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College of Ophthalmology of Eastern, Central and Southern Africa (COECSA)

Editorial: Reimagining cataract financing in Uganda

As an ophthalmologist and clinical lecturer at Mbarara University of Science and Technology, I am deeply committed to transforming eye health in Uganda. My academic journey began with earning a medical degree and a Master's in Medicine from Mbarara University, followed by a PhD from the London School of Hygiene & Tropical Medicine (LSHTM), where I focused my research on corneal infections in Uganda. With a strong emphasis on anterior segment diseases and public health innovation, I have dedicated my career to combating preventable blindness and reimagining Uganda's eye care landscape through research, leadership, and advocacy. My vision is to create accessible and sustainable solutions for the challenges we face, which are substantial.

In Uganda, the need for eye care is immense. With only 50 ophthalmologists serving a population of 45 million, and similar shortages in allied eye health professions, the lack of resources is staggering. Of the 1.26 million people currently requiring cataract surgery, just 13,500 surgeries are performed annually. Financial constraints exacerbate the problem—only 10% of those in need can afford the procedure, leaving a vast unmet demand.

To help address this, I founded Dr. Arunga's Eye Hospital (DAEH) as the first social enterprise facility in Uganda dedicated to improving eye health. The hospital provides quality, affordable eye care to underserved communities, ensuring that no patient is turned away due to financial constraints. However, operating within the current model is challenging. At times, the hospital struggles to cover its costs, limiting our ability to invest in the future and tackle the broader gap in Uganda's eye care system. Uganda does not have a National Health Insurance scheme that is able to minimise out of pocket expenditure for the patients.

Through my journey I have been fortunate enough to encounter fantastic colleagues and mentors. One such colleague is Dr. Andrew Bastawrous, founder and CEO of Peek Vision and Professor of Global Eye Health at LSHTM. A few years ago, we began talking about some of my challenges and what needed to change. What if there was an innovative solution to the problem – far from unique to Uganda – of huge backlogs, patients who can't afford surgery and a system that can't sustainably provide high-quality care? Peek has been at the forefront of developing technology-led solutions to support eye health programmes at scale. In many regions Dr Bastawrous and his team experience the same issues we see in Uganda – even where programmes are successfully using Peek's technology to help them find patients and connect them to care, people are unable or unwilling to pay and continue to live without sight. What if patients could access low-cost capital to enable them life changing cataract surgery? Such an approach wouldn't just change lives—it could transform household incomes and futures.

From there, an idea was born! Using Peek's technology and our know-how, we approached Opportunity Bank, who are at the cutting edge of providing loans to underserved communities and have a fantastic track record of helping people in Uganda. Together, we developed the outline for a programme whereby cataract patients can be identified in the community then assessed medically at a local facility, all using the Peek technology so outcomes can be monitored. Those who need straightforward cataract surgery but cannot pay upfront are referred to Opportunity Bank, who provide the individual with counselling and financial literacy training. Where appropriate, the patient or their caregiver will be offered a small loan to cover the cost of surgery.

The programme pilot launched in March 2025 and is now underway. Our collective goal is to ensure that financial barriers do not prevent access to life-changing care. While it is still early days, our aspiration is that this model creates a self-sustaining system by connecting patients to financial resources, ensuring access to surgery, and making our hospital financially sustainable. We have dubbed this as a "see now, work and pay later" model. While we are at the very early stages, the potential is huge and could change the lives of so many families in Uganda.

These ideas inspire me to keep pushing for a future where no one in Uganda is left in the dark due to preventable blindness.

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Barriers to the uptake of eye care services in people with distance and near visual impairment in Lusaka: A questionnaire-based study

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ABSTRACT

Objective: To determine the socio-demographic factors associated with the uptake of eye care services among individuals with Distance Visual Impairment (DVI) and Near Visual Impairment (NVI).
Methods: A prospective, questionnaire-based study was conducted at two outpatient clinics located in Lusaka, Zambia from August to September 2023. A total of 460 participants aged ≥15 years with presenting distance Visual Acuity (VA) <6/12 in their better eye and binocular near VA < N6 were included. The barriers reported by the participants were used for the analysis. A Chi-square test was used to find the association between the barriers and socio-demographic factors, such as age, gender, education, occupation, and the type of visual impairment.
Results: Among the 460 participants enumerated, 378 (82%) had DVI and 82 (18%) had NVI. In the DVI group, the mean (SD) age was 62.6 (16.2) years; 59% were women. Based on VI, 43.9% had mild VI, 38.6% had moderate or severe VI, and 14.8% were blind. In the NVI group, the mean age was 53.2 (10.8) years; 72% were women. The leading barriers reported in the DVI group were the cost of the treatment (43.4%) and the distance of the services (35.7%). Lack of felt need (31.7%), cost of the treatment (22%), inadequacy of hospitals (22%) and the distance of the services (20%) were reported as barriers by participants in the NVI group.
Conclusion: Economic, service and person-related barriers, strongly impact the likelihood of seeking eye care services across all age groups, with the elderly being particularly affected.

Key words: Barriers, Eye care, Visual impairment, Lusaka- Zambia, Utilisation

INTRODUCTION

In 2020, the Vision Loss Expert Group estimated that, 258 million people had mild Distance Vision Impairment (DVI), 260 million had moderate DVI, and 34.8 million had severe DVI globally[1]. The leading causes of VI were under-corrected refractive error, cataract, age-related macular degeneration, glaucoma, and diabetic retinopathy[2]. In addition, 510 million people had Near Vision Impairment (NVI) due to uncorrected presbyopia[1]

Lusaka, the capital city of Zambia, has a population of approximately three million people, with 86.3% living in urban areas and 13.7%, living in rural areas. A 2012 Rapid Assessment of Avoidable Blindness study conducted in Southern Zambia revealed that approximately 2.3% of the population were blind, with 65.1% of cases being avoidable (predominantly cataract). The refractive error contributed 29.2% of VI. The study also found that women were more affected than males[3]. Globally, there has been a noticeable increase in the number of people with DVI and NVI, rising from 3.92% in 2010 to 4.34% in 2020. This increase in VI has been attributed to the following key factors: (a) an increased life expectancy, leading to a shift in disease burden, as many people live into adulthood; (b) a lack of understanding in the provision of eye care services; (c) barriers in assessing the eye care service[1]. Between 2010 and 2020 the trend in the barriers to the uptake of the eye care, has changed from economic and service-related barriers to personal barriers[4,5]. In the region of Lusaka, no studies have been conducted to elucidate the utilisation of eye care services.

Therefore, this research study aims to identify the current barriers to the utilization of eye care services among individuals presenting to our clinic with distance and near vision impairment in the Lusaka region.

Study definitions

Visual impairment: Visual impairment is defined as presenting Visual Acuity (VA) of <6/12 in the better eye. DVI was defined as presenting VA of <6/12, with or without N6, for Near Visual Acuity. (NVI) was defined as binocular near vision <N6 at the participant's customary working distance in people aged >40 years and those with presenting distance VA of 6/12 (0.3 log MAR) or higher in the better eye[6].

Barriers: A barrier is defined as "any reason that prevents a person who could benefit from spectacles or further treatment from accessing eye care services"[7].

Person-related barriers: Person-related barriers are any reasons that comprise cognitive and emotional factors that prevent a person from seeking eye care services, such as unaware of the problem, home or traditional treatment, no one to escort, and no sufficient time for treatment[8].

Economic or service-related barriers: Economic or service-related barriers are any reasons related to the service provider or treatment that hinder a person from seeking eye care services, such as accessibility, affordability, crowding, and long waiting time[8].

MATERIALS AND METHODS

Study settings: This qualitative study, which employed a questionnaire-based approach, was conducted by optometrists at two outpatient clinics located in Lusaka Province, Zambia. Participants attending these clinical facilities were eligible for inclusion in the study, provided they fulfilled the established study protocol. Data collection was carried out between August and September 2023.

Sample size: A total of 460 participants were selected for this study through convenience sampling. Participants who utilized our outpatient services for examination were recruited based on the study inclusion and exclusion criteria and their willingness to participate.

Inclusion and exclusion criteria: The study included individuals aged 15 years or older who had distance visual acuity worse than or equal to 6/12 (0.3 log MAR) in their better eye or binocular near visual acuity less than N6 at a customary working distance of 40cm. Participants with a presenting visual acuity better than 6/12 or N6 were excluded.

Sampling technique: Any participants who aged 15 years or older were involved in the study employing simple random sampling technique, ensuring that each participant meeting the given study criteria had an equal chance of selection.

Data collection: Each participant underwent a comprehensive eye examination that included clinical history, refraction, and torch light examination. After the examination, the participants were given a questionnaire with the list of barriers. They asked to select at least three barriers they faced to the uptake of eye care out of a list of 18 and rank them from 1 to 3 based on their perceived significance. They were allowed to select only two barriers from the list if only two barriers applied. The questionnaire was administered by a clinical optometrist in both study centers. The barriers were categorized as Person-related barriers and economic or service-related barriers to better understand the barriers and the suggestions to overcome them.

Storage: The data supporting the findings of this study are available in a drive. The dataset is stored in Excel format and includes all raw and processed data, organized according to the unique research ID number and time point. A data code sheet detailing the variable definitions and units of measurement is provided as a supplementary file. Data are backed up regularly on secure institutional servers. The data set are encrypted, where only the authors have the access for them.

Data analysis: Data management and statistical analyses were performed using Statistical Package for Social Science (IBM Corp. Released in 2013. IBM SPSS Statistics for Windows, Version 29.0.1.0 Armonk, NY: IBM Corp.). A non-parametric test was used to obtain p-values for respective variables, as all the variables considered in this study were categorical. The Mann-Whitney U test was used to find the difference in the mean age among the participants in both groups. The Chi-square test was used to assess the statistical significance among the other categorical variables. Statistical significance was set at $p<0.05$.

Ethics approval: The study was approved by the Institutional Ethics Committee of the University of Hyderabad (UH/IEC/2023/594). The procedure of the study was explained to each participant, and they provided informed consent before the eye examination began. The research protocol adhered to the tenets of the Declaration of Helsinki.

RESULTS

A total of 471 participants were examined from both study centers. Among them, 11 were excluded as they were not visually impaired. In the final sample of 460 participants, with 378 participants (100% response rate) in the DVI group and 82 participants (100% response rate) in the NVI group.

In the DVI group, the mean age was 62.6 years (SD=16.2 years) and 224 (59%) were women. Among those with DVI, 305 (80.7%) had none to twelve years of formal education and 63 (16.7%) had more than 12 years of education. Based on the degree of visual impairment, 166 (43.9%) had mild VI, 146 (38.6%) had moderate or severe VI, and 56 (14.8%) were blind. Skilled labor, clerical jobs, and administrative work were performed by 94 (24.9%) of participants, 167 (44.2%) were retired or engaged in home duties, and 112 (29.6%) were not employed. In the NVI group, the mean average age was 53.2 years (SD= 10.8 years), and 59 (72%) were women and 23 (28%) were men. Among those with NVI, 54 (65.9%) of participants had none to twelve years of formal education and 24 (29.3%) had more than twelve years of

education. Skilled labor, clerical jobs, and administrative work were performed by 46 (56.1%) of participants, 23 (28.0%) were retired or engaged in home duties, and 12 (14.6%) were not employed, as outlined in Table 1.

Table 1: Demographic data

Parameters	Groups	
	DVI	NVI
Total number of participants (n)	378	82
Age (years)-Mean (SD)	62.6 (16.23)	53.2 (10.80)
Gender n (%)		
Male	154 (40.7%)	23 (28%)
Female	224 (59.3%)	59 (72%)
Education level (years) n (%)		
0-12	305 (80.7%)	54 (65.9%)
>12	63 (16.7%)	24 (29.3%)
Occupation n (%)		
None	112 (29.6%)	12 (14.6%)
Home duties/Retired	167 (44.2%)	23 (28%)
Skilled labour/Clerical/Administrative work/ Business	94 (24.9%)	46 (56.1%)
Category of visual impairment n (%)		
Mild distance VI	166 (43.9%)	-
Moderate and severe distance VI	146 (38.6%)	-
Blindness	56 (14.8%)	-

In the DVI group, the most significant barrier to availing eye care services was the cost of treatment, which was reported by 43.4% of participants, followed by the distance of the services. The distance of the services was reported as both the second and third common barrier for the uptake of eye care services by 35.7% of and 18.5% of participants respectively.

In the NVI group, lack of felt need was the most common barrier, with 31.7% of participants reporting that they were aware of the problem but did not feel the need to seek treatment. The cost of treatment and inadequacy of hospitals were reported as additional barriers by 22% of participants each. The third most common barrier was the distance of services, which was 20.7%, as outlined in Table 2.

Table 2: The first three major barriers reported among the participants in DVI and NVI group

Barriers	DVI group			NVI group		
	Major reported barrier n (%)	Second barrier n (%)	Third barrier n (%)	Major reported barrier n (%)	Second barrier n (%)	Third barrier n (%)
I am unaware of the problem	22 (5.8%)	-	3 (0.8%)	18 (22%)	1 (1.2%)	1 (1.2%)
I am aware of the problem but my eyes are not yet bad enough to seek treatment	48 (12.7%)	12 (3.2%)	11 (2.9%)	26 (31.7%)	2 (7.3%)	4 (4.9%)
The cost of treatment	164 (43.4%)	57 (15.1%)	57 (15.1%)	15 (18.3%)	18 (22%)	8 (9.8%)

Hospital services are not adequate	70 (18.5%)	64 (16.9%)	37 (9.8%)	6 (7.3%)	18 (22%)	8 (9.8%)
Distance of services are too far away	28 (7.4%)	135 (35.7%)	70 (18.5%)	5 (6.1%)	17 (20.7%)	17 (20.7%)
I have other health priorities	16 (4.2%)	12 (3.2%)	12 (3.2%)	3 (3.7%)	5 (6.1%)	2 (2.4%)
No sufficient time to seek treatment	18 (4.8%)	46 (12.2%)	23 (6.1%)	4 (4.9%)	12 (14.6%)	16 (19.5%)
Ridicule- E.g. I will be teased if I seek treatment, cosmetics, discomfort	1 (0.3%)	1 (0.3%)	1 (0.3%)	1 (1.2%)	-	-
Visual impairment is destiny or God's will	-	2 (0.5%)	2 (0.5%)	-	-	-
I fear my eyesight will get worse with treatment	1 (0.3%)	2 (0.5%)	5 (1.3%)	1 (1.2%)	1 (1.2%)	-
A family member is restricting me from accessing services	-	-	-	-	-	-
Visual impairment is normal with aging	3 (0.8%)	21 (5.6%)	29 (7.7%)	1 (1.2%)	2 (2.4%)	5 (6.1%)
One eye vision is adequate/need not felt	-	2 (0.5%)	10 (2.6%)	-	1 (1.2%)	1 (1.2%)
No one to escort	1(0.3%)	11 (2.9%)	17 (4.5%)	-	-	1 (1.2%)
Use of traditional/home remedies	-	1 (0.3%)	-	-	-	-
Time consuming/waiting time	-	1 (0.3%)	2 (0.5%)	-	-	2 (2.4%)
I am of the problem but thought there is no treatment or solution	-	2 (0.5%)	6 (1.6%)	-	-	-
Other	2 (0.5%)	2 (0.5%)	-	-	-	-

A comparison of the barriers to utilization of services with various sociodemographic variables in the DVI group revealed a significant difference between the age groups (p=0.018) and the utilization of services. There was a significant correlation between utilization of eye care and the type of occupation (p=<0.001), and categories of visual impairment (p=0.033). In addition, participants in the DVI group reported more service-related and economic barriers than person-related barriers (Table 3).

Table 3: Barriers for not utilising eye care services compared with various socio demographic variables and the categories of VI among participants with DVI

Parameters	Distance VI group		P-value*
	Person related barriers n (%)	Service & economic related barriers n (%)	
Age group (years)			
15-29	11 (9.6%)	11 (4.1%)	0.018
30-49	23 (20%)	33 (12.3%)	
50-69	44 (38.3%)	107 (39.9%)	
70+	37 (32.2%)	117 (43.6%)	

Gender			
Male	49 (42.6%)	106 (39.7%)	0.576
Female	66 (57.4%)	162 (60.4%)	
Education (years)			
0-12	86 (77.5%)	222 (84.7%)	0.091
>12	25 (22.5%)	40 (15.3%)	
Occupation			
None	19 (16.5%)	94 (35.7%)	
Home duties/Retired	58 (50.4%)	110 (41.8%)	<0.001
Skilled labor/Clerical/ administrative work/ Business	38 (33%)	59(22.4%)	
Categories of VI			
Mild distance VI	59 (53.6%)	106 (41.2%)	
Moderate and severe Distance VI	41 (37.2%)	105 (41%)	0.033
Blindness	10 (9.1%)	45 (17.9%)	

*Chi Square test

Table 4: Barriers for not utilising eye care services compared with various socio demographic variables among participants with NVI

	Near VI group		
Parameters	Person related barriers n (%)	Service & economic related barriers n (%)	P-value*
Age group (years)			
30-49	34 (61.8%)	5 (18.5%)	
50-69	18 (32.7%)	16 (59.3%)	0.001
70+	3 (5.5%)	5 (18.5%)	
Gender			
Male	16 (29.1%)	8 (29.6%)	0.96
Female	39 (70.9%)	19 (70.4%)	
Education (years)			
0-12	29 (56.9%)	25 (92.6%)	0.001
>12	22 (43.1%)	2 (7.4%)	
Occupation			
None	5 (9.3%)	8 (29.6%)	
Home duties/Retired	13 (24.1%)	10 (37.0%)	0.009
Skilled labor/Clerical/ Administrative work/ Business	36 (66.7%)	9 (33.3%)	

*Chi Square test

In the NVI group, a comparison of the association between various factors and eye care-seeking behavior revealed a significant association with age group (p=0.001), level of education (p=0.001) and the type of occupation (p=0.009). In contrast to the DVI group, the participants in the NVI group reported more person-related barriers (Table 4).

DISCUSSION

In eye care services, barriers such as cost and access to eye examinations leave nearly 500 million people, particularly in developing countries, without proper care. Approximately one-third of this population resides in Africa[9]. The current study investigated the barriers to the utilization of eye care services among people with DVI and NVI in Lusaka, Zambia, and its association with various socio-demographic factors.

For this purpose, the participants were divided into two separate groups based on the presenting VI (DVI and NVI). In the DVI group, most of the participants didn't seek eye care services due to *"service and economic-related barriers"*. The cost of the treatment, the distance of the eye care facility, and its transportation were the major barriers reported in the DVI group. This was consistent with previous studies conducted in other countries, which showed that financial constraints were a significant barrier to accessing eye care services[4,5,7,10-13].

People aged 70 years and over comprised the highest proportion (43.6%) of participants to report economic and service-related barriers, especially the cost and distance of the eye care facility. This could be because they are financially dependent due to their age. Supporting our finding, several other studies have indicated that affordability is a key barrier to accessing eye care services[14,15]. In contrast, a Rapid Assessment of Refractive Error survey conducted in Durban concluded that the cost of spectacles was among the least concerning barriers compared to other factors listed. This difference may be attributed to a higher recruitment of female participants who were more likely to be confined to home duties rather than engaging in outdoor work[16].

The cost of eye care services encompasses not only the price of spectacles but also the indirect costs such as transportation and living expenses if you need to travel far to avail the services. According to a report from the national health insurance scheme in 2019, most people in Lusaka paid a minimum of USD 1.37 for transportation to the nearest eye care facility[17]. Individuals confined to home duties or those who have retired find it particularly challenging to bear these costs. Reducing surgical cost and providing transportation incentives have been shown to improve cataract surgical coverage and the utilization of eye care services[18].

