Syria (18.19%) among 1479 patients seeking refractive surgery,[5] in the Jazan region, Saudi Arabia (18.72%) among patients seeking refractive surgery as detected by corneal topography,[29] and in Kenya among patients presenting with allergic conjunctivitis (14.6%).[30] However, it is higher than the 1.7% reported by Rashid et al.[9] in their population-based study conducted among 3051 high school students aged 13–25 years in Kenya. The differences in prevalence rates among the various studies could be attributed to differences in the study populations and diagnostic modalities. Appropriate empirical data are needed, with comparative diagnostic protocols and study populations. It is recommended that population-based studies be undertaken to appropriately inform eye care planning in Tanzania.

Demographic profile

The mean age (21.6 years) at diagnosis of KC found was indicative that the disease is more prevalent in younger populations, reportedly starting at puberty,[9] with associated progression. It is similar to a hospital-based study conducted in Central China, Jordan, and South Africa, which found mean ages of 20.98 years,[31] 20–24 years,[32,33] and 20.64 years,[32] respectively. Keratoconus was diagnosed in a higher proportion of men than women, which was consistent with previous findings.[31,34]

Clinical profile

Munson's sign was the most common corneal sign observed in KC patients. The possible reason for this could be that the majority of patients had moderate to severe KC, making it easily observable even with the naked eye. However, the prevalence may be underestimated as only 23 out of 109 (21.1%) KC patients in the study had records on signs as shown in Figure 3. This further highlights poor record keeping and the possibility of late presentation to the facility by patients, warranting practitioner training and KC advocacy among lower-level referral centres and within communities. Generalised late presentation was also attested to by Naderan et al.,[35] who reported Munson's sign as one of the most common clinical signs in KC, observed in over 50% of KC patients, and Nkoana,[32] who reported a prevalence of 21.8%. However, one study in Malaysia reported a small proportion of KC patients with Munson's sign,[36] perhaps indicating better access to early diagnosis. It is advised that in countries where most patients present with Munson's sign, a sign of moderate-advanced KC, strategies for early detection of the disease need to be developed.

The study found that the majority of KC patients exhibited moderate myopia and high astigmatism (Table 3). Progressively steepening corneal curvature can contribute to high myopia and astigmatism, leading to corneal distortion and resulting in irregular astigmatism, a known precursor to KC. Similar associations have been reported in other studies.[32] High refractive errors lead to poor quality of life and require optical interventions at their early stages of development.

TABLE 3: Distribution of symmetry in keratoconic patients.

Variable	All eyes	Symmetry (better and worse eyes)		
		Better eye	Worse eye	*P*
Unaided VA (LogMAR):	-	-	-	0.065
Number	208	109	109	-
Mean ± s.d.	0.77 ± 0.32	0.74 ± 0.37	0.79 ± 0.35	-
Range	-	0.00 to 1.60	0.00 to 1.90	-
Refractive error (SE) (DS):	-	-	-	0.523
Number	212	106	106	-
Mean ± s.d.	-4.00 ± 5.57	-3.74 ± 5.60	-4.25 ± 5.84	-
Range	-	-23.50 to -7.00	-25.8 to -10.00	-
Astigmatism (Cylinder) (D):	-	-	-	0.660
Number	210	105	105	-
Mean ± s.d.	-2.43 ± 1.90	-2.38 ± 2.02	-2.47 ± 2.09	-
Range	-	-10.00 to -0.50	-10.75 to -0.25	-
Mean K (D):	-	-	-	0.243
Number	26	13	13	-
Mean ± s.d	49.64 ± 36.00	46.74 ± 17.17	52.53 ± 10.11	-
Range	-	36.00 to 67.98	40.93 to 71.70	-

s.d., standard deviation; VA, visual acuity; SE, spherical equivalent.

Factors associated with keratoconus

Univariate analysis demonstrated that directly related significant factors for the development of KC were being a male patient, resident of the Arusha region, referred from lower-level health care facilities and diagnosed with myopia, astigmatism, VKC, refractive errors and ocular allergies. Patients with other corneal abnormalities were less likely to develop KC. Multivariate analysis with binary logistic regression demonstrated that determinants of the development of KC were found to be residence in Arusha region, referral from lower-level health facilities, and diagnosis of ocular allergies and VKC. Diagnosis of other corneal abnormalities was found to be protective for the development of KC.

Although in multivariate analysis (Table 2), gender was not a determinant for the development of KC, univariate analysis in studies conducted elsewhere has reported a similar finding on gender differences, with a significant predominance of male KC patients over female patients.[7,13,31,32,34] However, other studies have reported a significant predominance of female KC patients compared to male patients,[37,38] while some studies have not demonstrated a significant gender difference in KC patients,[5,14,33] requiring further studies with larger sample sizes.

When compared to patients aged 35–45 years presenting with corneal abnormalities, those aged 12–24 years were significantly more likely to develop KC. This finding aligns with that demonstrated in a study by Hashemi et al.[39] where the mean age for KC patients was significantly lower than that of non-KC patients in a population-based study in Sharoud. However, studies by Shilpy et al.[37] and Das et al.[31] conducted among refractive surgery patients in India and a population-based study among high school students in Kenya[37] found no statistically significant difference in age between KC and non-KC patients.

