



Knowledge, experience and practices of optometrists in Uganda about keratoconus

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Background: Keratoconus has a global prevalence of 0.2 to 4790 per 100 000 persons and there is currently no published report about its incidence, prevalence or the role of optometrists in its management in Uganda. This study looked at the role of optometrists in the diagnosis, management and referral of patients with keratoconus in Uganda.

Aim: To determine the knowledge, experiences and practices of optometrists in the management of keratoconus in Uganda.

Setting: This study was conducted in Uganda.

Methods: Fifteen optometrists who had practiced for at least one year were recruited into the study, which was conducted in accordance with the International Conference on Harmonisation Tripartite Guideline for Good Clinical Practice. The study involved interviews that were conducted over zoom and telephones, which were considered for participants who had internet challenges. The sessions were recorded, transcribed verbatim, coded and themes were derived.

Results: The median number of years of experience was 7 years. The participants' experiences were reported in terms of diagnosis, management and referral of patients with keratoconus and common themes were explored. Retinoscopy and Munson's sign were the most common diagnostic methods while spectacles were the most common management option used by the optometrists.

Conclusion: Most optometrists relied on retinoscopy for diagnosis and spectacles for the management of keratoconus because of the lack of diagnostic equipment and challenges associated with contact lens practice in Uganda.

Contribution: This is the first study to explore how keratoconus is managed by optometrists in Uganda and the results can be used to improve patient care in the country.

Keywords: contact lenses; keratoconus; optometrists; spectacles; Uganda.

Introduction

Keratoconus (KC) refers to a bilateral and asymmetric disorder, characterised by a conical shape of the cornea because of thinning and protrusion leading to irregular astigmatism and decreased vision.^{1,2,3} The condition has been linked to risk factors such as age (first or second decade of life), allergies, eye rubbing, family history of KC and asthma.^{2,4} Patients with KC present with poor vision, allergies and refractive errors especially high myopia and irregular astigmatism.^{2,4} Some of the clinical signs of KC include scissor reflex on retinoscopy, oil droplet reflex, Rizzuti's sign, Munson's sign, Vogt's striae and Fleischer's ring.⁴

Optometrists play a significant role in the non-surgical management of KC. In addition to diagnosing the condition, optometrists can prescribe spectacles or contact lenses to these patients. The non-surgical procedure that is most widely used for KC management is contact lens fitting,⁵ which is the primary form of visual correction for patients with KC.⁶ The surgical management by ophthalmologists includes partial or full-thickness corneal transplant, intracorneal ring segments and corneal collagen cross-linking, which are available in some private tertiary hospitals in Uganda.

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Dates: Received: 27 June 2024 | Accepted: 10 Dec. 2024 | Published: 18 Feb. 2025

How to cite this article: Wanok G, Arunga S, Dhillon B, Nsubuga N. Knowledge, experience and practices of optometrists in Uganda about keratoconus. Afr Vision Eye Health. 2025;84(1), a968. <https://doi.org/10.4102/aveh.v84i1.968>

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In low- and middle-income countries (LMICs), the optometrist to population ratio is 1:600 000, worse in rural areas with up to millions per optometrist.⁷ Uganda is one of the countries with a small number of optometrists. This study involved 15 optometrists who have been practicing in Uganda for at least one year. Of the 15 optometrists, 14 were registered with the Optometrists Association of Uganda (OAU) while one who was not registered with the association but had their optometry training from Kenya and had enough experience to qualify to take part in the study. By the time of this research project, the Allied Health Professionals Council (AHPC) had just started the implementation of regulation and licensing process of optometrists in the country. Therefore, some optometrists could practice without being registered and licensed by the council but by the end of 2023 or early 2024, this was no longer possible.

Globally, the prevalence of keratoconus ranges from 0.2 and 4790 per 100 000 persons with an incidence rate of 1.5 and 25 per 100 000 persons/year.² It is the leading indication for corneal transplantation in many countries, especially in Australia, Middle East and Africa.⁸ A systemic review carried out to establish the prevalence and factors associated with keratoconus in Africa found a prevalence of 7.9% with males more affected than females.⁹ It is worth mentioning that there is a dearth of well-designed population-based studies on KC in Africa, resulting in a lack of epidemiological information and this highlights the urgent need for research on KC in Africa.⁹

There is currently no published study about the prevalence of KC or the role of optometrists in its management in Uganda. This study will look at the role of optometrists in the diagnosis, management and referral of KC in Uganda.