Access to health insurance also plays a vital role in the uptake of eye care services. Health insurance phases out the immediate financial burden and allows anyone to utilize the medical services periodically or when required. Research indicates that individuals with health insurance are twice as likely to utilize eye care services, resulting in improved eye care-seeking behavior[19]. This trend aligns with our current study, where only 20 (4%) of the 460 participants recruited reported not having any form of insurance. On the other hand, in the Ashanti region of Ghana, interviews indicated that following financial constraints, extended waiting times and overcrowding in hospitals represented the second most common barriers to accessing healthcare[20,21]. However, in the current study, these factors were reported as the least significant reasons (3.2%) for not seeking eye care services.

In contrast to the DVI group, the participants in the NVI group reported the highest proportion of person-related barriers, with the most common being that their eyes were not bad enough to seek treatment, followed by economic and service-related barriers, such as the cost of the treatment, hospital inadequacy, and distance of the facilities. Lack of felt need was the second most common person-related barrier reported in previous studies, particularly among those with presbyopia[4,7]. However, a recent study found that people with asymptomatic conditions, like glaucoma, often report a lack of felt need as a primary barrier[22]. People with NVI can often manage their day-to-day activities with minimal or no adjustments and tend to seek treatment only when their condition becomes worse or they are no longer able to manage their daily activities. Such issues could be successfully addressed by extensive screening camps to diagnose any refractive or ocular condition and create awareness among the community about the available eye care services.

There are a few limitations to our study that restrict the generalization of its results. First, we included a higher proportion of the urban population and were limited to people visiting the eye centers. Second, the sample size of the study was not large enough to represent the entire population of Lusaka. However, this is the first study to be conducted in Lusaka on utilisation of eye care services, which can help policymakers, healthcare professionals, and other stakeholders with the planning and implementation of eye care services. Further research is needed to explore eye care-seeking behavior, particularly among the rural population.

CONCLUSION

In conclusion, we found that certain barriers present significant challenges to accessing eye care services in the Lusaka region of Zambia. It is crucial to focus on improving the infrastructure and the number of trained professionals to address these barriers. Such initiatives and improvements can guarantee that eye care services are accessible to all individuals within the region. Therefore, it is imperative to prioritize the development of a more effective and inclusive eye care service delivery model that can provide accessible eye care to all those in need.

Declaration

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Author contribution statements: Vaishaali Gunalan conceived the presented idea and collected data in one of the test centres. Bichappa Geedla was an examiner in the second centre and was involved in data collection. Srinivas Marmamula developed the theory and verified the analytical methods performed by Vaishaali Gunalan. All authors discussed the results and contributed to the final manuscript. All the requirements for authorship have been met and author each other believes that the manuscript represents honest work.

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REFERENCES

1. Bourne R, Steinmetz JD, Flaxman S, *et al*. Trends in prevalence of blindness and distance and near vision impairment over 30 years: An analysis for the Global Burden of Disease Study. *The Lancet Global Health*. 2021; **9**(2):e130-143.
2. Flaxman SR, Bourne RR, Resnikoff S, *et al.* Global causes of blindness and distance vision impairment 1990–2020: a systematic review and meta-analysis. *The Lancet Global Health*. 2017; **5**(12): e1221-34.
3. Lindfield R, Griffiths U. A rapid assessment of avoidable blindness in Southern Zambia. *PLoS One*. 2012; **7**(6): e38483.
4. Merepa S, Akowuah P. Barriers to utilization of eye care services in the Upper East Region, Ghana. *Advances Ophthalmol Visual System*. 2017; **7**(6):10-5406.
5. Marmamula S, Khanna RC. A population-based cross-sectional study of barriers to uptake of eye care services in South India: The Rapid Assessment of Visual Impairment (RAVI) project. *BMJ Open*. 2014; **4**(6):e 005125.
6. World report on vision. Geneva: World Health Organization; 2019. Licence: CC BY-NC-SA 3.0 IGO.
7. Marmamula S, Keeffe JE. Population-based cross-sectional study of barriers to utilisation of refraction services in South India: Rapid Assessment of Refractive Errors (RARE) study. *BMJ Open*. 2011; **1**(1): e000172.
8. Saunders SM, Zygowicz KM. Person-related and treatment-related barriers to alcohol treatment. *J Substance Abuse Treatment*. 2006; **30**(3):261-270.
9. Holden BA, Sulaiman S. The challenge of providing spectacles in the developing world. *J Comm Eye Health*. 2000; **13**(33):9–10.
10. Ezinne NE, Ekemiri KK, Chukwuma I, *et al.* Utilization of eye care services in an underserved community in Enugu State, Nigeria. *Nigerian J Clin Practice*. 2023; **26**(1):81-89.
11. Marmamula S, Yelagondula VK, Kumbham TR, *et al*. Population-based assessment of barriers for uptake of eye care services among elderly people: Findings from rapid assessment of visual impairment studies from Telangana, India. *Indian J Ophthalmol.* 2022; **70**(5): 1749-53.
12. Elam AR, Lee PP. Barriers to and suggestions on improving utilization of eye care in high-risk individuals: focus group results. *Intern Scholarly Res Notices*. 2014; **2014**:1-8.
13. Okoye RS, Bell L, Papadopoulos I. Barriers to accessing good eye care services in Nigeria: A focus on Anambra State. *J Nigerian Optometric Ass*. 2018; **20**(1):30-37.
14. Thompson S, Naidoo K, Gonzalez-Alvarez C, Harris G, Chinanayi F, Loughman J. Barriers to use of refractive services in Mozambique. *Optometry Vision Sci.* 2015; **92**(1):59.
15. Kovai V, Krishnaiah S, Shamanna BR, Thomas R, Rao GN. Barriers to accessing eye care services among visually impaired populations in rural Andhra Pradesh, South India. *Indian J Ophthalmol*. 2007; **55**(5):365-371
16. Naidoo KS, Chinanayi FS, Ramson P, Mashige KP. Rapid assessment of refractive error in the eThekwini Municipality of KwaZulu-Natal, Durban, South Africa. *Clin Experimen Optometry*. 2016; **99**(4):360-365.
17. Customer satisfaction survey report. Lusaka. Zambia. National Health Insurance Management Authority (NHIMA). [Nov 2019]. 1-94.
18. Ellwein LB, Lepkowski JM. Operations Research Group. The cost effectiveness of strategies to reduce barriers to cataract surgery. *Intern Ophthalmol*. 1991; **15**:175-183.
19. Akuffo KO, Sewpaul R. Eye care utilization pattern in South Africa: results from SANHANES-1. *BMC Health Services Res*. 2020; **20**:1-2.
20. Sengo DB, Marraca NA. Barriers to accessing eye health services in suburban communities in Nampula, Mozambique. *Intern J Environ Res Public Health*. 2022;**19**(7):3916.
21. Mohammed AK, Munsamy AJ. Ophthalmic services utilisation and associated factors in the Ashanti region, Ghana. *Ghana Med J.* 2023; **57**(1):58-66.
22. Ja E, Go OO. Barriers to utilization of eye care services in rural communities in Edo State, Nigeria. *Borno Med J*. 2014; **11**:98-104.

Factors associated with the uptake of cataract surgery among adults identified with operable cataract in South Western Uganda

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ABSTRACT

Objective: To determine the factors associated with the uptake of cataract surgery among adults identified with operable cataract in South Western Uganda.
Methods: In a hospital-based cross-sectional study, patients presenting with operable cataract at two large tertiary level eye hospitals in south-western Uganda were prospectively consecutively enrolled between, October 2020 to January 2021. Operable cataract was defined, as a best-corrected visual acuity equal or less than 6/60 where the principal cause is cataract. The outcome of interest was undergoing a cataract surgery within 3 months of diagnosis. In a multivariable logistic regression model, we tested for social demographic and other baseline features associated with uptake of a cataract operation.
Results: During the study period, a total of 400 patients with operable cataract were enrolled out of a total outpatient attendance of 1692 in the two hospitals (23.6%). The median age was 71 (IQR 65-80, full-range 30-102) and 222 (55.5%) were female. Most were married 242 (60.5%), the majority with no formal education 184 (46%). The most common occupation was being a peasant 256 (64%). The majority of the patients were household heads 285 (71.2%) and a large proportion required an escort to the hospital 384 (87%). Bilateral operable cataract was present in 146 (36.5%). Within the study period, the uptake of cataract surgery was 64% 95% CI (59- 68). In a multivariable logistic regression model, <50 years (OR 3.0, 95% CI (1.26 – 7.23) P-value = 0.021), female gender (OR 1.5, 95% CI (1.04 – 2.34) P-value=0.032) and bilaterally affected eyes (OR 2.95, 95% CI (1.8 – 4.8) P-value 0.001) were associated with uptake of cataract surgery.
Conclusion: This study showed that younger patients compared to older ones, females compared to males and bilaterally affected patients compared to unilateral were more likely to uptake cataract surgery. This provides useful background information for planning improvements in the uptake of cataract services.

Key words: Cataract, Factors associated, Uptake, Gender, Age, Bilateral cataract, Hospital-based

INTRODUCTION

Cataract is clouding of the lens of the eye which prevents clear vision. Although most cases of cataract are related to the ageing process, occasionally children can be born with the condition, or a cataract may develop after eye injuries, inflammation, and some other eye diseases. It develops slowly and can affect one or both eyes. Symptoms may include faded colours, blurry or double vision, halos around light, trouble with bright lights, and trouble seeing at night. Furthermore, there are different types of cataract among these are nuclear, cortical and Posterior Subscapular (PSC)[1].

Blindness and visual impairment are unequally distributed throughout the world and vary with place of residence, race, religion, occupation, gender, age, socioeconomic status, and literacy levels, accompanied by other disabilities such as hearing, walking, cognition, self-care, and communication. Cataract distribution patterns are more commonly prevalent among older age groups and in people residing in developing compared to developed countries[2].

According to the world vision report 2019, the prevalence of cataract was 65.2 million people amongst 2.2 billion people with visual impairment worldwide. Cataract surgery is one of the most commonly performed procedures, offering significant improvement in the quality of life for patients of all ages[3].

Cataract blindness is avoidable and surgical intervention can effectively restore visual impairment in the population. Socially disadvantaged population groups have a higher prevalence of poor uptake of

cataract services than their more privileged counterparts, primarily due to lower uptake of good quality services. For example: across the globe in 2015, women were 1.21 times more likely than men to be blind or visually impaired from cataract[4]. Gender difference could be due to gender-defined social roles, which could be confounded by factors like literacy rate, socioeconomic status as well as urban-rural differences. Women in countries with lower cataract surgical uptake are likely less educated, have other domestic responsibilities and are not the main earning member of the house, thus having less access to eye care as well as other health care services[5].

Despite the gradual rise of cataract surgical uptake and cataract surgical coverage in recent years with regard to advances in technology, safer practices of procedures show that the provision of cataract surgery is the most effective option of combating this imbalance in the socially disadvantaged groups[6].

Although the prevalence of cataract is high, the services available do not match the needs of the people. Several studies on factors associated with the barriers of uptake of these services have been done; however, few studies have assessed the factors that determine the motivation and willingness of undergoing cataract surgical services.

MATERIALS AND METHODS

This was a hospital based cross-sectional study of all patients with cataract that presented to Ruharo Eye Centre (REC) and Mbarara University and Referral Hospital Eye Centre (MURHEC) during the period from October 2020 to January 2021. MURHEC is a government owned tertiary eye unit established in 2013. It provides mostly free services and sees about 6,000 - 10,000 patients/year. REC is a church-based fee-paying tertiary eye hospital founded in the 1960's. It offers eye care services to about 20,000 - 25,000 patients/year. Both hospitals are located in Mbarara Municipality, South-Western Region, Uganda, approximately four hours' drive from Kampala. The two units are about 5km apart and work closely together.

The study included all patients who are greater or equal to 18 years of age with operable cataract and who provided written consent to participate in the study at MURHEC and REC and excluded patients with any mental condition that deters them to consent or clearly respond to study questions and with ocular comorbidities that make them surgically unsuitable like a dense corneal scar, retinal detachment with afferent pupillary defects, advanced glaucoma, diabetic retinopathy.

All patients had their Visual Acuity (VA) recorded with a Snellen (E) chart at 6 meters or counting fingers between 5 and 1 meter, then hand movement and perception of light. Patients were classified as operable cataract blind if their best-corrected visual acuity of less than 6/60 (severe visual impairment) where the principal cause is cataract. The ophthalmologist used a direct and/or indirect ophthalmoscope, as well as a slit lamp with condensing lens.

Face to face interview was done using pre-tested structured questionnaire, which consists of information on socio-demographic, ocular and medical history of the participants.

After checking completeness and consistency of the data; it was coded and entered into EPI info version 7.2, and then exported into STATA version 15 software for analysis. Descriptive and analytical statistics were performed for analysis of the entered data. Binary logistic regression was used to determine the significance of socio-demographic factors associated with uptake of operable cataract. The strength of association was expressed by using an adjusted odds ratio at a 95% confidence interval. The model of fitness was assured using goodness of fit. A variable with a P-value of less than 0.05 was considered as statistically significant. Finally, the analysed data was organized and presented with tables and text form as necessary.

Ethical approval was obtained from the Department of Ophthalmology (MUST), Clinical Director of Ruharo Eye Centre, Faculty Research and Ethics Committee (MUST) and Institutional Ethical Review Committee of Mbarara University of Science and Technology After a full explanation of the objective of the study, written informed consent was obtained from each study participant during data collection. The right of discontinuing or refuse to participate in the study was informed for all study subjects. Confidentiality was maintained by omitting any personal identifier. Generally, the study was conducted in tenet of the Principle of Declaration of Helsinki. The examination was done using tools and drugs usually used in routine practice at REC and MURHEC.

RESULTS

A total of 400 participants were consented and enrolled in the study between October 2020, to January 2021. Of the 1692 patients that came to MURHEC and REC during the study period, 69 and 331 patients were enrolled at MURHEC and REC respectively.

Table 1: Sociodemographic of the participants

Characteristic	Overall, (n)	(%)
Gender		
Female	222	(55.5)
Male	178	(44.5)
Age (years) (median = 71, IQR= 65 – 80, full range 30-102)		
<50	36	(9.0)
50-69	134	(33.5)
70 or more	230	(57.5)
Districts (median = 53, IQR= 33 – 103, full range 5-494)		
0 - 50 km	147	(36.7)
50 -100 km	141	(35.3)
100 -150 km	87	(21.7)
> 150 km	25	(6.3)
Marital status		
Unmarried [a]	158	(39.5)
Married	242	(60.5)
Education level		
None	184	(46.0)
Primary	174	(43.5)
Higher education	42	(10.5)
Occupation		
None	66	(16.5)
Peasant	256	(64.0)
Others	78	(19.5)
Household size		
0 - 4	125	(31.2)
5 or more	275	(68.8)
Need for escort to hospital on the appointment day		
No	52	(13.0)
Yes	348	(87.0)
Being head of household		
No	115	(28.8)
Yes	285	(71.2)
Affected eye		
Unilateral	254	(63.5)
Bilateral	146	(36.5)
Another patient disability		
Yes [b]	134	(33.5)
No	266	(66.5)

[a] Unmarried included single divorced and widowed

[b] other patient disabilities included, challenges seeing with glasses (1.3%); Hearing disabilities (16.3%); Movement disabilities (15.3%); Difficulties in remembering (14.5%); Difficulties in self-care (5.3%); Community ability (3.8%)

The baseline characteristics of the study participants are presented in Table 1. The participants were predominantly aged 50 years and above (91%), with slightly more females (56%) than males and with a median age of 71 years. The majority had primary or no formal education (90%). A fairly large proportion was married (61%) and with a house occupancy of five or more people (69%). The majority had been accompanied at the current visit (87%) and (71%) were the heads of their families.

The majority (63.5%) of the participant's presented with unilateral eyes with operable cataract compared to bilateral and (33.5%) of the patients had other physical disabilities.

Among the 222 females in the study, 70% were willing to uptake cataract surgery among 120 being the heads of the household and compared to 178 males in the study with 59% willing to uptake cataract surgery among 165 being the head of households. Of 1692 patients that attended the two hospitals within the study period, 400 had operable cataract hence giving an overall prevalence of 23.6%.

Overall, of the 400 patients who enrolled with operable cataract, 256 took up cataract surgery. This gives an overall uptake of cataract surgery of 64% (95% CI: 0.59 – 0.68), with no significant disparities across sites.

In a bivariable analysis as shown in Table 2, the factors significantly associated with uptake of cataract surgery were; age < 50 years, female gender, need for an escort to hospital on the appointment day, those with bilaterally affected eyes, individuals with peasant and professional occupations and those married, P-value < 0.2 were considered for multivariate analysis.

After adjusting for confounders, the final model had; Age < 50 years (aOR=3.0, 95% CI: 1.26 – 7.23, P-value 0.0102). Being female (aOR = 1.5, 95% CI: 1.04 - 2.34, P-value 0.032) and having bilateral cataract (aOR = 2.95, 95% CI: 1.8 – 4.8, P-value 0.001), P-value <0.05 were the factors significantly associated with the uptake of cataract surgery.

Table 2: Factors associated with uptake of cataract surgery among operable cataract (N=400)

Variable	Univariate analysis			Multivariate analysis		
	Crude Or[a]	(95% CI)	P-value	Adjusted Or[b]	(95% CI)	P-value
Age categories (years)						
50 - 69	1.0		0.045	1.0		0.0102
< 50	2.6	(1.00 -5.24)		3.0	(1.26 – 7.23)	
> 70	1.5	(0.98 -2.35)		1.6	(0.97 – 2.6)	
Gender						
Male	1.0		0.062	1.0		0.032
Female	1.5	(0.98 - 2.23)		1.5	(1.04 – 2.34)	
Need for escort to hospital on the appointment day						
No	1.0		0.024	1.0		0.212
Yes	1.95	(1.1 – 3.5)		1.5	(0.8 – 2.9)	
Affected eyes						
Unilateral	1.0		0.0001	1.0		0.001
Bilateral	2.97	(1.8 – 4.7)		2.95	(1.8 – 4.8)	
Marital status						
Unmarried	1.0		0.093	1.0		0.392
Married	0.7	(0.5 – 1.1)		0.8	(0.48 – 1.33)	
Occupation						
None	1.0		0.177	1.0		0.661
Peasant	0.9	(0.5 – 1.6)		1.1	(0.57 – 2.0)	
Others	0.6	(0.3 – 1.1)		0.8	(0.36 – 1.9)	
Distance (kilometres)						
0 – 50	1.0		0.487			

50 – 100	1.4	(0.9 – 2.3)	
100-150	1.3	(0.76 – 2.3)	
>150	1.4	(0.6 – 3.6)	
Education level			
None	1.0		0.469
Primary	0.87	(0.6 - 1.3)	
Higher education	1.3	(0.7 – 2.8)	
House hold size			
0 – 4	1.0		1.0
5 or more	1.0	(0.64 – 1.6)	
Being head of house hold			
Yes	1.0		0.890
No	0.97	(0.62– 1.52)	
Other patient disability			
No	1.0		0.698
Yes	0.92	(0.6 – 1.41)	

Legend
[a]All crude estimates were adjusted for age and sex
[b]Final predictive model adjusted for age and sex

DISCUSSION

In this study, about 23.6% of participants had operable cataracts. This finding was much lower than other hospital-based studies, from our literature search on the prevalence of operable cataract, we found that a large number of hospital-based studies recruited patients with any lens opacity regardless of their visual impairment, giving a general dissimilar prevalence of operable cataract.

However, other hospital-based studies in sub Saharan African showed a higher prevalence of operable cataracts reported in Malawi by Sherwin *et al*[7] (52.8%), in Ethiopia by Mengistu *et al*[8] (57%), Wale *et al*[9] and Tegegn *et al*[10] (49.5%). In these studies, all patients with any lens opacity regardless of its impact on vision were included contrasting our study where we recruited only patients with vision-impairing lens opacities. Our case definition was a patient with vision equal to and below 6/60.

In comparison with the high-income countries, Gupta *et al*[11] reported lower prevalence (9.2%) in Singapore and (1.92%) in Los Angelis[12]. This was expected considering these countries are quite developed with advanced cataract surgical services where they operate mostly on incidence cases, contrasting to our set up where we are still operating on the large backlog of operable cataracts.

