

Knowledge of Early Keratoconus Diagnosis and Management in Nyanza and Western Kenya: Practitioners' Perspective



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Abstract:

Introduction: Keratoconus is a bilateral, progressive corneal ectasia characterized by thinning and conical protrusion of the cornea. Its global prevalence is increasing, with higher rates reported in Africa, including Kenya. In Kenyan studies, most patients are diagnosed at advanced stages, where management is often costly, and complications are severe. Early detection enables more effective and affordable interventions with reduced risks. However, accurate early diagnosis requires advanced equipment and clinical expertise. In many low-resource settings, these factors are lacking, resulting in delayed diagnosis and poor outcomes. Strengthening early diagnostic capacity is essential to reduce the burden of advanced keratoconus and prevent avoidable visual impairment. The objective of this study was to assess the level of knowledge among eye care practitioners in the diagnosis and management of early-stage keratoconus in Nyanza and Western Kenya.

Methods: A cross-sectional study was conducted across hospitals in Nyanza and Western Kenya. A census sampling technique was employed to include all eligible eye care practitioners. Data were collected using a structured questionnaire and analysed using both descriptive and inferential statistical methods to evaluate knowledge levels and associated factors.

Results: A total of one hundred and thirty-four practitioners completed the questionnaire. Regarding early keratoconus diagnosis, 36.6% demonstrated good knowledge, 60.4% had fair knowledge, and 3.0% exhibited poor knowledge. For early keratoconus management, 36.6% had good knowledge, 61.2% had fair knowledge, and 2.2% reported poor knowledge. A statistically significant association was observed between practitioners' qualifications and knowledge in early keratoconus management ($p=0.006$).

Discussion: A substantial number of practitioners demonstrated limited knowledge of early keratoconus, possibly due to the low rates of keratoconus services, which may ultimately limit their experience.

Conclusion: Most practitioners demonstrated only fair knowledge in the diagnosis and management of early keratoconus. Practitioners' qualifications were significantly associated with knowledge in early keratoconus management.

Keywords: Early keratoconus, Corneal ectasia, Eye care practitioners, Cornea, Visual impairment, Allergic conjunctivitis.

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1. INTRODUCTION

Keratoconus (KC) is a progressive corneal ectasia and a significant cause of visual impairment worldwide. In Kenya, few studies have addressed its prevalence and clinical management. One study estimated the prevalence at 1.672% [1], being ten times higher than the global rate of 0.138% [2]. Another study among patients with allergic conjunctivitis reported a prevalence of 30.894%, highlighting a strong association between KC and allergic conjunctivitis, and demonstrating the potential of corneal topography for detecting mild disease [3]. This study revealed that it is possible to detect mild KC using a corneal topographer.

The diagnosis and management of KC are stage-dependent, categorized into early, moderate, and severe disease [4]. Early detection requires advanced diagnostic tools, such as corneal topographers, tomographers, and pachymeters [4-6]. Timely diagnosis provides significant advantages, including lower costs, fewer complications, and improved outcomes, compared to management at advanced stages [7-10]. However, the absence of advanced diagnostic equipment, coupled with limited practitioner knowledge, often results in missed cases of early KC and delayed intervention [11]. Similar challenges have been reported internationally, including misdiagnosis in South Africa [12, 13] and inadequate knowledge among eye care practitioners in Switzerland [14]. Sufficient knowledge and competency in KC, including the use of advanced diagnostic technologies, are therefore crucial [15, 16].

In Kenya, available studies have focused on KC in general, without specifically addressing knowledge of the early disease [17]. This is concerning, as early intervention, particularly corneal cross-linking (CXL), can halt progression and prevent the economic and psychosocial burden of severe disease [18]. Most importantly, if progressive KC is diagnosed early and managed by crosslinking (CXL), it halts further progression, thus saving the patient from severe stages, which are economically and emotionally draining [19]. A Kenyan study on contact lens use found that most patients presented with moderate to severe KC, suggesting delayed diagnosis, possibly due to knowledge gaps among practitioners [20]. Furthermore, ophthalmologists, who are at the apex of referral systems, have not been included in earlier studies [17, 20]. Moreover, the studies have not reported on the eye care practitioners' (ECPs) knowledge, yet it is a key determinant of the ability to diagnose and manage early KC. This study

was designed to address these gaps by focusing on the specific objectives, including assessment of knowledge levels of ECPs in the diagnosis and management of early KC in hospitals across Nyanza and Western Kenya.