Aim

This study aimed to determine the knowledge, experiences and practices of optometrists in Uganda about KC.

This was achieved by the following objectives:

1. to investigate the existing understanding of KC held by actively practicing optometrists in Uganda
2. to determine non-surgical management available and provided by optometrists in Uganda
3. to determine referral criteria and pathways available for people living with KC being managed by optometrists in Uganda.

Research methods and design

Design

A cross-sectional study design was used, and it included semi-structured interviews for 15 optometrists practicing in Uganda. As of 15 October 2021, the Optometrists Association of Uganda (OAU) register had only 21 optometrists with majority working in stand-alone practices. Some optometrists who had not yet registered with OAU were also recruited into the study.

The interview sessions were conducted by the same interviewer, and they lasted for an average of approximately 16 min. Telephone conversations were considered for participants who had internet challenges. An interview guide was used that consisted of 17 questions.

Inclusion criteria: (1) Only qualified optometrists from recognised institutions practicing in Uganda and (2) optometrists who were willing and able to provide informed consent to participate in the study. Exclusion criteria: Optometrists who had practiced for less than one year were excluded.

Data analysis

Thematic analysis of data was used. The session recordings were transcribed verbatim and then coded. Analysis was performed using themes derived from the transcription verbatim.¹⁰ Data information flow is shown in Figure 1.

Ethical considerations

The study was conducted in accordance with the principles of the International Conference on Harmonisation Tripartite Guideline for Good Clinical Practice. Ethical clearance was obtained from The University of Edinburgh Medical School (reference no.: 151221) and Makerere University School of Health Sciences Institutional Review Board (reference no.: MAKSHSREC-2021-245). Permission was also obtained from the OAU before accessing contact details of the participants. Written consent was obtained by email before participants took part in the study. After transcription, all the scripts were de-identified and participant IDs were assigned instead of using names or any other identifying information.

Results

Demographic characteristics of participants

The number of participants by type of practice (whether hospital or stand-alone) is shown in Figure 2 and their number by regions of Uganda is shown in Table 1. Table 2 and Table 3 show the classification of participants based on the type and setting of practice, respectively. A map of Uganda showing the types of practice and location of the study participants is shown in Figure 3.

Knowledge and experience of the participants

The study participants trained and graduated from different institutions: 40% graduated from Makerere University,

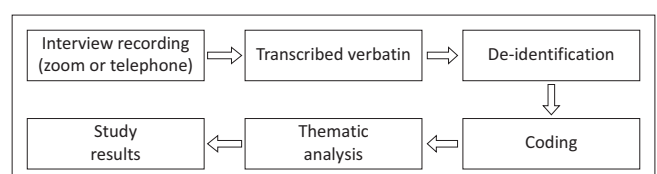


FIGURE 1: Data information flow for the study.

Uganda, 33.3% from Kenya, 13.3% from India, 6.7% from Tanzania and 6.7% from the United Kingdom. Out of the 15 participants, 93.3% practiced optometry in urban settings while the rest practiced in a rural setting. In relation to the type of practice, 46.7% were hospital-based while 53.3% worked in stand-alone optometry practices. The median of the years of experience of participants was seven years with a minimum of one year and maximum of 34 years. Optometrists in hospital settings reported a higher number

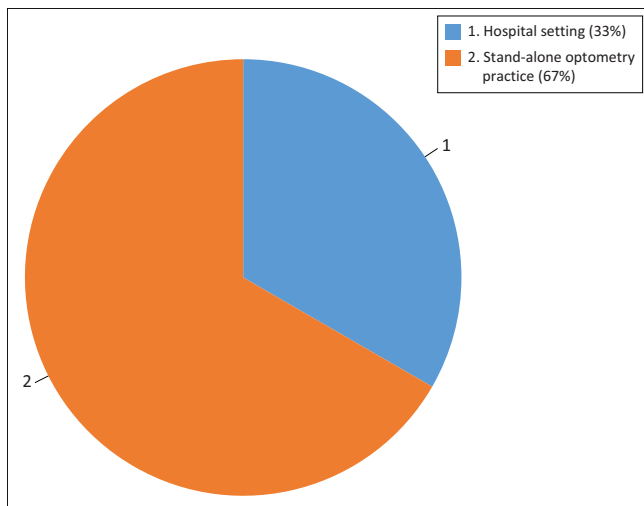


FIGURE 2: Pie chart showing the percentage of participants by type of practice whether it is a hospital setting or stand-alone optometry practice.