The overall proportion of uptake of cataract surgery among patients with the operable cataract was 64%. From our literature search on the proportions of uptake of operable cataract, we found few hospital-based studies, most of the studies done were community and population-based studies, the hospital-based studies recruited patients with any lens opacity regardless of their visual impairment, giving a general dissimilar proportion of uptake of operable cataract.

A study done in Kenya reported a similar proportion of uptake of cataract surgery (58.6%). This was comparable to our study due to the fact that the majority of patients who up took cataract surgery were younger aged, breadwinners with high visual and occupational needs[13].

This study had a relatively higher uptake compared to other studies in sub Saharan Africa. For example, one study from Ghana reported uptake of 48.5%[14], in Madagascar 24.6%14[15] and in Tanzania 24.4%[16]. This was clearly due to the fact that these studies enrolled patients aged 50 years and above, contrasting to our study where we enrolled all patients aged 18 years and above. As we have already noted above, younger aged patients are more willing to uptake cataract surgery due to their need for better vision for daily routine activities therefore a higher proportion of cataract surgical uptake.

This study found that the most important factors associated with the uptake of cataract surgery were aged less than 50 years, female gender and bilaterality of the cataract.

We found, those aged less than 50 years were three times more likely to uptake cataract surgery, than those above 50 years. This was similar to other studies in sub Saharan Africa, reported in Kenya[12] and Nigeria by Abubakar *et al*[17] with higher uptake of cataract surgery

among the lower aged group (below 50 years) compared to the higher aged group (above 70 years). This was probably due to the visual functional needs desired among the younger age group for their occupational needs as they are the main breadwinners of the family than the older aged group.

In our study, females were one and a half times more likely to uptake cataract surgery compared to males and the majority being the heads of the household, this was similar to studies done in Ethiopia by Mehari *et al*[18] and in Nigeria by Kurawa *et al*[19]. This may be due to the fact that the majority of females who up took cataract surgery were heads of the household which might have influenced the decision-making for the uptake of cataract surgery in these studies.

However, compared to many studies in sub-Saharan Africa, male patients showed to have a higher proportionate of uptake compared to females. For example, in Nigeria Abubakar *et al*[17] and Geneau *et al*[20] in Tanzania this may have been due to the fact that the majority of males were heads of households and involved in the decision-making for the uptake of cataract surgery in these studies.

In this study, patients who had bilateral cataracts were three times more likely to uptake surgery than those who had unilateral cataracts. This was similarly seen in studies done in Malawi by Msamati *et al*[21] at Queen Elizabeth Central Hospital, in Nigeria[18] and India by Sobti *et al*[22]. This was due to the fact that the patients were more encouraged to seek cataract surgical treatment in the absence of a good eye (functional vision). Our observation is that compared to people with unilateral visual impairment, people with bilateral operable cataract are more motivated to have at least one of their eyes done so that they regain their vision.

CONCLUSION

The overall prevalence of operable cataract among patients seen at MURHEC and REC is low (23.6%). The proportion of uptake of cataract surgery among patients with operable cataract at MURHEC and REC was high (64%). Factors associated with the uptake of cataract surgery among patients with operable cataract were being less than 50 years of age, female gender, bilaterality of the cataract.

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REFERENCES

1. Raghuvanshi P, Maiti S. Canine cataracts and its management: An overview. *J Animal Res*. 2013; **3**:17-26.
2. Flaxman SR, Bourne RR, Resnikoff S, Ackland P, Braithwaite T, *et al.* Global causes of blindness and distance vision impairment 1990–2020: a systematic review and meta-analysis. *The Lancet Global Health*. 2017; **5**: e1221-e1234.
3. Lundström M, Wendel E. Duration of self assessed benefit of cataract extraction: a long term study. *Br J Ophthalmol*. 2005; **89**:1017-20.
4. Ramke J, Gilbert CE, Lee AC, Ackland P, Limburg H, Foster A. Effective cataract surgical coverage: An indicator for measuring quality-of-care in the context of universal health coverage. *PLOS One*. 2017; **12:** 0172342.
5. Trimmel J. Inequity and inequity in eye health. *Comm Eye Health*. 2016; **29**:1-3.
6. Abou-gareeb I, Lewallen S, Bassett K, Courtright P. Gender and blindness: a meta-analysis of population-based prevalence surveys. *Ophthal Epidemiol*. 2001; **8**: 39-56.
7. Sherwin JC, Dean WH, Metcalfe NH. 2008. Causes of blindness at Nkhoma Eye Hospital, Malawi. *Eur J Ophthalmol*. 2008; **18**,1002-1006.
8. Mengistu M, Admassu F, Wondale T, Tsegaw A. Refractive outcome of cataract surgery done at University of Gondar tertiary eye care and training center, North West Ethiopia. *Patient Rel Outcome Measures.* 2021; **10:**173-79.
9. Wale MZ, Derbew M, Tilahun M, Terefe M. Cataract and associated factors among adults visiting ophthalmic clinic at Debre Markos comprehensive specialized hospital, northwest Ethiopia. *SAGE Open Med.* 2021; **9**:2050312121989636-2050312121989636.
10. Tegegn MT, Assaye AK, Mersha GA. Proportion, causes and associated factors of blindness among adult patients attending tertiary eye care and training center in Ethiopia. *Clin Optometry*. 2021; **13**:83-91.
11. Gupta P, Zheng Y, Ting TW, Lamoureux EL, Cheng C-Y, Wong T.-Y. Prevalence of cataract surgery and visual outcomes in Indian immigrants in Singapore: the Singapore Indian eye study. *PLOS One*. 2013; **8**:e75584.
12. Richter GM, Chung J, Azen SP, Varma R. 2009. Prevalence of visually significant cataract and factors associated with unmet need for cataract surgery: Los Angeles Latino Eye Study. *Ophthalmology*. 2009; **116**: 2327-2335.
13. Syed A, Polack S, Eusebio C, Mathenge W, Wadud Z, *et al.* Predictors of attendance and barriers to

cataract surgery in Kenya, Bangladesh and the Philippines. *Disability Rehabil.* 2013; **35**:1660-67.
14. Ackuaku-dogbe EM, Yawson AE, Biritwum RB. Cataract surgical uptake among older adults in Ghana. *Ghana Med J*. 2015; **49**:84-89.
15. Razafinimpanana N, Nkumbe H, Courtright P, Lewallen S. Uptake of cataract surgery in Sava Region, Madagascar: role of cataract case finders in acceptance of cataract surgery. *Intern Ophthalmol*. 2012; **32:** 107-111.
16. Chibuga E, Massae P, Geneau R, Mahande M, Lewallen S, Courtright P. Acceptance of cataract surgery in a cohort of Tanzanians with operable cataract. *Eye*. 2008; **22**:830-833.
17. Abubakar T, Gudlavalleti MV, Sivasubramaniam S, Gilbert CE, Abdull MM, Imam AU. Coverage of hospital-based cataract surgery and barriers to the uptake of surgery among cataract blind persons in Nigeria: the Nigeria National Blindness and Visual Impairment Survey. *Ophthalmic Epidemiol.* 2012; **19**:58-66.
18. Mehari ZA, Zewedu RTH, Gulilat FB. Barriers to cataract surgical uptake in central Ethiopia. *Middle East Afr J Ophthalmol*. 2013; **20**:229-233.
19. Kurawa MS, Abdu L. Demographic characteristics and visual status of patients undergoing cataract surgery at a tertiary hospital in Kano, Nigeria. *Annals Afr Med*. 2017; **16**:170-174.
20. Geneau R, Lewallen S, Bronsard A, Paul I, Courtright P. The social and family dynamics behind the uptake of cataract surgery: findings from Kilimanjaro Region, Tanzania. *Br J Ophthalmol*. 2005; **89**:1399-1402.
21. Msamati BC, Igbigbi PS, Batumba NH. Prevalence of lens opacity at Queen Elizabeth Central Hospital in Blantyre, Malawi. *East Afr Med J.* 2000; **77**:583-587.
22. Sobti S, Sahni B, Bala K. Surgical coverage of cataract in a rural area of north India: A cross-sectional study. *J Family Med Primary Care*. 2020; **9**:4112-17.

Ocular manifestations and factors associated with haematological malignancies at two tertiary hospitals in Tanzania

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ABSTRACT

Backgroud: Ocular involvement in haematological malignancy may profoundly affect the visual outcome of survivors, although little about this is known in our setting. Haematological malignancies include lymphoma, leukemia, and multiple myeloma. Ocular manifestations may be the initial diagnostic symptoms or the earliest identifiers for relapse or progression of haematological malignancies. Ocular involvement can result from direct malignant infiltration or indirect sequel of haematological cellular derangement.
Objective: This study aims to determine the burden of ophthalmic manifestations, describe the manifestations and the factors associated with haematological malignancies among patients attending Muhimbili National Hospital (MNH) and Ocean Road Cancer Institute (ORCI) in Dar es Salaam.
Methods: Hospital-based cross-sectional study at MNH and ORCI from June 2021 to January 2022. Patients who met the inclusion criteria were recruited consecutively. Data analysis was done with SPSS version 23.
Results: A total of 99 patients with haematological malignancies were recruited, 61.6% were males. The age range was 2 to 77 years with a mean age of 29 years. Two-thirds (61.6%) of the participants had ophthalmic manifestations. Posterior segment manifestations were the most common with roth spots (31.1%) and intraretinal haemorrhage (21.0%) as the most frequent presentations. Vision-threatening manifestations such as sub-hyaloid haemorrhage and optic nerve swelling were present in 6.7% and 11.1% of patients respectively. Direct infiltration was present in 15.15% of the patients. Low haemoglobin level was the statistically significant factor associated with ocular involvement among the study participants.
Conclusion: The prevalence of ophthalmic manifestations of haematological malignancies at MNH and ORCI was significantly high. Roth spots and intraretinal haemorrhages were the most common manifestations. Direct malignant ocular infiltrations were present in a few patients. Patients with haemoglobin level of 8g/dl or less had four times increased odds of having ocular manifestations. A comprehensive ophthalmic exam needs to be done for all patients with haematological malignancies for early detection and intervention.

Key words: Ocular manifestation, Leukemia, Lymphoma, Multiple myeloma

INTRODUCTION

Haematological malignancies are cancers that originate in the blood-forming tissues which are the bone marrow and lymphoid tissue. They account for 6.5% of all cancers globally, with 25% of the burden in sub-Saharan Africa[1]. Haematological malignancies account for 10% of the malignancies diagnosed in sub–Saharan Africa[2]. They are mainly classified into three types which are leukemia, lymphoma, and multiple myeloma[3]. Non-Hodgkin's lymphoma is the most common haematological malignancy in western Tanzania and sub-Saharan Africa[1,4].

Ocular manifestations of haematological malignancies are features that occur in any part of the eye as a result of haematological malignancy and may be caused by direct malignant infiltration, or as a result of haematological cellular derangements. They may be the initial presenting symptoms of haematological malignancies or the first site for detection of disease relapse. The prognostic significance of ocular manifestation of haematological malignancy is important as it may signify involvement of the central nervous system[5]. The global prevalence of ocular manifestations among patients with haematological malignancies ranges from 6 to 90%, with majority of affected individuals in developing countries[6,7].

Different types of haematological malignancies may present with similar haematological derangements. It is postulated that in cases of acute myeloid leukemia and acute lymphoid leukemia, anaemia, thrombocytopenia, and leukocytosis may be the factors predicting the occurrence of ocular manifestations[5,8]. There is a paucity of information on the relationship between haematological malignancies and ocular manifestations in sub-Saharan Africa.

This study aimed to assess the proportion, clinical manifestations, and factors associated with haematological malignancies at Muhimbili National Hospital, Haematology and Ophthalmology Units and Ocean Road Cancer Institute in urban Tanzania.

MATERIALS AND METHODS

Study design and setting: This was a hospital-based cross-sectional study, conducted for a period of 7 months from June 2021 to January 2022 at two tertiary hospitals, Muhimbili National Hospital Haemato-oncology and Ophthalmology Units and Ocean Road Cancer Institute, Haemato-oncology Unit in Dar es Salaam, Tanzania.

Inclusion criteria: A consecutive sampling technique was used to recruit participants with a confirmed diagnosis of haematological malignancy before initiation of treatment.

Exclusion criteria: Patients with comorbidities such as HIV, diabetes mellitus, hypertension, and other malignancies were excluded as these diseases may have overlapping ophthalmic manifestations with haematological malignancies. Patients with dense cataracts that may have precluded posterior segment examination were also excluded.

Sample size: The minimum estimated sample size was 98 and it was calculated using the sample size calculation formula for finite population. The study population size which was used for calculation was 154, obtained from the 2020 oncology registry and a proportion of ophthalmic manifestations of 77.7% from a study done in Nigeria in 2010 with a marginal error of 5%[9].

Data collection procedure: Data was collected using a researcher-administered questionnaire at the haemato-oncology clinics and wards. For children aged 6 years and above, written assent was obtained in addition to informed consent from their parents. For children of less than 6 years of age, very sick adults and adult patients, informed written consent was obtained from their parents or guardians, caretakers and the patients respectively. Interviews were carried out by the principal investigator to obtain the patients' demographic data. Information on the particular malignancy including haematological parameters, bone marrow aspiration cytology results, and biopsy results were obtained from the patients' files.

The ocular examination included a visual acuity assessment followed by ophthalmic examinations of the external and anterior segment which were performed using a torch and portable slit lamp biomicroscope. An indirect ophthalmoscopy examination was performed using an overhead indirect ophthalmoscope with a 20D lens after pupillary dilatation with 1% tropicamide eye drops. All data was collected and recorded using a pretested questionnaire.

Data analysis: Data was analyzed using the Statistical Package for Social Science (SPSS) version 23. Frequency distribution tables for demographic data, type of malignancy and type of ophthalmic manifestations were generated. The chi-squared test was used to assess the associations present, with a p-value of less than 0.05 used as a maximum marginal error of statistically significant associations. Logistic regression analysis assessed the independent associated factors of ophthalmic manifestations.

Ethical consideration: Ethical approval was obtained from the Muhimbili University of Health and Allied Sciences, (MUHAS) institution review board. The permission to conduct the study was obtained from the Research and Publication Department of Muhimbili National Hospital and Ocean Road Cancer Institute.

RESULTS

A total of 99 patients diagnosed with haematological malignancies were enrolled in the study. Majority of the patients were males (61.6%), with a male to female ratio of 1.6:1. The majority (64.7%) of patients were adults with a median age of 29 years, (Table 1).

Table 1: Demographic characteristics of the study participants (N= 99)

Characteristic	Frequency	
	No.	(%)
Sex		
Male	61	61.6
Female	38	38.4
Age (years)		
0-17	35	35.4
≥18	64	64.7
Median (Range)	29 (4, 77)	
Level of education		
Nonformal	6	6.1
Pre-school	9	9.1
Primary	33	33.3
Secondary	20	20.2
College	31	31.3
Occupation		
Employed	32	32.2
Self-employed	25	25.3
No job	42	42.4

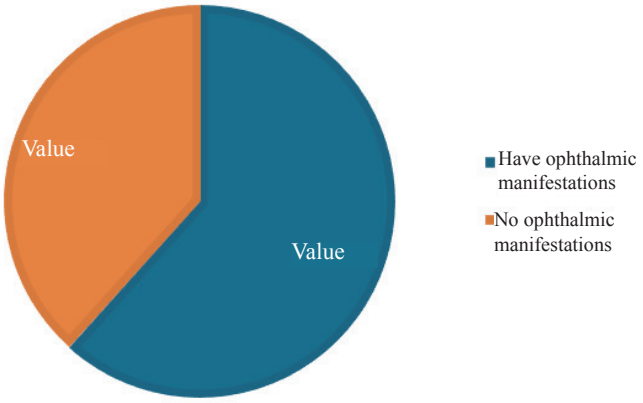
Table 2: Clinical characteristics of the study participants (N=99)

Characteristic	Frequency	
	No.	(%)
Type of haematological malignancy		
ALL	26	26.3
AML	34	34.3
CML	12	12.1
HL	2	2.0
NHL	11	11.1
MM/Plasmacytoma	14	14.1
Total WBC count($\times 10^9$/L)		
≤3	18	18.2
4-11	31	31.3
>11	50	50.5
Platelet level($\times 10^9$/L)		
<150	67	67.7
150-450	26	26.3
>450	6	6.1
RBC($\times 10^{12}$/L)		
<4	73	73.7
4-6	26	26.3
Haemoglobin level(g/dl)		
≤8	66	66.7
8.1-11	23	23.2
>11	10	10.1

AML=Acute Myeloid Leukemia, ALL=Acute Lymphoblastic Leukemia, CML=Chronic Myeloid Leukemia, HL=Hodgkin Lymphoma. NHL=Non-Hodgkin lymphoma. MM= Multiple Myeloma

Acute myeloid leukemia was the most common haematological malignancy (34.3%). Half (50.5%) of the patients had a leukocytosis (WBC count > than 11×10^9/L), two-thirds (67.7%) of patients had thrombocytopenia (platelet count <150 x10^9/L) and most of the patients (66.7%) had anaemia (haemoglobin level of less or equal to 8g/dl), (Table 2). The proportion of ocular manifestations among patients with haematological malignancy at Muhimbili National Hospital and Ocean Road Cancer institute was 61.62% of the participant (Figure 1).

Figure 1: Proportion of ophthalmic manifestations among patients with haematological malignancies at MNH and ORCI (N=99)



Majority (75.90%) of the patients had normal presenting visual acuity of 6/18 or better in the better eye while 7% were blind with a visual acuity less than 3/60 according to the WHO classification of vision (Figure 2).

Figure 2: Presenting visual acuity among patients with haematological malignancies (N=99)

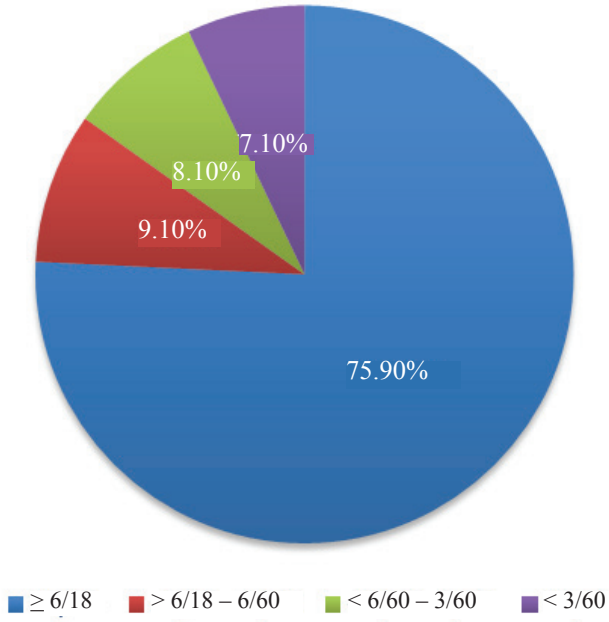


Table 3: Ocular manifestations among patients with haematological malignancies (N=99)

Group	Manifestations	No.	(%)
Ocular adnexa and anterior segment manifestations*	Proptosis	10	10.10
	Periorbital edema	14	14.10
	Ptosis	5	5.10
	Corneal ulcers	2	2.02
	Subconjunctival haemorrhage	21	21.20
	Chemosis	6	6.06
	Cells/Flare	2	2.02
	Pseudohypoyon	2	2.02
	Hyphema	2	2.02
	Iris nodule	1	1.01
Posterior segment*			
	Vitreous haemorrhage	4	4.04
	Optic nerve swelling	11	11.11
	Retinal infiltrates	15	15.15
	Subhyaloid haemorrhage	8	8.08
	Intraretinal haemorrhage	25	25.25
	Subretinal haemorrhage	3	3.03
	Roth spot	37	37.37
	Retinal detachment	2	2.02
	CRVO	3	3.03
	Cotton wool	9	9.09
	Optic atrophy	2	2.02

*Multiple responses for the variable, percentage do not add to hundred
CRVO=Central Retinal Vascular Occlusion

Ocular adnexa and anterior segment manifestation were present in 28.28%, where subconjunctival haemorrhage and periorbital edema were the most common features. Posterior segment manifestations were the commonest, present in 56.57% of patients. The frequently seen manifestations were the roth spots followed by intraretinal haemorrhage. Primary haematological malignancy infiltrates including optic nerve involvement and retinal infiltrates were present in 9.2% and 12.6% respectively (Table 3).