2. MATERIALS AND METHODS

This study adopted a cross-sectional design. A census technique was applied due to the low number of the study population in the study area, thus allowing all the eligible ones to participate. The eligible practitioners were the ophthalmic clinical officers (OCOs), comprehensive ophthalmology and cataract surgeons (COCs), optometrists, and the ophthalmologists working in levels 4, 5, and 6 facilities with eye units in Nyanza and Western Kenya. The inclusion criteria involved practitioners trained at a certified higher learning institution in Kenya, with a study period comprising at least three years of training and working in L4, L5, and L6 healthcare facilities. Practitioners on attachment and internship were excluded, in addition to those who were non-consenting or unwilling to participate. Data regarding the ECPs were obtained from their respective professional associations. All the eligible eye care practitioners (one hundred and forty-three) were invited to participate in the study, out of whom one hundred and thirty-four responded to the questionnaire. Data were collected from healthcare facilities in the Western and Nyanza regions of Kenya in August and September 2024. The study was conducted in sub-county, county referral, and tertiary hospitals in Kenya. Eye care practitioners (ECPs), including OCOs, COCs, optometrists, and ophthalmologists, working at these facilities, were eligible for inclusion. The dependent variables included knowledge on various KC attributes, and on diagnosis and management of early KC. The independent variables were the practitioners' attributes, while the confounding variables were the hospital levels. Data were collected using a structured questionnaire, comprising mainly closed-ended items with some partially open-ended questions in the socio-demographic section. The questionnaire assessed participants' ability to use diagnostic equipment for KC, knowledge of early KC signs, risk factors, indicators of progression, and strategies for early management. The questionnaire was subjected to a face and content validity test by a team of senior eye care professionals that included academicians, researchers, a senior ophthalmologist, optometrists, and OCOs. This collectively enhanced its internal validity. Moreover, internal consistency was tested using Cronbach's alpha for the knowledge section after

piloting. The test reported a Cronbach's alpha of 0.75, which was within the range of adequate levels, hence making the questionnaire reliable. The tool was piloted to enhance its validity, and the feedback from the pilot test informed subsequent revisions. The final questionnaire was disseminated to eligible ECPs via electronic platforms. Ethical approval was obtained from Masinde Muliro University's institutional scientific research and ethics committee (MMUST-ISREC), Kenya (approval number: MMUST/ISERC/074/2024), and the National Commission of Science, Technology, and Innovation (NACOSTI - Kenya), bearing license approval number NACOSTI/P/24/39382. Informed consent was obtained electronically from all participants after providing detailed study information, including the voluntary nature of participation. The study adhered to the principles of the Declaration of Helsinki. Completed questionnaires were automatically exported into Microsoft Excel and later analyzed using Statistical Package for the Social Sciences (SPSS), version 29. Descriptive statistics were used to summarize socio-demographic data. Knowledge questions were scored using a 5-point Likert scale, with responses ranging from "strongly agree" to "strongly disagree". For positively worded items, correct "strongly agree" responses received the highest score (5), while "strongly disagree" responses received the lowest score (1). For negatively worded items, the scoring was reversed. Chi-square tests were performed for inferential statistics and for the analysis between the groups. Knowledge levels were classified as poor (<50%), fair (50–75%), or good (>75%). This scoring criterion was adapted from a study by Lestari *et al.* on knowledge towards diabetic retinopathy among general practitioners [21]. Since the questionnaire assessed knowledge, there was a possibility of recall bias. However, the ECPs were allowed to fill in the questionnaire at their own convenience.