TABLE 1: Percentage of participants by regions of Uganda.

Region	Participants (%)
Northern	13.3
Western	6.7
Central	80.0
Eastern	0.0



FIGURE 3: Map of Uganda showing the different types of practices and the locations of optometrists who participated in the study.

of patients with KC than their counterparts in stand-alone practices as shown in Figure 4.

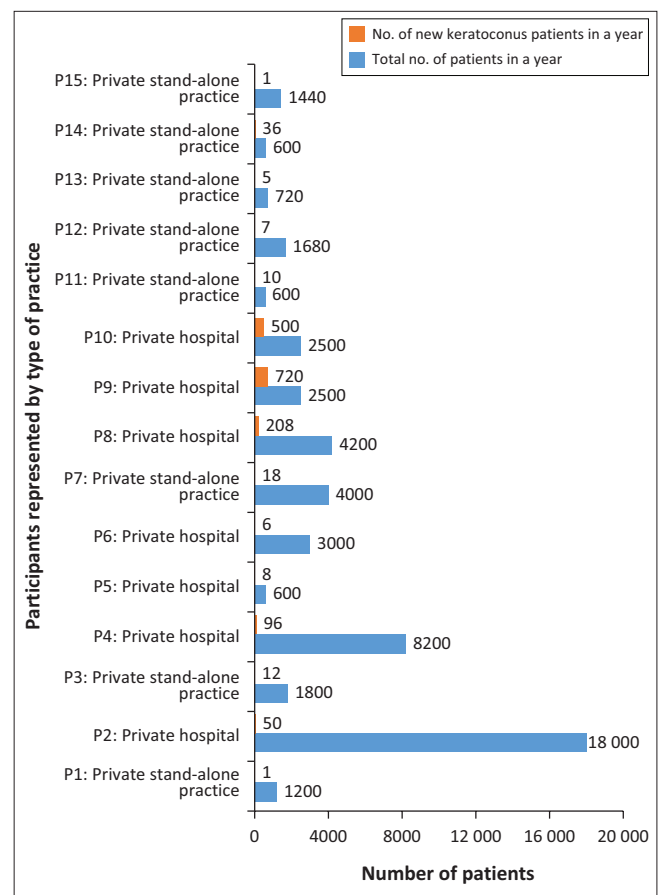
Generally, KC was defined as a progressive condition characterised by thinning and bulging of the cornea, which leads to a decline of vision; it is associated with allergic conjunctivitis and usually corrected by spectacles and contact lenses in its initial stages. For example, a participant defined it as:

‘[A] disorder of the cornea, whereby you have it thinning and is usually associated with vernal keratoconjunctivitis and eye rubbing ...’ (Participant 5, private hospital)

This definition of keratoconus was similar to that made by another participant who also emphasised the method of management:

‘Keratoconus is a condition which leads to progressive decline in vision, refractive that can be dealt or managed by using spectacles and contact lenses: soft, hard and hybrid contact lenses.’ (Participant 2, private hospital)

All the other participants used similar words to define KC. They shared their experiences in diagnosis and management and referral of KC as shown in the sections that follow. In the interview, participants were asked about the number of patients seen in a year and how many new KC patients they see in the same year. The results are shown in Figure 4.



P, participant.

FIGURE 4: New keratoconus cases compared to the total number of patients seen in a year.

Diagnosis

The diagnostic tests are summarised in Table 4. In addition to the information shown in Table 4, only 6.7% of the participants relied solely on retinoscopy, while the rest used it with at least one other test to confirm diagnosis of KC.