Table 4: Distribution of ophthalmic manifestations among patients with haematological malignancies at MNH and ORCI by demographic and clinical characteristics (N=99)

Characteristic	Ophthalmic manifestations			P-value
	Frequency			
		Yes	No	
	Total	No. (%)	No. (%)	
Sex				
Male	61 (61.6)	38 (62.3)	23 (37.7)	0.86
Female	38 (38.4)	23 (60.5)	15 (39.5)	
Age (years)				
≤17 (Paediatric)	35 (35.4)	19 (54.3)	16 (45.7)	0.267
18+ (Adults)	64 (64.6)	42 (65.6)	22 (34.4)	

AML_CML				
Yes	46 (46.5)	34 (73.9)	12 (26.1)	0.019
No	53 (53.5)	27 (50.9)	26 (49.1)	
MM				
Yes	14 (14.1)	8 (57.1)	6 (42.7)	0.71
No	85 (85.9)	53 (62.4)	32 (37.7)	
NHL				
Yes	11 (11.1)	4 (36.4)	7 (63.6)	0.099*
No	88 (88.9)	57 (64.8)	31 (35.2)	
HL				
Yes	2 (2.0)	0 (0)	2 (100)	0.145*
No	97 (98.0)	61 (62.9)	36 (37.1)	
WBC ($\times 10^9$/L)				
≤3	31 (31.3)	17 (54.8)	14 (45.2)	0.02
4-11	18 (18.2)	7 (38.9)	11 (61.1)	
>11	50 (50.1)	37 (74.0)	13 (26.0)	
PLT ($\times 10^9$/L)				
<150	67 (67.7)	45 (67.2)	22 (32.8)	0.186*
150-450	26 (26.3)	12 (46.2)	14 (53.9)	
>450	6 (6.1)	4 (66.7)	2 (33.3)	
RBC ($\times 10^{12}$/L)				
<4	73 (73.7)	50 (68.5)	23 (31.5)	0.018
4-6	26 (26.3)	11 (42.3)	15 (57.7)	
HB (g/dl)				
≤8	66 (66.7)	53 (80.3)	13 (19.7)	<0.001*
8.1-11	23 (23.2)	5 (21.7)	18 (78.3)	
>11	10 (10.1)	3 (30.0)	7 (70.0)	

**p-value from Fisher's exact test*

AML=Acute Myeloid Leukemia, ALL=Acute Lymphoblastic Leukemia, CML=Chronic Myeloid Leukemia, HL=Hodgkin Lymphoma. NHL=Non-Hodgkin Lymphoma. MM= Multiple Myeloma

The proportion of ophthalmic manifestations among patients with haematological malignancies at MNH and ORCI was 61.62%. Manifestations were more common among males, patients with myeloid leukemia, leukocytosis and low haemoglobin levels. (Table 4).

Table 5: Logistic regression analysis to assess factors associated with ophthalmic manifestations in patients with haematological malignancies at MNH and ORCI (N=99)

Characteristic	Ophthalmic manifestations		Crude OR (95%CI)	P-value	Adjusted OR (95% CI)	P-value
	Total	Yes				
Sex						
Male	61 (61.6)	38 (62.3)	1.03 (0.74-1.42)	0.86	1.07 (0.80-1.42)	0.64
Female	38 (38.4)	23 (60.5)	Ref		Ref	
Age (years)						
≤17 (Paediatric)	35 (35.4)	19 (54.3)	Ref		Ref	

18+ (Adults)	64 (64.6)	42 (65.6)	1.21 (0.85-1.72)	0.29	1.02 (0.73-1.43)	0.91
Level of education						
None/ Primary	20 (31.3)	15 (75.0)	1.39 (0.79-2.46)	0.25	-	
Secondary	13 (20.3)	7 (53.9)	Ref			
College	31 (48.4)	20 (64.5)	1.20 (0.68-2.12)	0.54	-	
Occupation						
Employed	32 (32.3)	22 (68.8)	1.25 (0.87-1.80)	0.22	-	
Self-employed	25 (25.3)	16 (64.0)	1.17 (0.78-1.75)	0.45		
No job	42 (42.4)	23 (54.8)	Ref			
Acute leukemia						
Yes	33 (33.3)	26 (78.8)	1.49 (1.11-1.98)	0.01	1.05 (0.76-1.44)	0.77
No	66 (66.7)	35 (53.0)	Ref		Ref	
MM						
Yes	23 (23.2)	15 (65.2)	1.08 (0.76-1.53)	0.68		
No	76 (76.8)	46 (60.5)	Ref		-	
NHL						
Yes	26 (26.3)	9 (34.6)	Ref		Ref	
No	73 (73.7)	52 (71.2)	2.06 (1.19-3.57)	0.01	1.42 (0.81-2.50)	0.22
HL						
Yes	2 (2.0)	0 (0)	IND			
No	97 (98.0)	61 (62.9)				
WBC ($\times 10^9$/L)						
0-3	31 (31.3)	17 (54.8)	1.41 (0.73-2.74)	0.31	Ref	
4-11	18 (18.2)	7 (38.9)	Ref		1.47 (0.82-2.66)	0.20
>11	50 (50.1)	37 (74.0)	1.90 (1.04-3.48)	0.04	1.19 (0.69-2.06)	0.54
PLT ($\times 10^9$/L)						
<150	67 (67.7)	45 (67.2)	1.46 (0.93-2.28)	0.10	1.05 (0.69-1.61)	0.81
150-450	26 (26.3)	12 (46.2)	Ref		Ref	
>450	6 (6.1)	4 (66.7)	1.44 (0.71-2.92)	0.31	1.72 (0.89-3.32)	0.11
RBC ($\times 10^{12}$/L)						
<4	73 (73.7)	50 (68.5)	1.62 (1.01-2.61)	0.05	Ref	
4-6	26 (26.3)	11 (42.3)	Ref		1.22 (0.76-1.96)	0.41
HB (g/dl)						
≤8	66 (66.7)	53 (80.3)	2.68 (1.03-6.98)	0.04	3.18 (1.08-9.36)	**0.04**
8.1-11	23 (23.2)	5 (21.7)	0.72 (0.21-2.48)	0.61	0.84 (0.23-3.10)	0.80
>11	10 (10.1)	3 (30.0)	Ref		Ref	

Note: All associations with p-value<0.20 in bivariate analysis plus age and sex were considered in multivariable analysis IND=Indeterminate; AML=Acute Myeloid Leukemia; ALL=Acute Lymphoblastic Leukemia; CML=Chronic Myeloid Leukemia; HL=Hodgkin Lymphoma' NHL=Non-Hodgkin Lymphoma; MM= Multiple Myeloma

In multivariate analysis, only haemoglobin level remained as an independent associated factor for the development of ophthalmological manifestation of haematological malignancy. Patients with haemoglobin levels of less than 8g/dl had 3.18 times increased odds (95%: 1.08-9.36) of having ophthalmic manifestation (Table 4).

DISCUSSION

This study focused on the prevalence, clinical presentation, and factors associated with haematological malignancies at two tertiary hospitals in urban Tanzania.

The prevalence of ocular manifestations of haematological malignancy in this study was high, relatively similar to the study done by Ilo *et al* in Nigeria[10]. The similarity to the findings of the Nigerian study may be accounted for by limited accessibility to haemato-oncological centers in Africa where patients usually seek health care services when the stages of disease are advanced with infiltration of different structures and significant haematological derangement that leads to ocular manifestations. The prevalence in this study was significantly higher than that found in India[11]. This may be accounted for by the availability of better health services and good health-seeking routine which aid early diagnosis of the disease before having ocular manifestation.

Visual impairment which is defined by visual acuity worse than 6/18 in the better eye according to WHO was present in nearly a quarter of the participants at (24.1%). This was higher than in a study carried out in India which found a (13.7%) prevalence[11]. This difference is because the Indian study included both newly diagnosed patients as well as patients who were already on treatment, unlike this study which included only newly diagnosed patients who had not started treatment. Treatment for the malignancies may cure some ocular manifestations leading to them not being identified during examination of the patients[11]. Vision threatening manifestations like optic nerve involvement, vitreous haemorrhage, retinal detachment and retinal vein occlusion were present in some participants in this study.

The most frequent anterior segment manifestation was subconjunctival haemorrhage. These results were similar to the findings in the study done by Eze *et al*[9] in Nigeria. The occurrence of subconjunctival haemorrhage may be attributed to low platelet count which causes coagulation dysfunction, hence leading into haemorrhage. Two-thirds of the participants in this study had a platelet count of less than 150×10^9/L, which puts them at a high risk for subconjunctival haemorrhage. Subconjunctival haemorrhage poses a psychological concern to the patients and its presence calls for a thorough evaluation of the underlying condition.

Posterior segment manifestations occurred more frequently than anterior segment features, with roth spots and intraretinal haemorrhage as the most common findings. This is similar to the findings in the study done by Renu *et al*[11] in India. The similarity may be due to the haematological cellular derangement in which damage of the blood vessels that leads into increased permeability and haemorrhages resulting into platelet aggregation causing roth spots. The presence of intraretinal haemorrhage may be sight-threatening depending on the location and severity. Follow-up is required as the observation of posterior segment manifestations may help in monitoring response to treatment because direct visualization of the malignant infiltration is possible during ocular examination.

Sight-threatening manifestations of retinal infiltrate and optic nerve involvement were present in a few of patients, (15.15%)[12]. This proportion was higher than that reported by Soman and Koshy in India[13,14]. The difference may be due to participants' late presentation to the hospital with infiltration of ocular structures in the current study. However, the Indian study also included patients who were already on treatment whose infiltration may have resolved by the time of ocular assessment. Chorio-retinal and optic nerve malignant infiltrates are observed in the end-stage of the disease and when the central nervous system is involved hence predicting a poor prognosis[12.15].

Haemoglobin levels of less than or equal to 8g/dl were the statistically significant factors associated with the presence of ocular manifestations. This was similar to the findings in the studies by Soman and Renu in India, where a low haemoglobin level of less than (7.35g/dl) was significantly associated with the occurrence of ocular manifestations[11,13]. A low level of haemoglobin leads to retinal hypoxia resulting in vascular dilatation, edema and haemorrhages. Low platelet counts further worsens the anaemia due to poor coagulation and haemorrhage. Early blood transfusion may be paramount to altering the pathogenesis[16].

Limitations

The study was limited by small sample size due to its relatively uncommon occurrence per year, a longer duration study needs to be done to get a bigger sample size. Being a hospital-based study may also limit generalization to the general population who have not come to the hospital.

CONCLUSIONS AND RECOMMENDATIONS

The proportion of ocular manifestations of haematological malignancies at MNH and ORCI is significantly high. Posterior segment manifestations were more frequent than anterior segment manifestations with intraretinal haemorrhage and roth spots as the most common manifestations. Sight-threatening complications such as sub-hyaloid haemorrhage retinal detachment, optic nerve swelling and optic atrophy were present in some patients. Lower level of haemoglobin increases the odds of occurrence of ophthalmic manifestations of haematological malignancies.

A comprehensive ophthalmic examination needs to be included in the evaluation protocol of patients with haematological malignancies for early detection and management of sight-threatening manifestations. More follow up studies need to be done to track the changes

with patients on treatment and to assess its association with patients' survival.

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Declaration

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Consent for publication: All the authors provided consent to submission of the manuscript

Availability of data and materials: The original full article is present from the author and at Muhimbili University Library. Any data needed is available from the corresponding author.

Authors' contributions: Gomba S designed the study, collected data, and analyzed through Statistical Package for Social Sciences (SPSS), also results interpretation, report writing and manuscript writing. Professor Mafwiri M, Nyamita O, Mhina C, Mosenene S and Sandi F were involved in proposal writing, data collection, and report writing. Further reviewed this manuscript for publication.

Competing interests: The authors declare no conflict of interest.

REFERENCES

1. Leak SA, Mmbaga LG, Mkwizu EW, *et al*. Hematological malignancies in East Africa. Which cancers to expect and how to provide services. *PLoS One* [Internet]. 2020;**15**(5):1–12. Available from: http://dx.doi.org/10.1371/journal.pone.0232848
2. Enawgaw B, Aynalem M, Melku M. Hematological malignancies in Northwest Ethiopia. *PLoS One*. 2021; **16**(12): e0260639
3. Mohan H. Textbook of Pathology, 6th edition, Jaypee brothers medical publisher. 2010.
4. Okello CD, Niyonzima N, Ferraresso M, *et al*. Haematological malignancies in sub-Saharan Africa: East Africa as an example for improving care. *The Lancet Haematol.* 2021; **8**(10):e756–e769.
5. Ohkoshi K, Tsiaras WG. Prognostic importance of ophthalmic manifestations in childhood leukemia. *Br J Ophthalmol*. 1992; **76**(11):651–655.
6. Japesh T, Anita M, Priyanka S, Panigrahi, Kumar P. Ophthalmic manifestations in hematological malignancies: An observational study from a tertiary care health center in Eastern India. *Indian J Ophthalmol.* 2024; **72**(5):659-663.
7. Charif Chefchaouni M, Belmekki M, Hajji Z, *et al*. Ophthalmic manifestations of acute leukemia. *J Fr Ophthalmol*. 2002; **25**(1):62–66.
8. Sharma T, Grewal J, Gupta S, *et al.* Ophthalmic manifestations of acute leukemias: The ophthalmologist's role. Vol. 18, Eye. Nature Publishing Group; 2004. p. 663–672.
9. Eze BI, Ibegbulam GO, Ocheni S. Ophthalmic manifestations of leukemia in a tertiary hospital population of adult Nigerian Africans. *Middle East Afr J Ophthalmol.* 2010; **17**(4):325.
10. Ilo OT, Adenekan AO, Alabi AS, *et al*. Ocular manifestations of leukemia: a teaching hospital experience. *Niger Postgrad Med J*. 2019; **26**: 205-210.
11. Dhasma R, Prakash A, Gupta N, *et al.* Ocular manifestations in leukemia and myeloproliferative disorders and their association with hematological parameters. *Ann Afr Med*. 2016; **15**(3): 97-103
12. Russo V, Scott I, Querques G, *et al.* Orbital and ocular manifestations of acute childhood leukemia: clinical and statistical analysis of 180 patients. *Eur J Ophthalmol.* 2008;**18**(4):619-623.
13. Soman S, Kasturi N, Srinivasan R, *et al*. Ocular manifestations in leukemias and their correlation with hematologic parameters at a tertiary care setting in South India. *Ophthalmol Retin*. 2018; **2**(1):17–23.
14. Koshy J, Joseph JM, Satish T, Kaur G. Ophthalmic manifestations of acute and chronic leukemias presenting to a tertiary care center in India. *Indian J Ophthalmol.* 2015; **63**(8): 659-664.
15. Abu el-Asrar AM. Correlation of fundus lesions and hematological findings in leukemic retinopathy. *Eur J Ophthalmol.* 1996; **6**(2): 167-172
16. Shah GY, Modi R. Anemic retinopathy: case reports and disease features. *Retina Today*. 2016; 30-32.

A health care worker needs assessment to develop rural diabetic training workshops for diabetes and diabetic retinopathy screening in Kilimanjaro

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ABSTRACT

Background: A needs assessment was undertaken in Tanzania to identify what problems People With Diabetes (PWD) and their Health Care Workers (HCW) were facing, as preparation for a theory- and evidence-based intervention. In Tanzania only 1 out of 99 people with diabetes achieve good glycaemic control and Diabetic Retinopathy (DR) is common and the leading cause of preventable adult blindness.
Objective: The focus of the program was on improving self-management.
Methods: Intervention mapping was used to plan, develop, implement and evaluate a theory- and evidence-based screening program for DR to prevent avoidable blindness.
Results: HCW demonstrated a poor knowledge of DR, treatment and the need for annual screening. Dietary knowledge of HCW was poor and PWD did not rate them as good communicators. HCW understood the rational for PWD to take regular exercise but failed to recommend socially acceptable means of achieving this. HCW recognised that mental health issues such as anxiety and depression were hindering self-management and prevention of related complications and identified poverty as a key factor for PWD failing to undertake treatment regimens and self-manage their diabetes. Costs and a lack of resources was preventing good diabetes control. HCW recognised the need for diabetes training and resources with which to educate PWD.
Conclusion: The study highlighted the need for primary prevention of diabetes, with basic training for primary care focused on practical, local, and indigenous health challenges.

Key words: Diabetes, Diabetic retinopathy, Screening, Intervention mapping, Self-management

INTRODUCTION

A 'needs assessment' was undertaken to identify what problems People With Diabetes (PWD) and their Health Care Workers (HCW) were facing. The health intervention program based on the Intervention Mapping (IM) protocol was adopted to plan, develop, implement, and evaluate a theory and evidence-based screening program for Diabetic Retinopathy (DR), to prevent avoidable blindness[1].

As a non-communicable disease, Diabetes Mellitus (DM) is a metabolic disorder causing hyperglycaemia and resulting in microvascular and macrovascular complications[2]. Sub-Saharan Africa (SSA) is projected to carry the largest burden of diabetes (34.2 million) by 2030. It is estimated by the International Diabetes Federation in 2021 that diabetes prevalence was 10.3%, and it is thought that two thirds of people with diabetes are undiagnosed[3].

Complications of diabetes: Living well and staying healthy with diabetes requires that PWD effectively self-manage their condition to achieve good glycaemic and blood pressure control thus limiting complications[2]. In Tanzania only 1 out of 99 people with type-2 diabetes achieve good glycaemic control[4]; home and hospital glucose monitoring are not routinely available, neither is costly insulin. Diabetic Retinopathy (DR) is the most common microvascular complication and the leading cause of preventable adult blindness[3,5]. Microvascular complications of poorly controlled diabetes are insidious, often only detectable by PWD when irreversible damage has already occurred[6].

Diabetic retinopathy and the need for screening: DR screening should be initiated at diagnosis and repeated annually even when the person remains asymptomatic to detect and successfully treat vision threatening diabetic retinopathy[7]. There is a paucity of data for the prevalence of DR in Tanzania. The program conducted a pilot study of 79 self-selecting PWD in Kilimanjaro and found 11.39% DR, 16.1% maculopathy and 2.9% proliferative retinopathy[8]. The program later conducted screening and found a prevalence of any DR at 27.9% in 3187 PWD[9].