Patients residing in the Arusha region were significantly more likely to develop KC. The possible reason for this could be eye rubbing, which has been shown to be a risk factor for the development of KC.[9,35] Inhabitants in the Arusha region are predominantly the Masai and Waarusha, engaged mainly in herding livestock, and during the dry season, the area is dry and dusty which may trigger allergies and eye rubbing.

Our study demonstrated that astigmatism was significantly associated with KC, with the majority of KC patients having high astigmatism. A study by Ibrahim et al.[40] on the prevalence of KC in Egyptian subjects with high astigmatism found that KC was significantly more prevalent in the group with high astigmatism than in the low astigmatism group. Similar findings were reported by Serdarogullari et al.[38] and Shakir et al.[41] where astigmatism was also found to be a determinant of KC. As reported by Ismail et al.[42] regarding myopia, the study found that more than one-third of the KC cases had high myopia in either eye and that myopic patients were significantly more likely to develop KC. As expected, myopia remained significant even on multivariate analysis as it has been shown that KC leads to visual impairment by inducing myopia.[43] Studies have shown that changes in the position and tension of the eyelid, corneal collagen fibrils, Descemet membrane, and extraocular muscles can significantly impact corneal shape. These alterations may result in orthogonal astigmatism, characterised by principal meridians of the cornea positioned at right angles, leading to variations in light refraction.[44] Understanding these relationships is crucial for diagnosing and managing conditions related to corneal shape, such as KC. Also, research has indicated a link between steeper corneal power and higher levels of myopia,[38] with other researchers such as Tideman et al.[45] and Ojaimi et al.[46] agreeing that the curvature of the cornea plays a modest role in the overall magnitude of myopia.

Of note was that, unlike the expected KC profile, there was poor asymmetry between the two eyes in this study (Table 3). This supports the notion that patients only present when the visual acuity in the originally better eye has worsened enough to affect functionality. Therefore, early detection strategies should be investigated and corrective strategies implemented.

Vernal keratoconjunctivitis and ocular allergies were found to be significantly associated with the development of KC in both univariate and multivariate analysis. This finding is consistent with findings in other studies.[47,48] It has been shown that atopy, which includes ocular allergies and VKC, is a result of predisposition to allergen hypersensitivity mediated by CD4+Th2 differentiation and overproduction of immunoglobulin E (IgE),[9,47] and is highly associated with eye rubbing. Keratoconus patients have a significantly higher incidence of elevated serum IgE.

Limitations

This study was retrospective with the inherent weaknesses related to such types of studies, including missing data. Identified in the study was a significant number of records with missing or incomplete data on tests such as keratometry, slit lamp examination, retinoscopy, pachymetry, topography and tomography. Further, most records had no patient history recorded, and key information on patients' chief complaints and symptoms were also missing. It was therefore not possible to analyse risk factors such as consanguinity, level of parental education, history of eye rubbing or family history. Despite these limitations, this study, being the first in Tanzania, sheds light on the prevalence of KC in Tanzania, which will foster further studies on the subject.

Recommendations

It is therefore important to screen patients for KC, focusing on those residing in the Arusha region and presenting with ocular allergies or VKC. As many patient records did not contain information on important diagnostic tests, there may be patients with the disease who remain undiagnosed. It is recommended that relevant stakeholders develop clinical

guidelines for KC diagnosis and record keeping to be used across all eye departments in Tanzania. The use of less advanced KC diagnostic equipment could result in missing patients at early stages of disease progression; therefore, provision of advanced diagnostic equipment such as a corneal topographer, at least at referral and tertiary health facility levels, coupled with relevant training for clinicians, is highly recommended. Given that this was a retrospective, hospital-based study among patients only with corneal abnormalities, a prospective, population-based study is recommended to determine the true prevalence of KC in Tanzania.

Conclusion

The study demonstrated that among patients aged 12–45 years presenting at KCMC with all eye conditions, the prevalence of KC was 0.08%, while among those diagnosed with corneal abnormalities, it was 10.0%. The prevalence of KC was high in patients aged 12–24 years and among those referred from other health centres. The majority of KC patients were from the Arusha region and had a mean age of 21.6 years, with male patients with KC being in the majority and comparatively younger than female patients. Munson's sign was the most common sign in KC patients, and the majority had moderate myopia and high astigmatism. The severity of KC was moderate to severe in most of the patients. The predictors of KC were being myopic, astigmatic, and having VKC and ocular allergies.

This is the first study on KC in Tanzania and is expected to highlight the extent of the problem in the country. Specifically, it will provide critical information on the demographic profile of KC and the need for early screening.

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Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

F.P.M. conceptualised the research, undertook fieldwork, drafted the article and edited until finalisation; V.R.M. conceptualised the research, supervised the study, reviewed and managed editing of the article until finalisation.

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Data availability

Raw data were generated at the Kilimanjaro Christian Medical Centre. Derived data supporting the findings of this study are available from the corresponding author, F.P.M., on reasonable request.

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