Objective refraction

Most participants (86.6%) use objective refraction to diagnose KC. A scissors reflex that aids in the diagnosis of KC is seen during retinoscopy as mentioned by a participant:

‘[R]ight now, it is more of the retinoscopy. When you look at the reflexes, they appear scissor-like. They are not clear.’ (Participant 4, private hospital)

This response is similar to that of other optometrists who participated in the study. Another participant with a similar response said:

‘Most times, the first step we notice they have keratoconus is during refraction-retinoscopy, when I would see the scissor reflex.’ (Participant 8, private hospital)

The reason for relying on a retinoscope was mentioned by one of the optometrists who attributed it to the cost as the retinoscope is cheaper when compared to other diagnostic equipment for keratoconus. The participant said:

‘Advantage of retinoscopy is it is not expensive. I could say its free yet for corneal topography you have to pay ...’ (Participant 3, private stand-alone practice)

Munson’s sign

After retinoscopy, the second most used method for the diagnosis of keratoconus was identification of Munson’s

sign that was mentioned by 46.7% of the participants. A participant said:

‘In most cases because of having no equipment for diagnosis, I use the normal manual Munson sign where I tell the patient to look down and I see the conical shape or maybe V-shape and then diagnose it.’ (Participant 11, private stand-alone practice)

The above response was further re-affirmed by another participant who said:

‘[S]ometimes if it is really advanced, you can see that Munson sign. When you lift the eyelids and tell the patient to look down you can see that protruding part.’ (Participant 4, private hospital)

Corneal topography

This was mentioned by 33.3% of the participants who said it was the best for confirming the diagnosis. Only 20% of the participants who were hospital based had corneal topographers that they used routinely for their patients with KC. A participant said:

‘[T]he corneal topography would give you a final say about the keratoconus, but all the rest would give you a clue as to whether the person is a keratoconus patient ... Sometimes you end up miss-diagnosing a high compound myopic astigmatism as keratoconus. Without the topographer, it can be misleading.’ (Participant 5, private hospital)

Slit lamp biomicroscope

The use of slit lamp in KC diagnosis was mentioned by 33.3% of the participants. A participant highlighted the importance of slit lamp in diagnosing KC:

‘[Y]ou would want to do your slit lamp examination to see the ocular health and examine the cornea.’ (Participant 5, private hospital)

Another participant stated that the need for slit lamp can be got from the patient’s complaint:

‘When a patient complains of blurred vision, I go an extra mile during slit lamp examination. If I see the general protrusion of the cornea, I would definitely know this is keratoconus.’ (Participant 3, private stand-alone practice)

Keratometry

The use of keratometry in clinical practice was also mentioned by 33.3% of the participants. A participant said:

‘[T]he refractometer also has K readings. When I get that, I also just take the K readings ...’ (Participant 7, private stand-alone practice)

Other tests

Other tests that were mentioned by the participants, although less frequently included direct ophthalmoscopy, Placido disc, pachymetry and optical coherence tomography (OCT). Their frequencies are shown in Table 4.

Management

A summary of the management strategy used by the participants is shown in Table 5.

TABLE 2: Percentage of participants based on the type of practice.

Type of practice	Participants (%)
Private stand-alone	53.3
Private hospital	46.7
Public hospital (Government)	0.0

TABLE 3: Percentage of participants based on the setting of the practice.

Setting	Participants (%)
Urban	93.3
Rural	6.7

TABLE 4: Diagnostic tests for keratoconus among participants (*N* = 15).

Diagnostic test	<i>n</i>	%
Slit lamp examination	4	26.7
Objective refraction		
Retinoscopy	11	73.3
Autorefractor	2	13.3
Ophthalmoscopy or oil droplet reflex	2	13.3
Keratometry	5	33.3
Munson test	7	46.7
Corneal topography	5	33.3
Placido disc	1	6.7
Pachymetry	2	13.3
Optical coherence tomography	1	6.7

TABLE 5: Management options of keratoconus by the participants ($N = 15$).

Management	<i>n</i>	%
Spectacles	15	100.0
Contact lenses	5	33.3
Counselling	4	26.7
Treating allergies	3	20.0
Treatment of corneal hydrops	1	6.7

Spectacles

All the participants confirmed their use of spectacles in the management of the condition. A participant said:

'... [F]or the early ones, I definitely do complete refractive correction and there comes a time when the refractive error does not improve ... when the vision does not improve with refractive correction then we start with contact lenses.' (Participant 13, private stand-alone practice)

Another participant emphasised the types of refractive errors, which lead to spectacle correction:

'Most of the patients come when they have progressive myopia and high astigmatism. At the beginning, it is hidden and we depend on visual acuity. If it improves with glasses, we prescribe them and then do a follow-up.' (Participant 11, private stand-alone practice)

Contact lenses

This was currently used by only 33.3% of the participants. A participant said:

'[W]e start with the hard contact lens or the rigid gas permeable lenses [RGPs]. Then if the RGPs do not work, and if they are young, sometimes, I refer them. If the astigmatism is very high, I would probably refer them at that stage to the ophthalmologist for cross linking.' (Participant 13, private stand-alone practice)

Another participant said:

'[E]arly diagnosis is the best thing and we can do some procedures to stop progression. We can give contact lenses at the first stage.' (Participant 9, private hospital)

The above responses represent the few participants who practice contact lenses. In addition, it was found that only 26.7% of the participants had KC fitting sets in their practices. The reasons for those who do not practice contact lenses are explored in the theme, which explains the barriers associated with management of KC.