Self-management of diabetes in Tanzania: The context of self-management for PWD in Tanzania is complex[8]. Combining co-morbidity with late diagnoses of diabetes, limited resources for diagnoses, management and

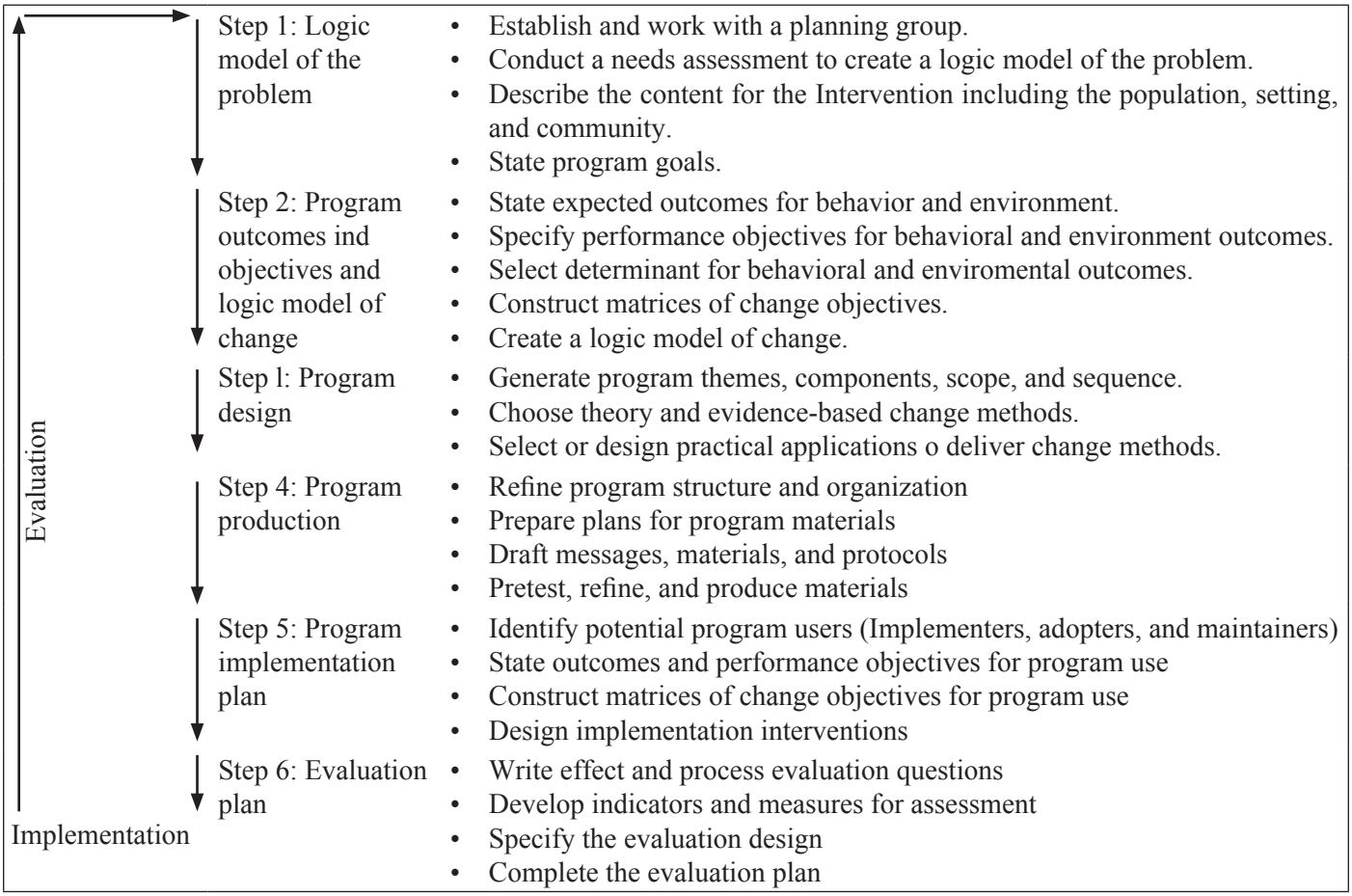
treatment of diabetes and DR leads to increased mortality and chronic complications amongst PWD[5,10]. In Tanzania 85.3% of the household budget is spent on food[11]. Studies on diet in the general population in Tanzania are limited but show that among PWD, 74-79% of daily calorific intake comes from carbohydrates[12]. Knowledge about healthy eating is particularly problematic due to economic restraints and cultural preferences for eating high carbohydrate food and meat, and vegetables cooked in fat. These findings were supported by the program's 'needs assessment' with PWD[8].

Physical activity and diabetes: The concept of physical activity as 'exercise' is considered unnecessary as many PWD and HCW work daily on their farms and their shambas (allotments) to grow subsistence food and coffee, collect water and firewood, and walk or cycle as a daily means of transport[8,13]. There is little leisure time for physical activity, although football/soccer is played in many communities[14]. There is little understanding among both PWD and HCW of the role that exercise plays in improving cardiac health, lowering blood pressure and blood glucose by improving the use of available insulin for glucose uptake during and after activity[15].

Theoretical basis of self-regulation and health behaviour: Self-management of diabetes involves complex behaviours requiring planning to develop appropriate goal setting for diet, physical activity, blood glucose monitoring, foot care, regular clinic attendance and screening to prevent complications[16,17]. Moving away from knowledge, attitudes, and belief models of behaviour change[18], the emphasis has shifted to the perspective of self-management, emphasising self-empowerment and self-efficacy to allow PWD to manage their self-care, and prevent potential microvascular and macrovascular complications, such as, DR[16,19]. These strategies require effort, persistence, resources, and development of appropriate strategies[20].

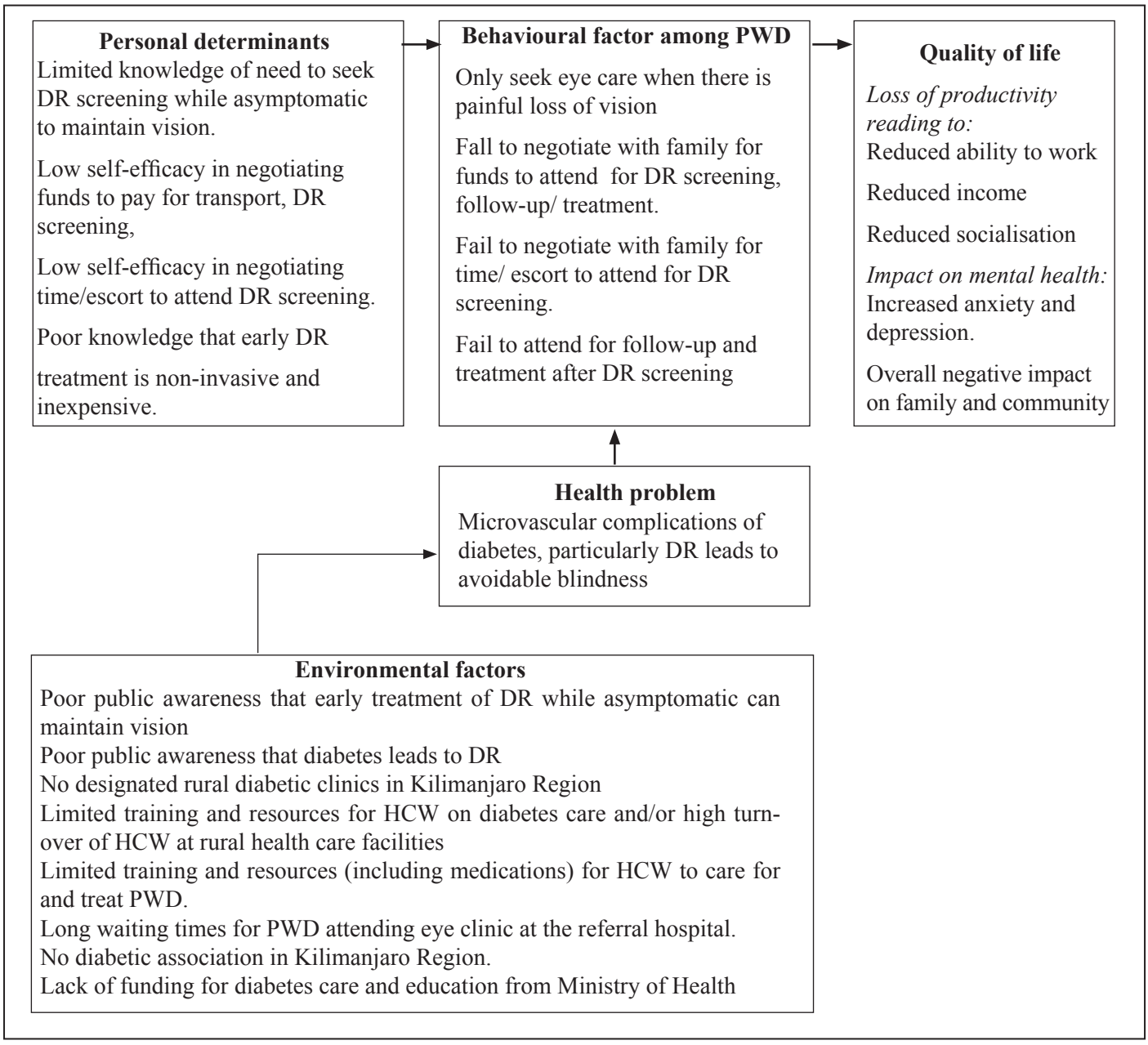
IM was used as the comprehensive, ecological, theoretical and evidence-based protocol for the development of the proposed health intervention (Figure 1)[1]. Through the 'needs assessment' the program aimed to gain an understanding of the eye health behaviour of PWD, identifying barriers to the uptake of eye screening services, leading to the development a comprehensive health promotion program that would draw upon local resources, being informed, and supported by the local community.

Figure 1: Intervention mapping steps 1-6 and related tasks



The program's Working Committee identified the behavioural and environmental determinants of behaviours that needed to change if HCW could influence the health outcomes of PWD who attend the health care facilities in Kilimanjaro Region. The Logic Model of the Problem (Figure 2), which had been used to identify the causes of the health problems, was used to create the Logic Model of Change (Figure 3) to promote and improve the health of the PWD (IM-steps 1, 2 and 3).

Figure 2: Logic model of the problem at the referral hospital



The aim of this paper is to report the findings of the HCW 'needs assessment' (IM-step 1)[1], which were then triangulated with the findings of the 'needs assessment' of the PWD and used by the program's Working Committee to develop the strategies for the health intervention[1,8].

Figure 3: Logic model of change

Determinants	Behavioural outcomes	Health	Quality of life
Knowledge-understands need for DR screening while asymptomatic.	Travels to outreach clinic at the referral hospital for DR screening.	Maintain vision.	Maintain productivity and income.
Have a positive attitude towards DR screening.	Attends DR screening clinic and accepts DR screening.	Prevent avoidable blindness.	Maintain social interaction.
Believes there are more benefits than barriers to DR screening.	Receives notification of DR screening and attends follow-up assessment or treatment as appropriate.		Maintain good mental health.
Self-efficacy to negotiate escort and fees for transport and cost of treatment at clinic.	Commits to annual DR screening.		
Expects that DR screening will prevent vision loss.			
	Behavioural outcomes from the environmental agents/implementers		
	Provide information on DR screening and treatment.		
	Provide DR counselling to PWD.		
	Provide fast track service to PWD in eye clinic at the referral hospital.		
	Provide digital retinal screening at diabetic and eye clinics at the referral hospital.		
	Provide digital retinal screening at outreach clinics.		

MATERIALS AND METHODS

Needs assessment

Using convenience sampling, to achieve theme saturation, the researchers conducted a qualitative 'needs assessment' of HCW in Kilimanjaro region[21]. The development of the semi-structured questionnaire for the 'needs assessment' were informed by the results of a mixed methods PWD 'needs assessment' conducted by the researchers in order to triangulate the data findings[8].

Developing the semi-structured questionnaire: The programme's working committee formulated the needs assessment questionnaires with reference to diabetes and diabetic retinopathy literature reviews. An international colleague provided training on qualitative thematic analysis using the software Atlas-ti. After analysing the results of the pilot study, the questions were refined.

The qualitative process: Interviews were conducted in English and recorded. To ensure diversity and reduce sampling bias[21], the 35 question semi-structured interviews was conducted with HCW (n=31) at different HCF in the districts of Kilimanjaro region and included a mix of health care workers: 5 Medical Officers, 6 Assistant Medical Officers, 4 Clinical Officers, 14 Nurses, 1 District Eye Co-ordinator and 1 Physiotherapist. The average age was 47.6 years; 17 men, and 14 women. Two recordings could not be used for technical reasons. This data was compared to the qualitative and quantitative data, and an eye health questionnaire from the PWD 'need assessment' previously conducted in the same region[8,21,22].

Ethics approval: This was granted by Tumaini University Ethics committee, Clearance Certificate Number 241, Research Proposal Number 273.

RESULTS

Finding of the needs assessment of health care workers (Step 2).
Examples of participants' answers are presented in Table 1.

Table 1: Findings of needs assessment of health care workers – Examples

Knowledge of diabetes diagnosis
Question: "Can you give me a definition of diabetes?"
Reply: *"Diabetes is a chronic disease which affects the pancreas, and when it is affected the production of increased sugar or sometimes it can lower the sugar. The causes of diabetic are not actually known, but a few people have been affected because of taking things like alcohol and toxic drugs. There are 2 types of diabetes, one affects children and the other affects adults."* (KTS)
Complications
Question: What information do you give to diabetic patients about complications of diabetes?
Reply: *"They should continue with drugs because they can get blindness, they can faint and even go into a coma."* (MSM)
Specific knowledge of eye health
Question: "Can you tell me what diabetic retinopathy is?"
Reply: *"Damage of the nerves so that the patient cannot see properly."* (MSM)
Question: "Do you know how it can be treated?"
"I know that when you get complication of diabetes you can't reverse (it)." (JL)
Mental health
Question: "Do you think any of your patients are feeling anxious or depressed?
Reply: *"Yes, they are very anxious because they know there is no cure of diabetes, and they are given so many rules they become unhappy; they are worried. Some are depressed."* (KCA)
Question: "Is there anything else that makes them feel anxious and depressed?
Reply: *"The family. They are now not able to be productive and the income becomes low."* (KCA)
Reply: *"Some are anxious because this is a chronic disease … They get depressed because of taking the drugs always, sometimes they are depressed because they want to go for check-up but don't have the money to travel."* (UAM*)*
Communication and following advice
Question: "How well do you think your patients follow instructions that you give them about their treatment?"
Reply: *"I know that they follow if they come regularly to clinic and if the blood sugar is controlled then I'm sure that they are following the instructions."* (UEM)
Limited resources due to poverty affect both PWD and HCW
Question: "So, they have some problems following their treatment?"
Reply: *"Yes because some of them involve expenses. Sometimes in our centre here we run short of drugs or insulin, or short of sticks so we tell them to go buy but we are not sure if they do that. Another problem is lack of knowledge so it is important for the health workers to be knowledgeable so that they may speak the same language. That is one of the challenges, the health workers also need to be knowledgeable pertaining to diabetes."* (UEM)
Question: "What problems do the diabetics face in following the treatment plan that is prescribed for them?"
Reply: *"There is a lot of problem, especially in our area, if the patient came to the hospital most of the time we have no reagent, so it is difficult for us to detect if it is hyperglycaemia or hypoglycaemia, sometimes we refer the patient, sometimes the patient delay to get a treatment. Most of the time there is a shortage of drugs."* (KCA)
Question: "So, you cannot do diagnosis at the moment, you can't treat, you must refer?"
Reply: *"Most of them we refer because if you can't check their blood sugar, you have no reagent. It is better to refer the patient to where they can get proper treatment."* (KCA)
Nutrition
Question: "What information do you give diabetic patients about their diet?"
Reply: *"It depends, some have hypoglycaemia and others have hyperglycaemia, so I teach them the diet according to the condition. In general, I tell them ripe bananas increase blood sugar, to eat small amount of 'ugali' and increase vegetables. We give them this information so that they can control that disease."* (ugali=cornmeal; KCA)
Physical activity
Question: "Do you tell them anything else about exercise?"
Reply: *"Yes, most people here work, most people here get exercise in their work."* (USS)
Reply: *"It's important, I tell them to do exercise so that they won't be obese."* (UEM)
Reply: *"We tell them to exercise, in order to burn sugar and to improve circulation in the body."* (MJL)

Knowledge of diabetes diagnosis: HCW classified diabetes as being controlled by the pancreas and a lack of insulin (7 out of 31), as an increase in blood sugar (16 out of 31), a lack of insulin (5 out of 31) and by signs and symptoms (5 out of 31).

Complications: Informing PWD about hyperglycaemia and hypoglycaemia was mentioned by 10 out of 31 HCW, microvascular (20 of 31) and macrovascular complications were almost equally mentioned (17 out of 31). The most mentioned microvascular complications to inform PWD of were cataract and blindness (11 out of 31), and the most important macrovascular complication to inform PWD of were wounds, diabetic foot, and gangrene (15 out of 31).

Specific knowledge of eye health: The majority of HCW knew that PWD need an eye examination because diabetes affects the eye, causing cataract, DR, and blindness (22 out of 31). The majority of HCW (18 out of 31) did not know that PWD should have an annual dilated eye examination. The majority of HCW, (21 out of 31) did not know how DR could be treated, (7 out of 31), recommended surgical treatment, (3 out of 31) recommended laser treatment, 2 out of 31, recommended Avastin injection and 1 out of 31 recommended eye drops.

Mental health: HCW (26 out of 31) identified mental health as a significant problem for PWD. HCW suggested that the majority (19 out of 31) of PWD were depressed about managing lifestyle changes of living with diabetes, specifically taking daily medication, adjusting diet, restricting alcohol consumption and not being able to work. HCW suggested that many (18 out of 31) PWD were anxious at initial diagnosis of diabetes, and with self-management of diabetes and associated complications.

Communication and following advice: HCW were asked to rate themselves as communicators on a scale of 1-10. The average self-rating score was 8.56 indicating high levels of self-efficacy as communicators. The majority of HCW (15 out of 31) felt that PWD followed the instructions given regarding their treatment regimens and to self-manage their diabetes if they remembered and understand the instructions they are given, this is reflected by their attendance at the clinic and their blood sugar levels.

Others (9 out of 31) felt that some PWD were hindered by poverty and local traditions regarding diet and beliefs in the use of traditional herbs. Other problems with following advice of self-management of diabetes included ignoring recommendations altogether out of despair.

HCW identified key reasons PWD failed to follow their treatment regimens and self-manage their diabetes as: poverty (27 out of 31), being unable to pay for transport to health care facilities for check-ups and care (7 out of 31), being unable to pay for medication and food (20 out of 31), shortage of medication and not taking mediation when feeling unwell (7 out of 31), diet being unsuitable, unpalatable and unavailable (9 out of 31), lack of education and understanding of diabetes (16 out of 31). The need to follow up PWD in the community was recognised by (9 out of 31) of HCW.

When asked what the specific barriers PWD faced in accessing treatment, the HCW identified similar reasons; cost and lack of medication and testing agents for blood sugar (26 out of 31), transport to health care facilities for check-ups and care (8 out of 31), staff knowledge of diabetes treatment and self-management (10 out of 31).

Limited resources due to poverty affect both PWD and HCW: When asked what resources were available to educate and provide treatment for PWD the HCW stated that 12 out of 31 had medication available for PWD, 11 out of 31 had testing for blood glucose, 15 out of 31 were able to provide education for PWD (the chosen method of education was one-on-one discussion as written or printed material was extremely limited), 5 out of 31 had some medical equipment (weighing scale, blood pressure machine). The researchers' 'need assessment' of PWD supported these findings[2]. When HCW were asked what additional resources would assist with educating PWD, 18 out of 31 requested additional staff in the rural clinics, training and 12 out of 31 requested leaflets and pamphlets.

Nutrition: The most mentioned dietary change recommended was to reduce carbohydrates or sugar (23 out of 31) followed by a need to increase fruit, vegetable, and roughage (58%) and protein (11 out 31). There were less frequent recommendations to reduce portion sizes (3 out of 31) or to eat a balanced diet (4 out of 31).

Physical activity: HCW reported that they instructed their clients to take regular exercise by either walking or jogging. The rationales for exercise were as follows; exercise is good, reduces weight or prevents obesity (15 out of 31) exercise helps reduce blood sugar and blood pressure (11 out 31) and it improves circulation and helps prevent complications (5 out 31).

DISCUSSION

The HCW 'needs assessment' findings were triangulated with those from the researchers' people with diabetes 'needs assessment' report of poor understanding of diabetes and self-management to avoid complications such as DR which stemmed from a poor diabetes knowledge base[8]. This information is considered important as outlined in the DR screening guidelines recommended by the International Council of Ophthalmology[7]. The clinical knowledge of diabetes of the majority of the HCW was poor and this was reflected in the varied and often conflicting information given to PWD[23].