3. RESULTS

One hundred and thirty-four out of the eligible 143 ECPs responded to the questionnaire, from which the data were analyzed (Fig. 1). The majority of the respondents were males (59.7%), while the females constituted the minority (40.3%). Level 4 was the highest represented level (64.9%), followed by level 5 (30.6%) and level 6 (4.5%) (Table 1). To determine ECPs' knowledge level in early KC diagnosis, three parameters were assessed. Risk factors accounted for seven questions, signs of early KC constituted fifteen questions, and six questions focused on the use of equipment to diagnose KC. With respect to the risk factors for KC, 39.3% of the ECPs had good knowledge, 51.1% had fair knowledge, while 9.6% had a poor level of knowledge. Regarding the signs of early KC, 80.0% had fair knowledge, 15.6% had good knowledge, while 4.4% had poor knowledge. With regards to the knowledge on the use of various equipment in the diagnosis of early KC, 45.9% had good knowledge, 48.1% had fair knowledge, and 5.9% had poor knowledge on a cumulative percentage. Overall, 36.6% of the ECPs had good knowledge, 60.4% had fair knowledge, while 3.0% had poor knowledge on early KC diagnosis, as shown in

Fig. (2). The knowledge level assessment of early KC management was based on three parameters. The strategies for early KC management comprised seven questions, indicators of progressive KC accounted for four, and six questions focused on the ability to use equipment for early KC management. In this respect, 18.5% of the participants had good knowledge, 78.5% had fair knowledge, while 3.0% had poor knowledge of the management strategies for early KC. With respect to the use of equipment in the management of early KC, 45.9% had good knowledge, 48.1% had fair knowledge, while 5.9% had poor knowledge. While regarding the indicators of progressive KC, 61.5% of the ECPs had good knowledge, 34.1% had fair knowledge, and 4.4% had poor knowledge. Overall, 36.6% of the ECPs had good knowledge, 61.2% had fair knowledge, and 2.2% had poor knowledge of the management of early KC, as shown in Fig. (2). Chi-square tests were performed for the analysis of socio-demographic variables between the groups. The results revealed a significant association ($p=0.006$) between qualification level and knowledge level in the management of early KC (Table 2). There were, however, no significant associations among gender, age, cadre, and years of experience with knowledge.

4. DISCUSSION

There were more male ECPs who responded to the questionnaire, possibly due to the African tradition in which more males pursue technical and higher academic fields. These results were similar to studies in Ghana (68.9%) and Switzerland (60%), where males outnumbered females [14, 22].

Most of the ECPs had only a fair knowledge level of KC risk factors. This may be likely because the KC practice is generally uncommon in Kenya. These findings have been found to be similar to a study in Switzerland, whereby very few ECPs (9%) have been reported to have good knowledge [14], even though in the current study, there were fairly more participants who scored good knowledge. This result was contrary to a Limpopo study in South Africa, whereby 62.5% of the ECPs had good knowledge of the risk factors of KC [13].

With respect to the signs of early KC, most ECPs had inadequate knowledge, with only 15.5% having good knowledge. This may be because there exists a thin line of variability between early and moderate KC. This result has been found to be in contrast to a study in South Africa, where 41.7% ECPs have been reported to be knowledgeable [13]. Interestingly, the number of ECPs who scored as having good knowledge of the signs of early KC was much lower compared to the number that self-reported as having good knowledge regarding the equipment to diagnose early KC, yet most of these signs are identified by the use of the equipment. Overall, most ECPs lacked good knowledge of early KC management, which could be due to limited higher qualifications, as most had a diploma or higher diploma, with very few holding a degree or master's, as this study found a significant association between qualifications and knowledge.