Counselling

Counselling about the condition was considered as a strategy in the management by 26.7% of the participants. The content of counselling included information about eye rubbing and its effect on KC, the progressive nature of the condition and the different management options. A participant mentioned that:

'I start by counselling, and then prescribe spectacles. I also recommend review depending on the extent of the keratoconus, and then the severity. The number of reviews may differ for example if it is mild keratoconus, I would tell them a review of 6 months to a year ...' (Participant 1, private stand-alone practice)

In addition to the above, another participant said:

'[A]dvising the patients to avoid the eye rubbing, and anything that could make the condition worse.' (Participant 4, private hospital)

Another participant who mentioned counselling after spectacle correction said:

'[Y]ou give that patient their pair of spectacles with a lot of counselling about the nature of the disease and the predisposing factors to progression which would include eye rubbing ...' (Participant 5, private hospital)

Treatment of allergies

This was considered as the first step towards the management of KC by 20% of the participants. A participant said:

'[M]ost of the cases are allergies. If we treat the allergy in a proper way, it may not progress to keratoconus.' (Participant 9, private hospital)

Another participant also emphasised the need for allergy treatment:

'[M]ost of them would present with allergies. So, we treat the allergies ...' (Participant 8, private hospital)

Treatment of corneal hydrops

This was mentioned by 6.7% of the participants who work in a hospital setting with an ophthalmologist. The participant said:

'[I]f they already have hydrops, we would manage with hypertonic saline until they have subsided.' (Participant 8, private hospital)

Referral

Clinical and non-clinical reasons for referral are summarised in Table 6. Of the 15 respondents, 80% cited a visual acuity of 6/18 as their preferred cut-off criterion for referral for contact lens fitting while each of the remaining respondents cited visual acuities of 6/9, 6/12 and 6/36. With regard to visual acuity for referral for surgical intervention, 33.3% of the respondents cited 6/60 as their preferred cut-off criterion, another 33.3% cited 6/36 and the remaining respondents cited 6/24, 3/60, 1/60, counting fingers and hand movement.

Main challenges associated with keratoconus management

Referral pathways

The referral pathways varied depending on the type of practice of the study participants. Those who worked in stand-alone optometry practices referred patients with keratoconus to either fellow optometrists or hospitals while for those who worked in hospital settings, it depended on whether they had available equipment and/or expertise.

One of the main challenges associated with the referral of patients with KC is the long distance to hospitals especially for optometrists who practice upcountry. A participant said:

TABLE 6: Factors that determine referral of keratoconus patients.

Clinical findings	%	Other factors	%
Quick change in prescription and advanced condition	6.7	Failure to come for review	6.7
Other ocular conditions such as severe infection, severe allergies and exposure keratopathy	13.3	Availability of ophthalmologist to refer to	6.7
Pain	13.3	Financial status of the patient	6.7
Poor visual acuity especially when not correctable with spectacles or contact lenses	60.0	Willingness of the patient	6.7
Acute hydrops	13.3	Age	26.7
High refractive errors such as myopia and astigmatism accompanied by frequent change of prescription	13.3	Patient's decision	6.7
Cornea scar	3.3	Place of origin or residence	6.7
Oil droplet reflex	6.7	Family history	6.7
Advanced Munson sign	20.0		
Severe allergies	6.7		

'The biggest challenge here is when I reach a point of referring a patient. The nearest option is Kampala which is quite a distance ... They find it hard to reach the next level of management. I meet someone 6 months down the line and the person has not gone to the hospital where I had referred them earlier ...' (Participant 3, private stand-alone practice)

Outcomes of the keratoconus surgical interventions

This challenge was identified by 6.7% of the participants who mentioned that the lack of information from hospitals and other tertiary centres about the surgical outcome was a hindrance to their management of KC. A participant said:

'[S]ometimes you don't really know where to send them because for instance in Uganda, we don't have any published data about how those people are managing keratoconus at tertiary levels. For instance, we are told of people who are doing corneal transplant and all, but we don't know how successful they are for patients with advanced keratoconus. If anything, most of the people that we meet who have done corneal transplant have issues, and we don't know about the success rate of the others. So, it also makes it a bit challenging to know where to refer the patients and how successful the keratoconus management has been in those places ...' (Participant 5, private hospital)

Failure to follow-up

One of the challenges associated with follow-ups and referral of keratoconus patients is the failure to follow-up, which was pointed out by 33.3% of the participants. A participant attributed this to the patients' health-seeking behaviour:

'I have not followed up patients with keratoconus all the way because in our setting, we have very poor follow-up habits. The patients rarely come back to see the doctor unless they are really doing badly. You do not know whether they are doing well or not, but you can only assume that they are okay because they are not looking for you.' (Participant 5, private hospital)

Communications between eye care practitioners

This was identified as a challenge by 13.3% of the participants who mentioned that they do not receive feedback or any communication after referring their patients with keratoconus for further management. A participant said:

'[M]ost of the patients I have referred to ophthalmologists have never come back especially here in Uganda. So, the follow-up just disappears.' (Participant 13, private stand-alone practice)

This was further re-affirmed by another participant:

'I first find out the cause of the keratoconus. If diagnosis is made, they have to be managed but I have not received feedback for most patients I have referred.' (Participant 14, private stand-alone practice)

Cost

This was also identified by the participants as a challenge associated with the management of KC. A participant said:

'I remember we fit contact lenses for a patient with keratoconus and then upon completion, he could not afford them. Also, we never saw the patient ever again ...' (Participant 5, private hospital)

Insufficient resources

In relation to this, a participant said:

'[L]ack of equipment and materials is the main barrier. I don't think there is any other.' (Participant 12, private stand-alone practice)

Challenges associated with contact lenses

These challenges included inadequate experience, lack of KC fitting sets, difficulty ordering, unavailability of ready supply and cost. A participant said:

'... I am not so experienced to do that; although I know what is supposed to be done, I do not have skills to do it. Even the contact lenses themselves are not available, so we take the shortest option which is to use glasses. When it fails then we look for where contact lenses fitting can be done.' (Participant 11, private stand-alone practice)

Even if some optometrists had the knowledge, a lack of KC fitting sets was a hindrance to their practice of contact lenses. A participant said:

'[C]ontact lenses and other options of management are really limited, so we go for the spectacles regardless of how severe it is.' (Participant 4, private hospital)

Another challenge was the ordering and unavailability of ready supply. A participant said:

'The availability of contact lenses and the problem of ordering for them. They are not readily available, so you have to order them ... mostly, I order them from UK or India, and they take a very long time. It is very discouraging for the practitioner and for the patient. We don't have the ready supply of contact lenses, especially the rigid gas permeable.' (Participant 13, private stand-alone practice)

The cost of the contact lenses and failure to follow instructions were also considered as significant challenges in contact lens practice.

Lack of awareness

A participant said:

'[I]t is also challenging when you are dealing for example with a child and then you are explaining this to the parents who may

not take you seriously and they may not bring them for follow-up.' (Participant 5, private hospital)

Non-cooperation

Non-cooperation from the patients was mentioned by 6.7% of the participants. This was reported to be noticed during examination. A participant said:

'You can do your keratoconus assessment and give your prescription and recommendation. Patient goes and comes back several months later only to find that it has progressed and you have to start up again.' (Participant 2, private hospital)

Discussion

Knowledge and experience

The participants had various levels of experience and the longest-serving optometrists trained from abroad while most of those with less than five years of experience were locally trained. This is because the first cohort of locally trained optometrists in Uganda graduated in 2019 from Makerere University and the number is expected to increase in the future as more are being trained. This is different from the number of optometrists in countries, which have had optometry training institutions for a long time like the United Kingdom (UK).¹¹ A similar study performed in the UK and Spain recorded responses from 126 optometrists from the former.¹¹ This number is higher when compared to the number of participants recruited in this study because there was initially no training institution for optometrists in Uganda. This study revealed that hospital-based optometrists see more patients and hence more KC cases. This is because many patients prefer to go to hospitals as compared to stand-alone practices. The average number of years of experience is low because most of the participants have practiced for less than 10 years. This was similar to a study carried out among optometrists in the public sector of KwaZulu-Natal, South Africa, which found that 80% had a work experience of less than 10 years.¹² This is because the optometry profession is still developing in Uganda and in the future, more optometrists in the country will be able to take part in similar studies. This is also different from that of other countries such as Cameroon in which a similar study found that most participants had more than 11 years of working experience.¹³