HCW demonstrated a poor knowledge of DR, how it could be treated and the need for annual DR screening, resulting in poor uptake of DR screening, treatment. and attendance for follow-up[24,25]. Dietary knowledge was poor with HCW failing to advise PWD to eat a balanced

diet and reduce portion sizes[8]. HCW rated themselves as good communicators but feedback from the PWD 'need assessment' did not support this view[8].

HCW understood the rational for PWD to take regular exercise but failed to recommend socially acceptable means of achieving this[8]. HCW recognised that mental health issues such as anxiety and depression were hindering self-management and prevention of related complications[8]. HCW identified poverty as a key factor for PWD failing to undertake treatment regimens and self-manage their diabetes[8]. In addition to cost, a lack of resources was identified as preventing good diabetes control. HCW recognised the need for diabetes training and resources with which to educate PWD.

One of the outcomes of the HCW 'need assessment' was the training of six facilitators from the university, who participated in the development and delivery of a three-year rural holistic health care training program for HCW in Kilimanjaro Region, as one of the IM strategies. One of the four days of the training focused on eye health and DR screening. This strategy is detailed elsewhere. The health program incorporated various theoretical methods that support each other including Social Cognitive Theory, encompassing self-efficacy and modelling[26]; Goal Setting Theory[27] with SMART goals (specific, measurable, attainable, relevant, and timely[28]) message framing on health behaviour[29,30], and the Persuasive Communication Model[31].

Strengths and weakness of the study

The study was able to triangulate the findings of the 'needs assessment' with PWD[8] with those of the HCW. The strength of the study was that it gave the health care workers an opportunity to talk about their lack of resources in the management and care of PWD. It gave the researchers the opportunity to identify the need for comprehensive education of health care workers in diabetes and specifically diabetic retinopathy in Kilimanjaro Region. This led to the development of the educational programme that would then run in the region over the next three years for these health care workers. It was supported by the diabetologist from regional hospital visiting the clinics and the provision of textbooks and equipment for the clinics.

This was a small study (n=31) of the HCW target population. For the findings to be of greater value it should be replicated and expanded to include more HCW. The study was limited to a semi-structured questionnaire and did not include focus groups and written feedback. There was an opportunity to expand this information after the training workshops were conducted.

The study was conducted in English by the primary investigator. This limited the understanding of the semi-structured questionnaire and feedback received from some of the HCW.

This study identified the need to provide education for HCW at rural Health Care Facilities in Kilimanjaro Region. In real terms, the issues surrounding poverty, and lack of resources, and policy regarding the conditions of training or retention of HCW in Kilimanjaro could not be addressed.

The way forward

The program's study highlighted the need for primary prevention of diabetes, with basic training for primary care focused on practical, local, and indigenous health challenges[32]. HCW should be locally recruited and trained close to their geographical origins and eventual place of service[33]. To develop primary prevention of diabetes there is a need to improve both education and salaries, these are policy issues[33]. As was identified by the HCW 'needs assessment', the need for community and village workers is of great importance in the effort to ensure primary and secondary prevention of chronic disease such as diabetes and prevent avoidable blindness from DR[33].

Self-management skills are important in optimising diabetes care[34-36]. In the Tanzanian context, there appears to be little opportunity to educate either HCW or PWD in diabetes self-management. While the program's training workshops provided HCW with tools to assist PWD to engage in self-management, the way forward is with more client-centred care as is suggested by self-regulating theory[37,38]. This moves people from regulating their health because of controlled regulation (following a prescribed health regimen of diet, exercise, and medication because it has been directed by health care providers and/or the social environment), to being committed to autonomous, self-determined health behaviour[39].

Future research

African institutions need to be empowered to do research that will encourage the development of best practices to address the needs of people in their regions[23,40,] The use of ecological frameworks that ensure an evidence-based theory derived approach to health interventions are recommended[1].

Declaration

Authors' consent: All authors have agreed with the submission of this paper.

Competing interests: All authors have no competing interest.

Authors' contribution: CH developed the needs assessment questionnaires and conducted the interviews. JM assisted in the data management. CH and AB analysed the findings. JM contributed to the implementation. GK helped supervise the project. CH took the lead in writing the manuscript. All authors discussed the results and contributed to the final manuscript.

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REFERENCES

1. Bartholomew Eldrigde LK, Markham CM, Ruiter RAC, Fernàndez ME, Kok G, Parcel GS. Planning health promotion programs: An intervention mapping approach. Hoboken, NJ: Wiley; 2016. 704 p.
2. Azevedo M, Alla S. Diabetes in sub-Saharan Africa: Kenya, Mali, Mozambique, Nigeria, South Africa and Zambia. *Int J Diabetes Dev Ctries.* 2008; **28**(4):101-108.
3. IDF. Diabetes Atlas. 2022;11 th Edition.
4. Maseko SN, van Staden D, Mhlongo EM. The rising burden of diabetes-related blindness: A case for integration of primary eye care into primary health care in Eswatini. *Healthcare.* 2021; **9**(7):835.
5. Ciulla TA, Amador AG, Zinman B. Diabetic retinopathy and diabetic macular edema: pathophysiology, screening, and novel therapies. *Diabetes Care.* 2003; **26**(9):2653-64.
6. Burgess PI, Msukwa G, Beare NA. Diabetic retinopathy in sub-Saharan Africa: meeting the challenges of an emerging epidemic. *BMC Med.* 2013; **11**:157.
7. Wong TY, Sun J, Kawasaki R, Ruamviboonsuk P, Gupta N, Lansingh VC, *et al.* Guidelines on diabetic eye care: The International Council of Ophthalmology Recommendations for Screening, Follow-up, Referral, and Treatment Based on Resource Settings. *Ophthalmology.* 2018; **125**(10):1608-22.
8. Hall CE, Hall AB, Kok G, Mallya J, Courtright P. A needs assessment of people living with diabetes and diabetic retinopathy. *BMC Res Notes.* 2016; **9**(1):56.
9. Cleland CR, Burton MJ, Hall C, Hall A, Courtright P, Makupa WU, *et al.* Diabetic retinopathy in Tanzania: prevalence and risk factors at entry into a regional screening programme. *Trop Med Int Health.* 2016; **21**(3):417-226.
10. Hall V, Thomsen RW, Henriksen O, Lohse N. Diabetes in sub Saharan Africa 1999-2011: Epidemiology and public health implications. A systematic review. *BMC Public Health*. 2011; **11**(1):564.
11. Mulangu F, Depetris Chauvin N, Porto G. Food production and consumption trends in sub-Saharan Africa: Prospects for the transformation of the agricultural sector 2012. *Academia*. 2012: pp.1-76.
12. Hoffmeister M, Lyaruu I, Krawinkel MB. Nutritional management of diabetes in Northern Tanzania. *Diabetes Care.* 2002; **25**(8):1486-1492.
13. Unwin N, Gan D, Whiting D. The IDF diabetes atlas: Providing evidence, raising awareness and promoting action. *Diabetes Res Clin Pract.* 2009; **87**(1):2-3.
14. John B, Todd J, Mboya I, Mosha M, Urassa M, Mtuy T. Physical activity and associated factors from a cross-sectional survey among adults in northern Tanzania. *BMC Public Health*. 2017; **17**(1):588.
15. Colberg SR. Key points from the updated guidelines on exercise and diabetes. *Front Endocrinol* (Lausanne). 2017; **8**:33.
16. Fredrix M, McSharry J, Flannery C, Dinneen S, Byrne M. Goal-setting in diabetes self-management: A systematic review and meta-analysis examining content and effectiveness of goal-setting interventions. *Psychol Health.* 2018; **33**(8):955-977.
17. Lawrenson JG, Graham-Rowe E, Lorencatto F, Burr J, Bunce C, Francis JJ, *et a*l. Interventions to increase attendance for diabetic retinopathy screening. *Cochrane Database Syst Rev*. 2018; **1**(1):Cd012054.
18. Glasgow RE, Osteen VL. Evaluating diabetes education. Are we measuring the most important outcomes? *Diabetes Care*. 1992;**15**(10):1423-32.
19. American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes Care*. 2010; **33** (Suppl 1):S62-S69.
20. American Diabetes Association. Standards of medical care in diabetes--2010. *Diabetes Care.* 2010; **33**(Suppl 1):S11-S61.
21. Wutich A, Beresford M, Bernard HR. Sample sizes for 10 types of qualitative data analysis: an integrative review, empirical guidance, and next steps. *Intern J Qual Methods*. 2024; **23**:16094069241296206.
22. Golzar J, Tajik O, Noor S. Convenience sampling. *IJELS.* 2022; **1**:72-77.
23. Albarqouni L, Hoffmann T, Straus S, Olsen NR, Young T, Ilic D, *et al.* Core competencies in evidence-based practice for health professionals: Consensus statement based on a systematic review and Delphi survey. *JAMA Netw Open*. 2018; **1**(2):e180281.
24. Mtuya C, Cleland CR, Philippin H, Paulo K, Njau B, Makupa WU, *et al.* Reasons for poor follow-up of diabetic retinopathy patients after screening in Tanzania: a cross-sectional study. *BMC Ophthalmol.* 2016; **16**:115.
25. Cleland CR, Burton MJ, Hall C, Hall A, Courtright P, Makupa WU, *et al.* Diabetic retinopathy in Tanzania: Prevalence and risk factors at entry into a regional screening programme. *Trop Med Int Health*. 2016; **21**(3):417-426.

26. Bandura A, editor Self-Efficacy: The Exercise of Control 1977.
27. Locke E, Latham G. Building a practically useful theory of goal setting and task motivation - A 35-year odyssey. *The Amer Psychol*. 2002; **57**:705-717.
28. Blanchard K, Johnson S. The one-minute manager. *Cornell Hotel Restaurant Admin Quarterly*. 1983; **23**(4):39-41.
29. Rothman AJ, Salovey P. Shaping perceptions to motivate healthy behavior: the role of message framing. *Psychol Bull*. 1997; **121**(1):3-19.
30. Werrij MQ, Ruiter RA, Van 't Riet J, De Vries H. Self-efficacy as a potential moderator of the effects of framed health messages. *J Health Psychol*. 2011; **16**(2):199-207.
31. Rice R, Atkin C. (2013). Public communication campaigns. SAGE Publications, Inc., https://doi.org/10.4135/9781544308449.
32. IDF. Diabetes Atlas. 2021; 10th Edition.
33. Mulangu F, Chauvin N, Porto G. Food production and consumption trends in sub-Saharan Africa: Prospects for the transformation of the agricultural sector. *Science and Education*. UNDP working paper 2012..
34. Malanda UL, Welschen LM, Riphagen, II, Dekker JM, Nijpels G, Bot SD. Self-monitoring of blood glucose in patients with type 2 diabetes mellitus who are not using insulin. *Cochrane Database Syst Rev*. 2012;**1:**Cd005060.
35. Nathan DM. The diabetes control and complications trial/epidemiology of diabetes interventions and complications study at 30 years: overview. *Diabetes Care*. 2014; **37**(1):9-16.
36. Stratton IM, Cull CA, Adler AI, Matthews DR, Neil HA, Holman RR. Additive effects of glycaemia and blood pressure exposure on risk of complications in type 2 diabetes: a prospective observational study (UKPDS 75). *Diabetologia*. 2006; **49**(8):1761-69.
37. Petrie KJ, Broadbent E, Meechan G. Self-regulatory interventions for improving the management of chronic illness. The self-regulation of health and illness behaviour. New York, NY, US: Routledge; 2003. p. 257-77.
38. Olesen K, Folmann Hempler N, Drejer S, Valeur Baumgarten S, Stenov V. Impact of patient-centred diabetes self-management education targeting people with type 2 diabetes: an integrative review. *Diabet Med*. 2020; **37**(6):909-923.
39. Ng JY, Ntoumanis N, Thøgersen-Ntoumani C, Deci EL, Ryan RM, Duda JL, *et al*. Self-determination theory applied to health contexts: A meta-analysis. *Perspect Psychol Sci*. 2012; **7**(4):325-340.
40. Liu G, Jack H, Piette A, Mangezi W, Machando D, Rwafa C, *et al*. Mental health training for health workers in Africa: a systematic review. *The Lancet Psychiatry*. 2016; **3**(1):65-76.

Development and evaluation of a rural diabetic training workshop for healthcare workers in Kilimanjaro based on findings of a needs assessment for diabetes and diabetic retinopathy screening

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ABSTRACT

Objective: The aim of the project was to create a comprehensive, ecological, theory and evidence-based screening program for diabetes and diabetic retinopathy to prevent avoidable blindness, using Intervention Mapping (IM).

Methods: The training workshop for Health Care Workers (HCW) in Kilimanjaro was based on findings of a needs assessment among HCW, showing mixed levels of knowledge regarding diabetes. The trainings highlighted that the rural HCW were not trained as diabetic specialists nor were they working in specialist diabetic clinics. They faced numerous obstacles in caring for People With Diabetes (PWD) due to varying levels of knowledge amongst colleagues, nurses, and clinical officers. When giving advice to PWD about how to avoid complications very few HCW were able to adopt a holistic approach to care promoting healthy living to prevent complications. The workshops were able to take comprehensive diabetes education to the rural HCF, reducing travelling time for HCW. Facilitators focused on changing both the attitudes and knowledge of HCW.

Results: The training workshops achieved the aim of training facilitators to educate HCW on diabetes care and self-management. The workshops met the expressed request of HCW for diabetes education and provided them with the resources they requested for self-study and reference in their clinical practice. The workshops empowered the facilitators who gained experience and confidence through the course of the three years. The commitment of the team to deliver the training in rural settings was acknowledged and appreciated by the recipients. The improvement in HCW diabetes knowledge was rewarding and satisfaction with the facilitators was high; training had informed the HCW clinical practice. Highly important was the engagement of HCW as stakeholders in the program, and continued support through annual HCW training workshop and stakeholder meetings.

Conclusion: The 'need assessment' of both PWD and HCW in Kilimanjaro Region, the dialogue with stakeholders, and the program's Working Committee, resulted in training workshops that are one strategy in the overall healthcare program in Kilimanjaro Region to plan, develop and implement a culturally relevant, evidence-based, theory-driven screening program for diabetic retinopathy to prevent avoidable blindness.

Key words: Evidence-based screening program, Diabetes, Diabetic retinopathy, Avoidable blindness, Intervention mapping

INTRODUCTION

The aim of the project was to create a comprehensive, ecological, theory and evidence-based screening program for diabetes and Diabetic Retinopathy (DR) to prevent avoidable blindness, using Intervention Mapping (IM)[1]. We describe the planning, development, implementation and evaluation of the annual Healthcare Workers (HCW) training workshops. Rural HCW, working in Kilimanjaro Region were provided with an overview of holistic diabetes management and care, including eye health.

The need for this training came from a 'needs assessment' conducted in the Kilimanjaro Region, with People With Diabetes (PWD) and HCW[2]. From the 'need assessment' the researchers had gained an understanding of the eye health behaviour of PWD, which revealed the dynamics between PWD and HCW and identified barriers to the uptake of eye screening services. The complexity of the power imbalance between the PWD and HCW was considered in its cultural and social context. The HCW training workshop was part of the IM-strategy: drawing upon local resources, being informed and supported

by the local community[1]. Potential barriers, but also facilitators, were already known. The interaction between PWD and HCW became evident: poor knowledge of diabetes, conflicting advice, limited resources and poor retention of staff.

Local screening for diabetic retinopathy: The program had trialled and then introduced screening for Diabetic Retinopathy (DR) at the regional referral hospital, in a rural outreach program. The advantages being that the screening could be conducted by a trained technician and taken into the rural areas[3] allowing for storage of the images for analysis, review, and epidemiological study[4]. Mydriasis (pupil dilation) for photography increases specificity and sensitivity of screening[5,6], additional benefit is the increased detection of other eye conditions[7]. Prevention of visual loss from DR in resource poor areas where access to care is often difficult, and socioeconomic factors add to the burden[8]. Throughout Africa, late presentation for screening and treatment is common[9-11].

Lack of specific knowledge of eye health: HCW's 'needs assessment' findings were triangulated with the PWD 'needs assessment' to reveal poor understanding of diabetes and self-management to avoid complications such as DR[12]. Patient education, good glycaemic control and attending for DR screening in a timely manner are among the recommendations set out by the International Council of Ophthalmology[12]. Of the HCW, 22/31 knew that PWD need an eye examination as diabetes affects the eye, causing cataract, DR, and blindness and 18/31 did not know how often PWD should be screened that in Kilimanjaro Region an annual dilated eye examination was recommended; 21/31 did not know how DR could be treated; 7/31, recommended surgical treatment; 3/31 recommended laser; 2/31, recommended Avastin injection and 1/31 recommended eye drops.

Limited healthcare provision: Tanzania has a predominantly rural population with 67.68% of its 57.31 million inhabitants living outside of the major cities[13] and 3.2 physicians to every 100, 000 people, primarily in the urban areas. In 2011, 49.1% were living in poverty on $1.90 per day[13]. Rural healthcare needs are often met by non-physician clinicians with approximately per 10,000 people, 4.8 nurses and midwives; 0.5 medical officers and 0.4 assistant medical officers. Staff shortages (± 56%), and poor retention of staff, particularly in rural areas, result in overwhelming workloads causing poor continuity of care; compounded by inadequate infrastructure and poor management[14]. Staff report limited training opportunities, favouritism in allocation of training, lack of cover during training absences, poor and unsafe working conditions, skill mix inequalities, lack of resources and equipment[14].

The role of traditional healers in Tanzania: Traditional healers register with the Tanzania Traditional Health Practitioners Association. It is not uncommon for PWD living in rural communities to seek care from traditional healers[15]. With traditional health beliefs there is a cure for every illness[16]. The biomedical model defines diabetes as incurable; traditional healers define diabetes as temporary, believing diabetes originated with ancestors and they will eventually provide a cure. This promotes the passive attitude of some PWD to their condition and self-management. Within the traditional paradigm diabetes is understood as being caused by conflicts or misdemeanours of previous generations[16]. Traditional healers are often able to explain illness in a way that is both culturally relevant and understandable[17]; this explanation is valued even when the symptoms are not alleviated. While traditional healers will sometimes refer patients to biomedicine (44-74%) collaboration is difficult[18].

The role of the Tanzanian Diabetic Association (TDA): The role of the TDA is potentially a powerful one supported by the International Diabetes Federation, with a good framework to support HCW and PWD[19]. The TDA initiated the development of diabetic clinics in regional hospitals in Tanzania and HCW-training, guidelines, and patient education. However, outside of regional hospitals, this has not translated into support for HCW caring for PWD attending other Healthcare Facilities (HCF), especially in rural areas[2,19]. When the TDA was first established, only three HCF provided diabetic clinics, illustrating that care for PWD is extremely limited in rural areas.

At the time of the 'need assessment' in the Kilimanjaro, there were no known district diabetic clinics, the only specialist care available to PWD was provided at the Kilimanjaro Regional Hospital[2]. The nurses in the hospital's specialist diabetic clinic explained that health information leaflets for PWD had to be purchased, remained on the shelf and were unavailable for the majority of PWD.

The need for diabetes education: Fundamental to diabetes education is the complex concept of health literacy[20], defined as "the degree to which people are able to access, understand, appraise and communicate information to engage with the demands of different health contexts in order to promote and maintain good health across the one's life-time"[21].

Health literacy is required by PWD to use prescribed medications, to access clinic and hospital services, negotiate for provision of information and healthcare from HCW; gain knowledge, skills and competence to self-manage their lifelong condition of diabetes and prevent complications[20].

In this program, providing health education to PWD was identified as a key area where resources were limited[2]. HCW must source scientific information from textbooks, journals, *et cetera*, which are both scarce and written in English. More information is now available via the internet. The majority of HCW speak English as a second

or third language[2]. To provide clear health education the information taught must be well understood by the HCW in English and then translated back into Kiswahili[2,21].