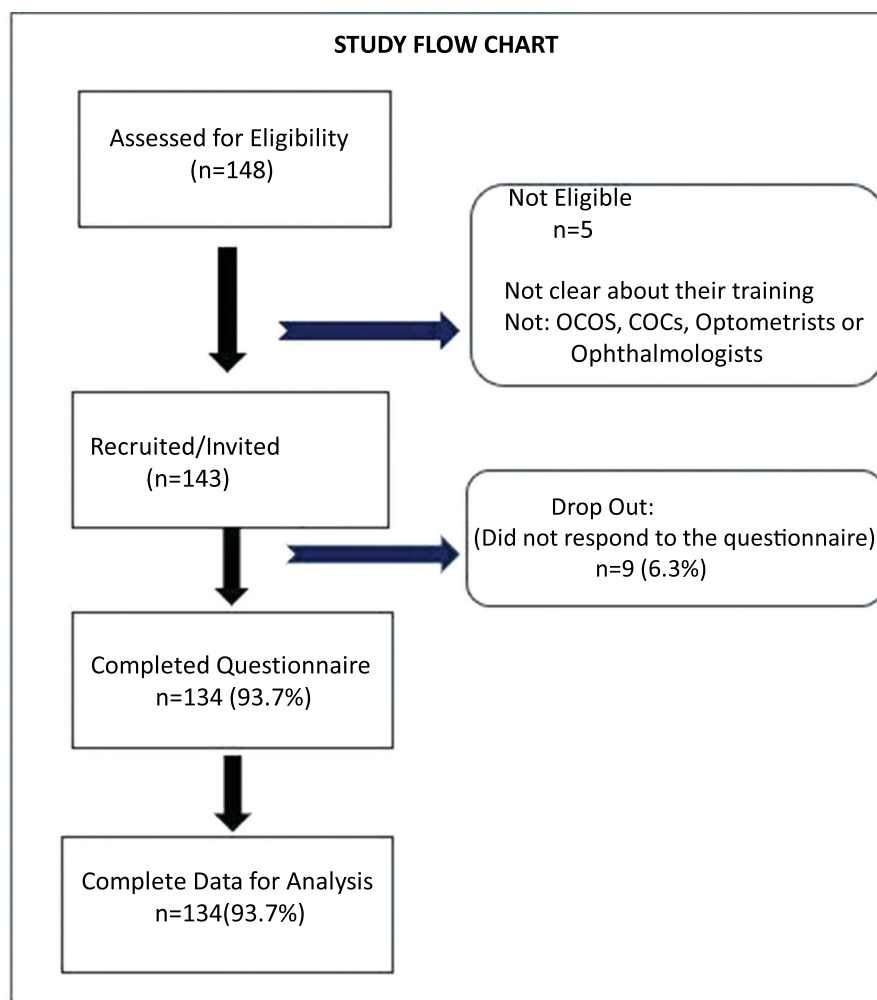


Fig. (1). A flow chart showing the process of study data collection.

Table 1. Sociodemographic characteristics of the participants [in frequency (n) and percentage (%)].

Demographics of the Respondents				
-	-	n	%	Years of Experience Characteristics
Gender	Female	54	40.3	-
	Male	80	59.7	
Qualification	Ophthalmologists	6	4.5	-
	Optometrists	79	59.0	
	COCs	24	17.9	
	OCOs	25	18.7	
Hospital level	L4	87	64.9	-
	L5	41	30.6	
	L6	6	4.5	
Years of experience	Mean	-	-	6.83
	Standard error mean	-	-	0.521
	Range	-	-	37
	Minimum	-	-	1
	Maximum	-	-	38

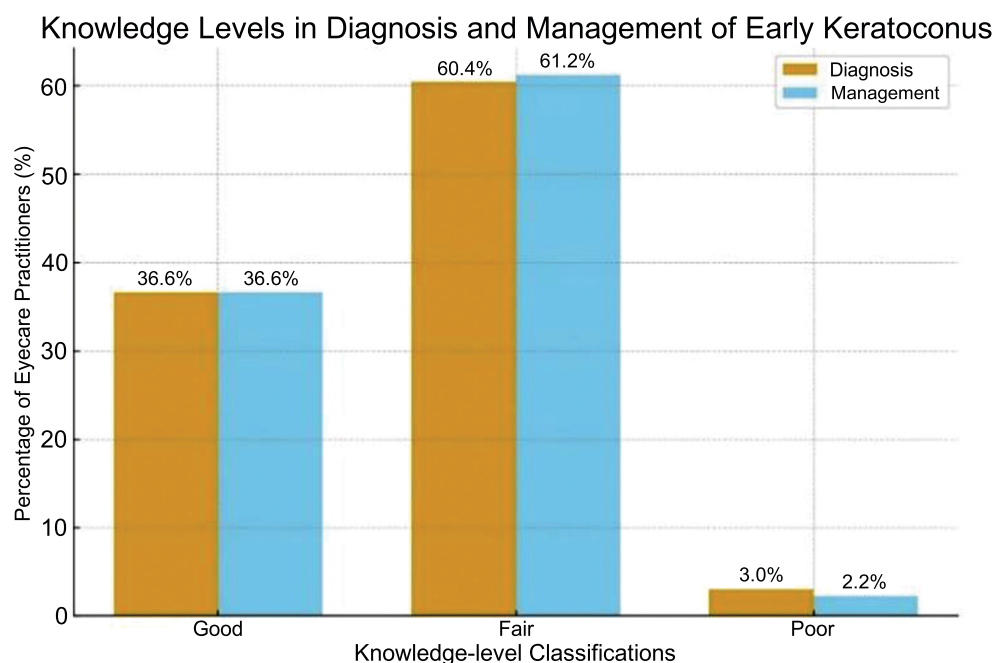


Fig. (2). A graph showing the percentage of the practitioners in various knowledge categories.