Diagnosis

Most of the participants use retinoscopy to diagnose KC. Scissoring of the red reflex on retinoscopy is a reliable and sensitive method for detecting early-stage KC.^{14,15} Retinoscopy was considered by the participants as one of the easiest ways of diagnosing KC and cheaper when compared to other diagnostic tools like corneal topography. It has been confirmed to be an extremely sensitive and reliable test for detecting KC at early stages in other studies.^{16,17} These findings are also similar to a study carried out in Kenya, which found out that most participants had access to retinoscopes.¹⁸

Munson's sign was the second most used method by participants for the diagnosis of KC. It was described by 46.7% of the participants. Moderate-to-severe KC tends to produce Munson's sign, while mild cases will not produce this because corneal bulging is more subtle.¹⁹ Munson's sign was described as one of the easiest ways of diagnosing KC especially when it is in the moderate or severe stages. Mild cases of keratoconus can easily be missed if an optometrist relies solely on the Munson's sign, which calls for the need to employ other techniques to aid in the diagnosis of the condition.

Slit lamp biomicroscope and keratometry were each considered by 33.3% of the participants as important equipment for diagnosing KC. Even though slit lamps are particularly important in making a diagnosis, they are not available in all optometry practices in Uganda. They are not only useful in examination of the ocular health but also play a crucial role in contact lens assessment and fitting, which can be used for the management of patients with KC.

Corneal topography has been documented to be one of the best equipment to use for diagnosis of KC and its management.³ Low availability of corneal topography was reported in Latin America (23%), although practitioners with topographers are more likely to prescribe rigid contact lenses (92.3%) and detect more new patients with keratoconus.²⁰ This was similar to the findings of this study as few practitioners (20%) reported having corneal topographers in their practice.

Most of the study participants (93.3%) relied on more than one test to diagnose KC in their practice, which reduced their chance of missing the condition or incorrectly diagnosing it. This is crucial as the diagnosis of the condition requires consideration of various parameters in the clinical signs.²

Management

All optometrists who participated in the study managed KC using spectacles and only four acknowledged the use of contact lenses in the management of the condition. Keratoconus management depends on the severity of the condition. In the early stages, it can be managed with spectacles and as the condition progresses, patients would benefit more from contact lenses.²¹ All the participants use spectacles because they are much easier to assess, dispense and cheaper as compared to contact lenses. This result is different from that of a similar study performed in Australia, which found that the majority of optometrists manage the condition using contact lenses.²² This could be attributed to the high number of optometrists in Australia when compared to Uganda and the fact that the profession is well-established in the former. The findings from this study are similar to the results of the study performed in Kenya, which found that the majority of the participants prescribed spectacles in mild and moderate cases of keratoconus.¹⁸ Our study did not comprehensively explore the management

options in relation to severity of keratoconus. The low practice rate of contact lenses is related to the challenges associated with this type of management, which are further explored under the barriers.

Referrals

In this study, 93.3% of participants would consider referring their patients for possible surgical intervention if their visual acuities were equal to or worse than 6/36. This is significantly different from a similar study performed in Australia, which found that 62.9% of the optometrists would refer a patient for surgical intervention when visual acuity dropped to between 6/9 and 6/12.²² Vision-related quality of life has been associated with visual acuity and the lower the visual acuity, the lower the quality of life.²³ Optometrists and other eye care providers should be encouraged to not wait for visual acuities to significantly deteriorate to 6/36 or worse before referring patients to other levels of care. This means patients have to live longer with the condition whose treatment or intervention would have alleviated their symptoms.