Training programs for HCW: Training programs for HCW have been effectively implemented in low resource, and multi-cultural settings for a variety of health interventions: for lay HCW to implement breast and cervical pap smearing for low-income workers[22]; diabetes prevention programs for community HCW in Thailand[23]; diabetes training for community HCW[24]; diabetes education for a Hispanic population using community HCW. These examples illustrate that trainings focus on changes in knowledge and attitude with little emphasis on evaluating skill and practice. Those are more difficult to evaluate due to time, staff and financial restraints[25].

The needs assessments of PWD and HCW showed poor knowledge and management of diabetes. It was clear from the assessment and from direct requests for training and resources from the HCW that the program should provide assistance[1].

MATERIALS AND METHODS

The curriculum programme production years 1 and 2

The approach: The trainings would be delivered in English. English is used for secondary and tertiary education in Tanzania. Medical textbooks and information available on the worldwide web are predominately in English.

The aims: Aims of the workshops were firstly, to deliver workshops on diabetes care and management to meet the expressed need for training by the HCW. Secondly, to build capacity in the facilitators who took on the role of teaching in the workshops so they would be equipped to train others. Objectives were to facilitate evidence-based learning aimed at behaviour change for PWD and to establish a link between rural HCW and the main hospitals to build referral services and increase awareness of diabetes management, care, treatment and rehabilitation services.

The time line: In year 1 the International Diabetic Federation (IDF) manual and HCW manual PowerPoint presentations were available to the facilitators[26]. Additional materials were provided by specialists and facilitators. A unified approach to the teaching methods ensured a standardised educational outcome to the training workshops.

The material was reviewed after each session and revised based on feedback and outcome evaluation from the participants. In the capacity building approach, each facilitator reviewed participants' feedback forms, and reflected on their experience from their delivery of the material and tasks set for the workshop participants.

The Teaching and Learning Module from the IDF provided a useful resource. The facilitators were teaching adult learners of varying educational backgrounds. Some of the HCW attending the workshops had not had any formal teaching for several years; some had a better comprehension of English than others. The aim was to deliver evidence-based messages about diabetes that all participants would understand, remember and be able to tailor and communicate effectively to their individual patients: an exciting but challenging task.

Training workshop facilitators: Educators from the referral hospital and university interested in diabetes were invited to act as facilitators, engaging other HCW and empowering them to motivate PWD to achieve self-management and an 'optimal' quality of life. Behavioural outcomes and performance objectives were developed for the facilitators to guide the objectives and content of the training workshops (Tables 1 and 2)[1]. All facilitators held a degree in their area of expertise. The program aimed to teach 15 HCW at the selected HCF with 4-day training workshops.

The ratio of male/female HCW attending the training could be equal or even more males than females, i.e. 2:1. At one workshop there were 11 males and 6 females attending (male HCW tend to be given preference over female workers when education opportunities are offered because men remain in their positions and do not leave to have children).

The training workshops were held at HCF in areas that were treating the highest number of diabetic patients, rotating this training annually through different HCF. The program's working committee was aware of the high turnover of HCW in Kilimanjaro region.

Table 1: IM Step 2 - Facilitators' behavioural outcomes and performance objectives

Behavioural outcomes	Main performance objectives
Facilitators provide evidence- based education on diabetes care and self-management to health care workers at HCF	Deliver evidence-based education on diabetes care and self- management. Ensure that teaching is culturally appropriate and relevant to the target population. Model communication skills that can be taught by health care workers to motivate people with diabetes to adopt efficacious self- management of diabetes. Ensure that health care workers are confident using goal planning for supporting people with diabetes in self-management and care. Raise awareness of primary prevention, e.g. diabetic retinopathy screening whilst asymptomatic.

Table 2: Examples of change objectives for facilitators educating health care workers:

Step 2 intervention mapping

Performance outcomes	Clinical knowledge	Communication skills	Self-efficacy	Outcome expectations
PO 1 - Communicate information to health care workers in Kilimanjaro Region about diabetes treatment and self-care	K 1 - State knowledge of diabetes treatment and self-care to be healthy living with diabetes	CMS 1 - Demonstrate how to effectively educate health care workers about treatment and self-care to be healthy living with diabetes	SE 1– Express confidence about training health care workers to counsel people with diabetes about diabetes treatment and self -care to be	OE 1 – Recognize that health care workers counselling will empower people with diabetes to better self-care of diabetes
PO 2 – Answer specific questions health care workers have regarding diabetes	K 2 – State specific knowledge about treatment and self-care of diabetes to prevent complications	CMS 2– Demonstrate how to provide health care workers with information about specific aspects of diabetes care targeted at prevention of complications, e.g. diabetic retinopathy screening, follow-up, and treatment options. Feel confident when answering questions to dispel the fears and anxiety of people with diabetes	SE 2 – Express confidence educating health care workers regarding difficult issues regarding the provision of diabetes treatment and self-care, e.g. for diabetic retinopathy	OE 3 – Describe belief about ability of health care workers to detect complications of diabetes, e.g. diabetic retinopathy. To make timely and appropriate referral for follow up and treatment as required.

How the material was delivered (Step 5): Prior to the first workshop the program held a day's diabetic training day, at the referral hospital. The Training of Trainers aimed at developing the curriculum for a Diabetic Day at the referral hospital. HCW from the region were invited to participate. Facilitators did present some of their material to be evaluated by the participants.

Two key slogans were used, 'You can be healthy living with diabetes' and 'KISS-Keep it simple sasa': keep it simple 'now', which was applied to goal setting, using action plans for all aspects of self-management[27-29], SMART goals[27-30], tailoring and framing[31,32].

In year 1, the training was divided into discrete sessions with an overview of material presented by power-point presentations followed by a group work session that allowed for a problem-based learning exercise. The sessions were interactive and aimed to build the communication skills and self-confidence of the HCW. Learning objectives were stated for each session. A summary and a take-home message concluded each session (Figure 1).

Figure 1: Outline of training workshop – year 1

1. An overview of diabetes: What is diabetes, diagnosis, treatment, targets for prevention and management of complications
2. Nutrition: Healthy diet, the food plate, meal planning, appropriate and locally available foods
3. Communication skills and self-management: Behaviour change by motivating self-care with action plans
4. Nursing advice: Practical advice on fasting during Ramadan, sick days and travelling, goal setting. Diabetes and pregnancy. Use of insulin
5. Exercise, foot care, diabetic neuropathy, and erectile dysfunction
6. Diabetic retinopathy and the need for annual eye screening
7. Data collection, referral of diabetic patients for specialist services

For year 2 the program presented feedback, outlined in the feedback from HCW who had participated in the year 1 training workshops, to a stakeholders meeting. The training material was updated[33] and combined with the previous material. The material was then based on a virtual healthcare team presentation of Patient X 34. This would allow HCW to follow a virtual person from initial diagnoses with type 2 diabetes through all aspects of care with task-based activities interspersed through each training session. The participants were given a detailed outline of each session plus additional fact sheets.

Figure 2: Outline of training workshop –year 2

1. For year 2 the program presented feedback, outlined in the feedback from postal questionnaires sent to HCW who had participated in the year 1 training workshops to a stakeholders meeting.
2. The training material could be updated (34) and combined with the previous material. The material was then based on a virtual health care team presentation of Patient X (35). This would allow HCW to follow a virtual person from initial diagnoses with type 2 diabetes through all aspects of care with task-based activities interspersed through each training session.
3. The participants were given a detailed outline of each training session plus additional fact sheets.
4. Each training center would receive a HCW training manual for their library, textbooks on diabetes, and a diagnostic and treatment resources pack such as a set of scales, blood pressure machine, glucometer and slips for blood glucose measurement.
5. The program's Working Committee and stakeholders agreed to continue support to the HCW at the HCF with regular visits by the diabetologist to supervise their clinical care.

Each training centre would receive a HCW training manual for their library, textbooks on diabetes, and a diagnostic and treatment resources pack such as a set of scales, blood pressure machine, glucometer and slips for blood glucose measurement. The program's Working Committee and stakeholders agreed to continue support to the HCW at the HCF with regular visits by the diabetologist to supervise their clinical care.

RESULTS

Results of the training workshops evaluation

Postal questionnaire: In year 1 a postal questionnaire to self-evaluate how the HCW had applied learning from the training workshops to their clinical setting, showed mixed results; 43 replies were received (Table 3).

Table 3: HCWs self-evaluation about how they had applied learning from the workshops to their clinical setting

What was the most interesting thing you learnt?	*'How HCW' behaviour and attitudes affect the management of diabetes'.*
How will you change your care of diabetic clients because of what you have learnt?	*'To tell the client facts about diabetes. To listen to their opinions and sharing of ideas'.* *'To teach them how to escape from complications.'*
Additional comments	*'We still need your help with our diabetic clinic and eye examinations.'* *'Please don't forget us, let you visit us for supervision, guidance and on job training and motivation.'* *'Need a recurrent seminar to improve the services.'*

There were nine reports by HCW that weekly diabetic clinics had been started in HCF. Improvements in management and care of PWD were reported by 33/43 respondents, 12 specifically reported early detection and management of complications of diabetes. Education in all areas of self-management of diabetes was reported by 39 respondents; effective communication with patients and relatives by 8 respondents; training of co-workers and improved teamwork by 3 respondents. The HCW reported significant barriers in instigating change in their clinical practice as had been identified in the literature and in the researchers' 'needs assessment'[2,35].

As outlined in Table 3, in year 2 the trainings were evaluated with pre- and post- workshop training tests (59 HCW); Using a paired sample t-test the mean was 23.39 (95% CI 20.68-26.10), t=17.26, df=58, std error=1.36, p-value <0.001. The knowledge questions related to medical diagnosis of diabetes (4), motivation of self-care (2), nutrition (3), physiotherapy (1), eye health (3), and self care (3).

Feedback from individual HCW was evaluated using a standardised evaluation form for healthcare students at the Kilimanjaro Region University (Figure 3). The level of satisfaction was measured on 15 criteria ranked 1 (poor) to 4 (excellent) with an overall rating of 87.5% and a separate overall satisfaction rating with the same ranking with an overall rating of 90% (Table 4).

Table 4: Outcome of HCW training workshops

Knowledge of 6 aspects	No.	Mean	SD	SEM
Pre-test	59	49.08	11.13	1.45
Post-test	59	72.47	13.08	1.7
Mean = 23.39. 95% confidence interval of this difference is (20.68, 26.10)				
t=17.2575, df=58, std error of difference =1.355, p value is <0.0001				
Total criteria rating	59	87.5	2.18	
Total satisfaction rating	59	90	2.35	

Figure 3: The evaluation form

EVALUATION FORM HCF

Gender: M/F Age: _____ Year of Qualifying: _____ Professional Title:_____

INSTRUCTIONS: These forms are to help provide feedback for the organisers and facilitator/s. Please be honest when scoring each section of the assessment. The outcome of these evaluation forms will be kept confidential. Thank you for participating. Mobile number: _____ email address: _____

		Poor-1	Satisfactory 2	Good 3	Excellent 4
	General	√	√√	√√√	√√√√
1)	Organisation: time management, teaching environment & resources				
2)	Attitude towards participants - respect and courtesy				
3)	Verbal skills: Audible, understandable, appropriate use of language and terminology				
4)	Use of explanations and examples: Understanding and cultural relevance				
5)	Use of questions: motivation and relevance				
6)	Interaction with participants: attitude and stimulation				
7)	Presentation of material: layout, font size, focus				
8)	Verbal descriptions and use of pictures etc				
9)	Content of lectures, comprehensive and relevant to clinical practice				
10)	Introduction: definitions and overview of topic				
11)	Key points of topics defined and explained				
12)	Explanations to questions raised by participants.				
13)	Relevance and application to your clinical care				
14)	Use of tasks for problem solving and group interaction				
15)	Development of critical thinking and challenge to engage in professional development				
	Participant's overall satisfaction with overall teaching of the sessions				

What was the most interesting fact you learnt today? How will you change your care of diabetic clients because of what you have learnt today? Comments: _____

DISCUSSION

The 'needs assessment' of HCW showed mixed levels of knowledge regarding diabetes. There was some knowledge of microvascular and macrovascular complications of diabetes, the need for PWD to avoid uncontrolled blood sugar levels through self-management of a healthy lifestyle of diet, exercise, and self-care. The trainings highlighted that the rural HCW were not trained as diabetic specialists nor were they working in specialist diabetic clinics. They faced numerous obstacles in caring for PWD due to varying levels of knowledge amongst colleagues, nurses, and clinical officers.

Earlier studies[36,37] showed that microvascular complications, such as DR can be reduced with improved glycaemic and blood pressure control, but only if monitoring and medications are consistently available[37]. Similarly, all other diabetes services must be integrated

and be consistently available, such as DR-detection and management of complications[37]. Whilst the program's training aimed to provide the rural HCW with a better understanding of diabetes management, especially of eye health, and to provide some basic resources; often blood sugar levels could not be monitored and medications were unavailable.

Complications: When giving advice to PWD about how to avoid microvascular and macrovascular complications (secondary prevention) very few HCW were able to adopt a holistic approach to care promoting healthy living to prevent complications[2]. HCW found that PWD present late to HCF with established complications of diabetes and there were few opportunities or resources to educate PWD on prevention of complications of diabetes. This supports the findings of the KDP 'needs assessment'[2]. The focus of HCW was generally on managing secondary and tertiary prevention of complications of diabetes due to late presentation at the HCF[2].

Evaluating the training workshops: The workshops were able to take comprehensive diabetes education to the rural HCF, reducing travelling time for HCW. Facilitators focused on changing both the attitudes and knowledge of HCW. This evaluation is supported by findings in both the outcomes of the pre and post-tests of the workshops (Table 3) and the feedback in the postal questionnaires. The facilitators were committed to the training and some of the HCW who attended the training had been interviewed during the initial 'need assessment' in Kilimanjaro Region.

Study limitations

The KDP was unable to undertake tests after completion of the workshops nor was it possible to monitor the clinical application of learning by HCW in the clinical setting. Future trainings should add these objectives to training programs.

CONCLUSIONS

The training workshops achieved the aim of training facilitators to educate HCW on diabetes care and self-management. The workshops met the expressed request of HCW for diabetes education and provided them with the resources they requested for self-study and reference in their clinical practice. The workshops empowered the facilitators who gained experience and confidence through the course of the three years. The commitment of the team to deliver the training in rural settings was acknowledged and appreciated by the recipients.

The improvement in HCW diabetes knowledge was and satisfaction with the facilitators was high. There was positive feedback on how training had informed the HCW clinical practice. The use of task-based learning in years 2 and 3 of the training workshops gave the HCW the opportunity to model the skills taught and reinforce knowledge and understanding before applying this in the clinical setting. The engagement of HCW as stakeholders in the program, and continued support through annual HCW training workshop and stakeholder meetings was an important aspect of the intervention.

The training workshops were one strategy used in the overall program healthcare intervention in Kilimanjaro to plan, develop and implement a culturally relevant, evidence-based, theory-driven screening program for DR to prevent avoidable blindness. The 'need assessment' of both PWD and HCW in Kilimanjaro, the dialogue with stakeholders, and the program's Working Committee led to the development and delivery of comprehensive education on diabetes management and care to HCW in the Kilimanjaro Region and strengthened the network between rural and urban HCW[2].

The way forward

To reduce microvascular (e.g. DR) and macrovascular complications of diabetes there need to be behavioural and environmental changes on numerous levels. The environmental factors that prevent self-management and restrict management and care of diabetes to secondary and tertiary prevention require organisational and policy changes, and provision of scarce resources to effect tangible change that will impact on the health of PWD and improve their quality of life.

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Availability of data and materials: All data and materials can be provided by the first author.

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REFERENCES

1. Bartholomew Eldrigde LK, Markham CM, Ruiter RAC, Fernàndez ME, Kok G, Parcel GS. Planning health promotion programs: An intervention mapping approach. Hoboken, NJ: Wiley; 2016. 704p.

2. Hall CE, Hall AB, Kok G, Mallya J, Courtright P. A needs assessment of people living with diabetes and diabetic retinopathy. *BMC Res Notes*. 2016; **9**(1):56.
3. Khan T, Bertram MY, Jina R, Mash B, Levitt N, Hofman K. Preventing diabetes blindness: cost effectiveness of a screening programme using digital non-mydriatic fundus photography for diabetic retinopathy in a primary health care setting in South Africa. *Diabetes Res Clin Pract*. 2013; **10**1(2):170-176.
4. Silva PS, Cavallerano JD, Sun JK, Noble J, Aiello LM, Aiello LP. Nonmydriatic ultrawide field retinal imaging compared with dilated standard 7-Field 35-mm photography and retinal specialist examination for evaluation of diabetic retinopathy. *Amer J Ophthalmol.* 2012; **154**(3):549-59.e2.
5. Ding J, Zou Y, Liu N, Jiang L, Ren X, Jia W, *et al*. Strategies of digital fundus photography for screening diabetic retinopathy in a diabetic population in urban China. *Ophthal Epidemiol*. 2012; **19**(6):414-419.
6. Shi L, Wu H, Dong J, Jiang K, Lu X, Shi J. Telemedicine for detecting diabetic retinopathy: a systematic review and meta-analysis. *Br J Ophthalmol.* 2015; **99**(6):823-831.
7. Owsley C, McGwin G, Jr., Lee DJ, Lam BL, Friedman DS, Gower EW, *et al.* Diabetes eye screening in urban settings serving minority populations: detection of diabetic retinopathy and other ocular findings using telemedicine. *JAMA Ophthalmol.* 2015; **133**(2):174-181.
8. Sivaprasad S, Gupta B, Crosby-Nwaobi R, Evans J. Prevalence of diabetic retinopathy in various ethnic groups: a worldwide perspective. *Surv Ophthalmol.* 2012; **57**(4):347-370.
9. Kashim RM, Newton P, Ojo O. Diabetic retinopathy screening: A systematic review on patients' non-attendance. *Int J Environ Res Public Health.* 2018; **15**(1):157-168. doi:10.3390/ijerph15010157.
10. Cleland CR, Burton MJ, Hall C, Hall A, Courtright P, Makupa WU, Philippin H. Diabetic retinopathy screening: experiences from northern Tanzania. *Lancet Diabetes Endocrinol.* 2016; **4**(1):10-12.
11. Lewis K. I wish someone had told me …. *Comm Eye Health*. 2011; **24**(75):10-11.
12. Wong TY, Sun J, Kawasaki R, Ruamviboonsuk P, Gupta N, Lansingh VC, *et al.* Guidelines on diabetic eye care: The International Council of Ophthalmology Recommendations for Screening, follow-up, referral, and treatment based on resource settings. *Ophthalmology.* 2018; **125**(10):1608-22.
13. Bank W. Poverty and Inequlity Platform [online]. World Bank; (2017)
14. Shemdoe A, Mbaruku G, Dillip A, Bradley S, William J, Wason D, Hildon ZJ. Explaining retention of healthcare workers in Tanzania: moving on, coming to 'look, see and go', or stay? *Hum Resour Health*. 2016; **14**:2.
15. Oliver SJ. The role of traditional medicine practice in primary health care within Aboriginal Australia: a review of the literature. *J Ethnobiol Ethnomed.* 2013; **9**:46.
16. Awah PK. An ethnographic study of diabetes: Implications for the application of patient centred care in Cameroon. *J Anthropology*. 2014; **2014**:937898.
17. Lemelson RB. Traditional healing and its discontents: efficacy and traditional therapies of neuropsychiatric disorders in Bali. *Med Anthropol Q.* 2004; **18**(1):48-76.
18. IDF. Diabetes Atlas. 2021;10 th Edition.
19. Ramaiya KL. Tanzania and diabetes—a model for developing countries?: *Br Med J.* 2005; **330**:679.
20. Nutbeam D, McGill B, Premkumar P. Improving health literacy in community populations: a review of progress. *Health Promot Int.* 2018; **33**(5):901-911.
21. Rootman I, Gordon-El-Bihbety D. A vision for a health literate Canada. Report of the expert panel on health literacy. 2007; **2**:1 - 48.
22. Fernández ME, Diamond PM, Rakowski W, Gonzales A, Tortolero-Luna G, Williams J, Morales-Campos DY. Development and validation of a cervical cancer screening self-efficacy scale for low-income Mexican American women. *Cancer Epidemiol Biomarkers Prev.* 2009; **18**(3):866-875.
23. Sranacharoenpong K, Hanning RM. Diabetes prevention education program for community health care workers in Thailand. *J Community Health.* 2012; **37**(3):610-618.
24. Ferguson WJ, Lemay CA, Hargraves JL, Gorodetsky T, Calista J. Developing community health worker diabetes training. *Health Educ Res*. 2011; **27**(4):755-765.
25. Liu G, Jack H, Piette A, Mangezi W, Machando D, Rwafa C, *et al*. Mental health training for health workers in Africa: a systematic review. *The Lancet Psychiatry*. 2016; **3**(1):65-76.
26. Federation ID. Diabetes education training manual - Sub-Saharan Africa. *Intern Diabetes Federation.* 2006: **238:**1-238.
27. Ogbeiwi O. Why written objectives need to be really SMART. *Br J Healthcare Management.* 2017; **23**:324-336.
28. Locke E, Latham G. Building a practically useful theory of goal setting and task motivation - A 35-year odyssey. *The Amer Psychologist*. 2002; **57**:705-717.
29. Fredrix M, McSharry J, Flannery C, Dinneen S, Byrne M. Goal-setting in diabetes self-management: A systematic review and meta-

analysis examining content and effectiveness of goal-setting interventions. *Psychol Health.* 2018; **33**(8):955-977.
30. Blanchard K, Johnson S. The one-minute manager. *Cornell Hotel Restaurant Admin Quart.* 1983; **23**(4):39-41.
31. Smith SM, Petty RE. Message framing and persuasion: A message processing analysis. *Personality Social Psychol Bull.* 1996; **22**(3):257-268.
32. Werrij MQ, Ruiter RA, Van 't Riet J, De Vries H. Self-efficacy as a potential moderator of the effects of framed health messages. *J Health Psychol.* 2011; **16**(2):199-207.
33. American Diabetes A. Diagnosis and classification of diabetes mellitus. *Diabetes Care.* 2010; **33**(Suppl 1):S62.
34. Kellet A. Diabetes mellitus, Type 2 virtual health care team. web. 2005.
35. Hall V, Thomsen RW, Henriksen O, Lohse N. Diabetes in sub Saharan Africa 1999-2011: Epidemiology and public health implications. a systematic review. *BMC Public Health*. 2011; **11**(1):564.
36. Stratton IM, Kohner EM, Aldington SJ, Turner RC, Holman RR, Manley SE, Matthews DR. UKPDS 50: risk factors for incidence and progression of retinopathy in Type II diabetes over 6 years from diagnosis. *Diabetologia.* 2001; **44**(2):156-163.
37. Burgess PI, Msukwa G, Beare NA. Diabetic retinopathy in sub-Saharan Africa: meeting the challenges of an emerging epidemic. *BMC Med.* 2013; **11**:157.