Table 2. Chi-square (χ^2) results of the association of demographic characteristics with keratoconus diagnosis and management knowledge.

Variable	-	df	Pearson's (χ^2)	p-value
Respondents' gender	Knowledge in diagnosis	40	46.52	0.222
	Knowledge in management	39	36.02	0.607
Age	Knowledge in diagnosis	1160	1070.81	0.97
	Knowledge in management	1131	1124.54	0.549
Experience	Knowledge in diagnosis	840	851.38	0.385
	Knowledge in management	819	860.04	0.153
Cadre	Knowledge in diagnosis	80	53.51	0.99
	Knowledge in management	78	90.56	0.157
Qualification	Knowledge in diagnosis	80	94.48	0.128
	Knowledge in management	78	112.88	0.006

Note: A chi-square table showing the associations between practitioners' socio-demographics and knowledge. *p*-value has been considered significant at $p < 0.05$ with 95% CI.

In the management of early KC, very few had good knowledge of the strategies for KC management using contact lenses. This may be likely due to the fact that contact lens practice is fairly new in Kenya; thus, practitioners may not have sharpened their skills in contact lens practice. This has been found to be contrary to a Kwa Zulu Natal study, which reported 83.3% of the ECPs to have good knowledge of contact lenses [12]. With respect to the indicators of progressive KC, most ECPs had good knowledge, possibly because KC progresses across all the stages, thus being non-specific. Generally, overall, most ECPs had only a fair knowledge of early KC management, possibly due to limited exposure to the advanced equipment, as recently reported in Kenya [23]. These

results have been found to be similar to a study in South Africa, which has reported limited knowledge because there was no keen attention to KC earlier [24], and to a study in Cameroon, where ECPs have reported poor KC knowledge, possibly due to inadequate training [25].

Even though there was no statistically significant association between knowledge and cadres, the ophthalmologists and the degree-level optometrists scored higher than other cadres. Generally, with regards to their training, the ophthalmologists handle most of the surgical procedures, whereas the optometrists examine, diagnose, and manage various eye health ailments, including contact lens care.

5. STRENGTHS AND LIMITATIONS

5.1. Strengths

To the best of the authors' knowledge, this is the first study to assess and report knowledge on keratoconus in Kenya, and most importantly, early keratoconus. Additionally, although few, the study has included ophthalmologists, who had been excluded in earlier studies on keratoconus.

5.2. Limitations

As this was a cross-sectional study, the associations obtained may not provide a causal-effect implication. Recall bias may also not be ruled out, as practitioners are required to remember their actions in practice.

CONCLUSION

Most practitioners had only fair knowledge, with fewer having good knowledge of both early keratoconus diagnosis and management. There was a significant association found between knowledge and practitioners' qualifications. There is a need for further study on skills in early keratoconus diagnosis and management at the national level. Moreover, it is worthwhile that the institutions of higher learning should consider the establishment of continuing education programs and the integration of corneal imaging technologies in training.

AUTHORS' CONTRIBUTIONS

It is hereby acknowledged that all authors have accepted responsibility for the manuscript's content and consented to its submission. They have meticulously reviewed all results and unanimously approved the final version of the manuscript.

LIST OF ABBREVIATIONS

CXL = Corneal cross-linking

ECPs = Eye care practitioners

OCOs = Ophthalmic clinical officers

COCs = Comprehensive Ophthalmology and Cataract Surgeons

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This research was approved by Masinde Muliro University's institutional scientific research and ethics committee (MMUST-ISREC), Kenya (approval number: MMUST/ISERC/074/2024), and the National Commission of Science, Technology, and Innovation (NACOSTI - Kenya), bearing license approval number NACOSTI/P/24/39382.

HUMAN AND ANIMAL RIGHTS

All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committee, and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Informed consent was obtained electronically from all participants.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

All data generated or analyzed during this study are included in this published article.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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