Barriers to management

The first barrier was limited investigations because of the lack of equipment such as corneal topographers, which have been confirmed to be crucial in KC detection and management.²⁰ This was also identified as the main challenge in a similar study performed in the public sector of KwaZulu-Natal, South Africa among optometrists.¹² Only 20% of the participants in this study had corneal topographers in their practices. In addition, they were all hospital-based optometrists. This is also similar to results of a study carried out in the UK and in Spain, which found that using corneal topography is uncommon from both countries.¹¹ These results are also in agreement with the study performed in Latin America, which established that only 23% of the participants had corneal topographers in their optometry practices.²⁰ In Africa, a similar study carried out in Kenya and South Africa also found that not many optometrists had access to corneal topographers.^{24,25} This affects their diagnosis and management of the condition as they might miss out on the early detection of KC, which might be seen on a topographer.

Success in the contact lens usage and maintaining higher visual acuity has been documented to improve vision-related quality of life in patients with keratoconus.²³ The challenges associated with contact lens practice included knowledge and experience, lack of keratoconus fitting sets, contact lens ordering and procurement, unavailability of ready supply and cost of the contact lenses. For the few participants practicing contact lenses, the challenges mentioned were failure to follow instructions by the patients and the cost. This is in agreement with a study done in Latin America, which found that optometrists had difficulty in fitting rigid gas permeable contact lenses and the practitioners also said keratoconus contact lens fitting requires more sets.²⁰

A lack of awareness by the patients was also a limiting factor as some of the participants said some patients failed to come for follow-up visits and do not adhere to the instructions given by the optometrists because according to them, the condition was not a serious one. More emphasis should be put by the government and other stakeholders in creating awareness about the various eye conditions, their prevention and when to seek professional advice.

Long referral distance was mentioned by optometrists practicing upcountry (more than 400 km from Kampala). The closest hospital for referral of patients with severe KC cases is in the capital city of the country, Kampala. This makes it difficult for patients to go for further management because of the cost involved in transportation, which calls for more resources and hospitals in other regions of the country.

A lack of data from tertiary centres was also mentioned as a challenge. If published data are available about KC patients who have undergone different types of surgical interventions from hospitals, it would increase the number of referrals from the primary healthcare providers of the eye and the visual system. This would also add to the imperative for evidence-based eye care practice in Uganda.

One of the challenges emphasised by 33% of the participants was the loss of patients after referral to other levels of care. If this challenge is addressed, the referral system in the country with regard to eyecare will also be strengthened as the optometrists would be able to establish the validity of their individual referrals.

Study's strength and weakness

This is the first study to examine how optometrists in Uganda manage KC and it will be used to identify areas of training and policy to improve eye care service delivery. Trainings can be delivered through Continuous Professional Developments (CPDs) organised by the OAU while policies can include advocating for more optometrists to be employed in the public sector and lobbying for more eye care equipment. The study enrolled participants with different levels of experience and from different training institutions (in Uganda and abroad), which broadened the range of data that were gathered.

One of the main challenges of the study is that most participants practiced optometry in the central region of the country and therefore the results were not entirely representative of other regions without any optometrists or where they did not participate in the study.

Conclusion

Most participants in this study were practicing in urban settings and despite the different training backgrounds, they had similar approaches to the diagnosis and management of KC. Most optometrists relied on retinoscopy for diagnosis

and spectacles for the management of KC. These approaches were attributed to the lack of diagnostic equipment and challenges associated with contact lens practice in Uganda. The challenges associated with the contact lens management of KC include inadequate experience, lack of contact lens fitting sets, cost, and unavailability of their ready supply.

Acknowledgements

The authors would like to thank all the optometrists who sacrificed their time to participate in this project and the OAU for granting access to them. This article is based on the author's thesis entitled 'Knowledge, experience, and practices of optometrists in Uganda about keratoconus' towards the degree of MSc Primary Care Ophthalmology (Online Learning) in the Deanery of Clinical Sciences, College of Medicine and Veterinary Medicine, The University of Edinburgh, United Kingdom, on 25 April 2022 with Dr. Simon Arunga as the supervisor.

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

G.W. authored the research proposal and implemented the study. S.A. supervised the study, read the main report and approved it before submission to the University of Edinburgh. B.D. reviewed the project at every phase of implementation. N.N. provided guidance during the implementation of the project and reviewed the content of the report. G.W., S.A., B.D., and N.N. reviewed and approved the final version of this article.

Funding information

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Data availability

All data generated or analysed during this study are included in this published article. The de-identified scripts transcribed verbatim from all the participants are available from the corresponding author, G.W., on reasonable request.

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