Optimal microwave settings for porcine cataract formation for Wet Lab Training

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ABSTRACT

Objective: The objective of this study was to determine the optimal microwave power in watts (w) and time in seconds (s) needed to form a visually significant cataract in fresh *ex vivo*, cadaveric, porcine eyes that can serve as a low-cost, surgical model for trainees.
Methods: Twenty-four fresh, cadaveric, porcine globes were tested. Sets of eight globes were individually microwaved at 1000w, 500w and 100w, the first eye for a time of 3s followed by subsequently adding 1s more for each additional eye up to 10s. The corneas and lenses were then surgically harvested, and the opacification of each was objectively graded using a Pelli-Robson contrast sensitivity chart on a log unit scale of 2.30 (transparent) to 0.00 (total opacification). Lens hardening was subjectively graded on a scale of soft, medium, hard, and scarred.
Results: At 1000w, lens opacification became significant beginning at 5s and hardening took place by 8s. At 500w, lens opacification became significant at 6s and hardening took place at 8s but quickly transitions to scarring by 9s. At 100w, significant lens opacification and hardening did not occur by 10 seconds. The cornea remained transparent at all parameters, except for a trend toward opacification at 500w after 9s.
Conclusion: Optimal settings for microwaving fresh, cadaveric porcine eyes were found to be 1000w for 5 to 10s. These settings induced fully opacified cataracts with a range of soft to hard lenses without leading to severe scarring of the lens-capsule complex or visually significant corneal opacification.

Key words: Porcine eye, Cataract model, Microwave induced cataract, Cataract surgery, Surgical training, Capacity building

INTRODUCTION

Cataracts are the leading cause of blindness worldwide, affecting 94 million people worldwide[1]. Cataracts have a greater burden in low-resource settings, contributing to a greater proportion of vision loss and blindness than in higher-resource settings[1]. In order to alleviate this burden, increased access to high-quality cataract surgery conducted by well-trained ophthalmic surgeons is needed. Successful surgery has the potential to increase eye care utilization as surgical recipients can become community champions[2,3]. These individuals can encourage other affected individuals to seek out ophthalmologic care, starting with those closest to them in their homes and neighborhoods[2-4]. Family members of patients can also serve as powerful advocates, testifying to the notable improvement in function and activities of daily living[4,5].

Surgical simulation through wet lab experiences allows trainees to practice fine motor skills, rehearse surgical steps, and gain a tactile understanding of instrument utilization[6]. The Accreditation Council for Graduate Medical Education considers surgical simulation training an essential part of ophthalmology resident training[6,7]. As only the operating surgeon can experience the fine balance of hand-eye coordination, micromovement in all three-dimensional planes, and visualization through a surgical microscope, wet labs have great utility in improving operating room performance and provide a setting for assessment and feedback from faculty[7].

Different models can be used for wet labs including animal eye models, synthetic models, and human cadaveric eyes (considered the best for training). However, *ex vivo* animal globes stand out as simple, accessible, and cost-effective models, especially in regions with active animal farming industries. The use of *ex-vivo* porcine globes as models for cataract surgery has been documented in the literature since as early as the 1990s with lens opacification induced through different methods including chemically, using formalin or formaldehyde, or electromagnetically using microwave energy[7-10]. Microwaves are increasingly accessible around the globe and are available in many training institutes and teaching hospitals in Low and Middle-Income Countries (LMIC). While microwave energy for cataract induction has been previously described, our purpose was to identify optimal microwave settings (power, in watts, and time, in seconds) for the opacification of porcine lenses without visually significant opacification of the corneas, with a focus on simple, reproducible strategies.

MATERIALS AND METHODS

Porcine globes were sourced from Sierra for Medical Science Ltd. The fresh globes were harvested within 48 hours of study use and kept cool via ice and refrigeration but never frozen. We utilized a simple microwave, built for kitchen capacity (Fridgidaire LFMV1846VFA model). Globes were excluded if lens opacification or visually significant corneal haze was noted subjectively. Qualifying cadaveric, porcine eyes were debrided of orbital fat and muscle tissue, to control for variations in the harvesting technique of the globes used by the butchers. To determine our time range of focus, six globes were exposed to 1000w of microwave energy until globe explosion was observed. This occurred around 12 seconds, allowing us to set our upper limit of microwave exposure time to 10 seconds. Twenty-four globes were randomly separated into three groups of eight globes. Eight eyes were individually microwaved at 1000w, the first eye for a time of 3 seconds followed by subsequently adding 1 second more for each additional eye up to 10 seconds for a total range of 3 to 10 seconds. These microwave exposure times were repeated for another eight eyes at 500w and another eight eyes at 100w.

Following microwave treatment, the corneas and lenses of each globe were surgically harvested. The opacification of each tissue was graded objectively using a small Pelli-Robson contrast sensitivity chart by placing each cornea and each lens over the chart letters. The highest contrast letter was assigned a value of 0.05 log units. The lowest contrast letter was assigned a value of 2.30 log units. When a letter could no longer be read through the tissue, a grade was assigned ranging from 2.30 (totally transparent) to 0.00 (totally opacified) log units. Lens hardening was subjectively graded by touch on a scale of soft, medium, hard, and scarred.

This project meets ethical requirements for investigation using cadaveric animal tissues. Since no human tissues or subjects were utilized in this project Institutional Review Board approval was not required. All porcine tissue was acquired from Sierra for Medical Science which is a compliant, United States Department of Agriculture approved source for biological tissues for research. Since all tissues were from slaughterhouses, no animals were harmed solely for the purpose of this research.

RESULTS

The opacification of lenses and corneas for globes microwaved at the three different powers over time are shown in Figures 1 and 2, respectively. At 1000w, lens opacification becomes significant beginning at 5s and hardening takes place by 8s. At 500w, lens opacification becomes significant at 6s and hardening takes place at 8s but quickly transitions to scarring by 9s. At 100w, the lenses did not achieve substantial opacification or hardening by ten seconds of microwave exposure. With regards to the corneas, the globes microwaved at 100w and 1000w were able to maintain relative transparency of the corneas (Pelli-Robson score of > 1.5 log units) when exposed to up to ten seconds of microwave treatment. In the 500W group, significant opacification of the corneas was seen at exposure times greater than eight seconds. Pelli-Robson scores and lens hardness grades are shown in Table 1.

Figure 1: Opacification scores for lenses microwaved at 1000w, 500w, and 100w over 3-10 seconds, graded on a Pelli-Robson contrast sensitivity chart with a scale of 2.30 log units (transparent) to 0.00 log units (total opacification)

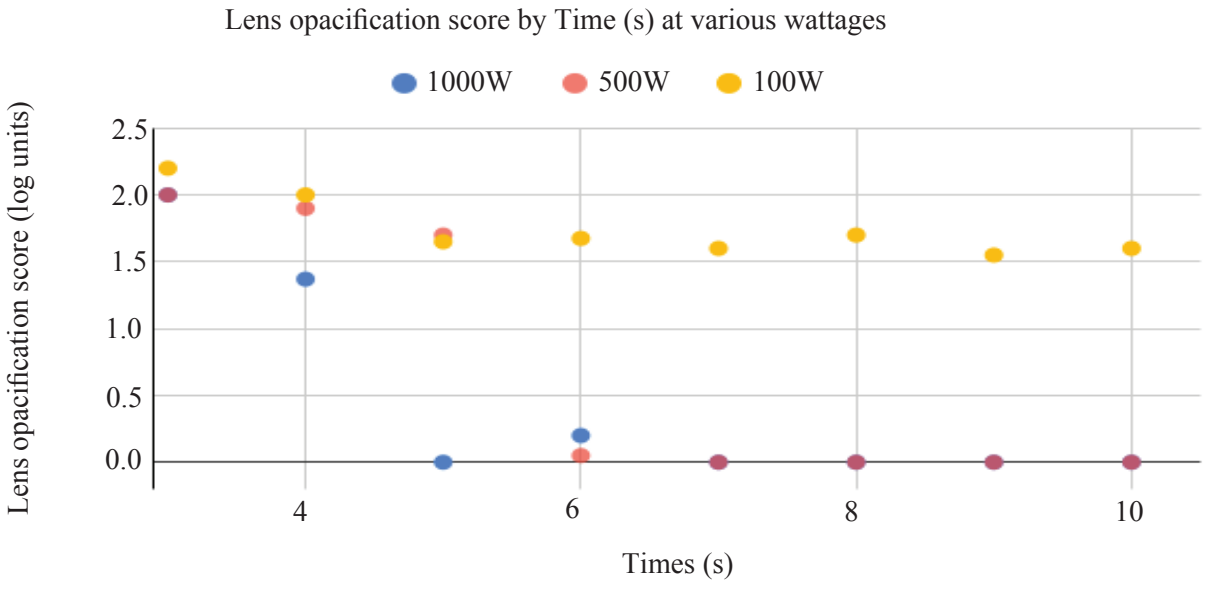

Figure 2: Opacification scores for corneas microwaved at 1000w, 500w, and 100w over 3-10 seconds, graded on a Pelli-Robson contrast sensitivity chart with a scale of 2.30 log units (transparent) to 0.00 log units (total opacification)

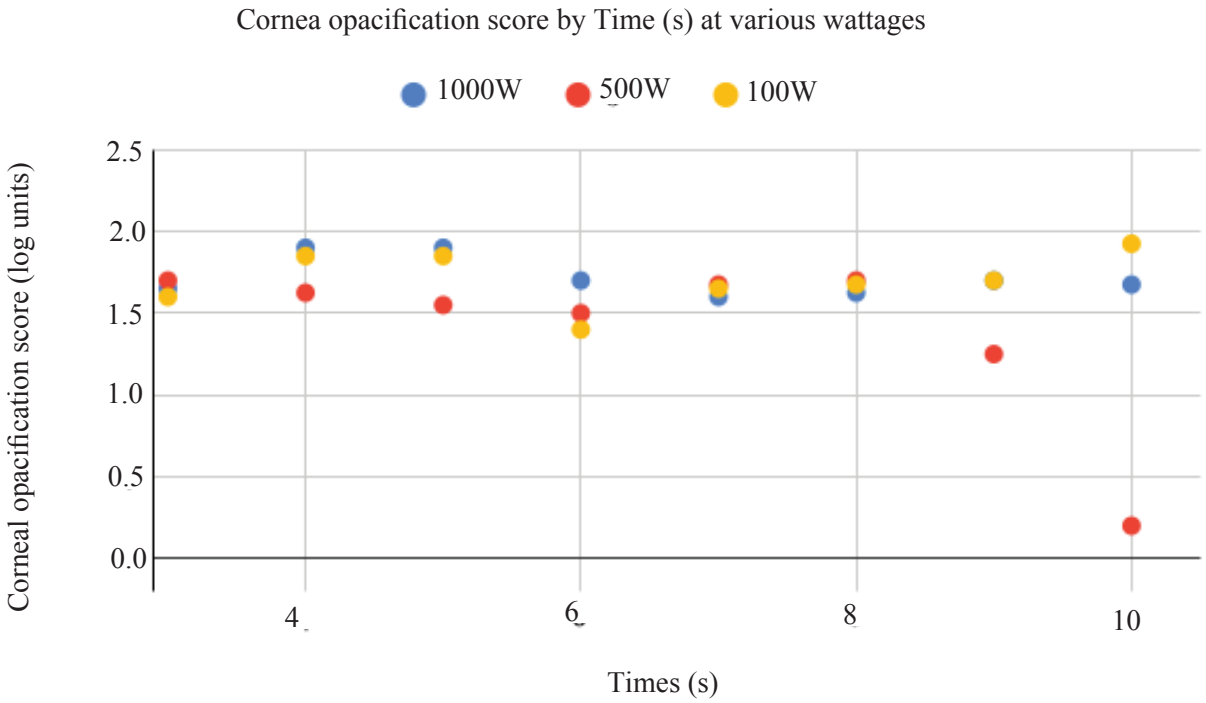

Figure 3: Opacified cornea and lens on Pelli-Robson contrast sensitivity chart

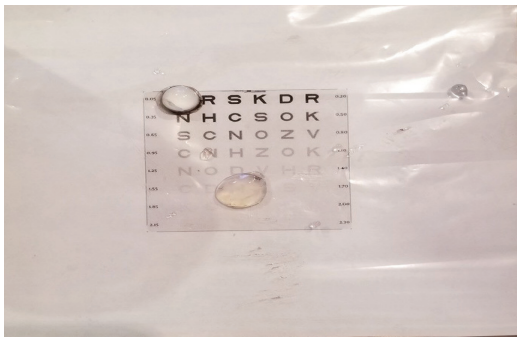

Table 1: Lens hardness grade for porcine globes

Eye	Power (W)	Time (S)	Microwave Freq. (MHz)	Lens Hardness Grade
1	1000	3	Done	Soft
2	1000	4	Done	Soft
3	1000	5	Done	Medium
4	1000	6	Done	Soft
5	1000	7	Done	Soft
6	1000	8	Done	Hard
7	1000	9	Done	Hard
8	1000	10	Done	Hard
*	1000	12	Explosion	
9	500	3	Done	Soft
10	500	4	Done	Soft
11	500	5	Done	Soft
12	500	6	Done	Soft
13	500	7	Done	Soft
14	500	8	Done	Hard
15	500	9	Done	Scarred
16	500	10	Done	Scarred
17	100	3	Done	Soft
18	100	4	Done	Soft
19	100	5	Done	Soft
20	100	6	Done	Soft
21	100	7	Done	Soft
22	100	8	Done	Soft
23	100	9	Done	Soft
24	100	10	Done	Soft

DISCUSSION

The purpose of this study was to determine the optimal microwave power in watts (w) and time in seconds (s) needed to form a cataract in fresh cadaveric, porcine eyes that can serve as a low-cost, surgical model for trainees in LMICs. Based on our findings, we recommend microwaving *ex-vivo*, fresh, cadaveric porcine globes at 1000w for 5 to 10s as it provides fully opacified cataracts with a range of soft to hard lenses without leading to severe scarring of the lens-capsule

complex or visually significant corneal opacification. Porcine globes are more human-like in size than cow globes giving them an intrinsic advantage for surgical trainees[11]. While porcine globes in our study came from an approved supplier for medical research, we feel porcine globes harvested from any local butcher who slaughters animals in a humane way is an ethical source of fresh tissue for use in wet lab.

Study limitations

Limitations of this study include transferability in light of the intrinsic variation between microwaves and globes. We attempted to control for this as much as possible by assessing various wattages of a typical domestic microwave and by debriding the globes of fat and muscle prior to microwaving. Another limitation was that only subjective assessment of the clarity of each lens and cornea was performed prior to microwaving. Objective assessment was only done after microwaving due to our grading method. This could allow bias to impact the results if the starting clarity of individual eyes was significantly different at baseline. Lens hardening was graded subjectively by touch. A more objective method would improve future studies.

CONCLUSION

In conclusion, microwaving fresh, cadaveric porcine eyes at 1000w for 5 to 10s provides fully opacified cataracts with a range of soft to hard lenses without leading to severe scarring of the lens-capsule complex or visually significant corneal opacification. Using these identified optimal settings as a starting point, this model can be replicated in wet lab training centers anywhere were fresh porcine eyes and microwaves are available.

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No conflicts of interest for any of the authors: All authors have approved the manuscript and consent to the submission of the manuscript to JOECSA.

Each author has met the requirements for authorship: Dr. Agnes Owete is first author and was the primary writer and data analyst, Micah Cropsey provided original ideas and conducted the experiments, Dr. John Cropsey contributed to each step of the project as the primary investigator. Each author believes the manuscript represents honest work.

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REFERENCES

1. World Health Organization. Blindness and vision impairment [Internet]. *World Health Organization*. 2023. Available from: https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment
2. Mailu EW, Virendrakumar B, Bechange S, Jolley E, Schmidt E. Factors associated with the uptake of cataract surgery and interventions to improve uptake in low- and middle-income countries: A systematic review. Wilkinson J, editor. *PLOS One*. 2020; **15**(7):e0235699.
3. Jasper S, Amritanand A, Paul P, Kuriakose T. Facilitating factors in overcoming barriers to cataract surgical services among the bilaterally cataract blind in Southern India: A cross-sectional study. *Indian J Ophthalmol*. 2018; **66**(7):963.
4. Finger RP, Kupitz DG, Fenwick E, Balasubramaniam B, Ramani RV, Holz FG, *et al.* The impact of successful cataract surgery on quality of life, household income and social status in South India. Mendelson JE, editor. *PLoS One*. 2012; **7**(8):e44268.
5. Applegate WB. Impact of cataract surgery with lens implantation on vision and physical function in elderly patients. *J Amer Med Ass*. 1987; **257**(8):1064.
6. Bhagat P, Jethva J. Wet laboratory training in ophthalmology as a tool for formative assessment. *Intern J Applied Basic Med Res.* 2022;**12**(4):228.
7. Pujari A, Saluja G, Bhaskaran K, Modaboyina S, Asif MI, Agarwal T, *et al.* Animal and cadaver human eyes for residents' surgical training in ophthalmology. *Survey Ophthalmol*. [Internet]. 2022 Jan 1 [cited 2024 Feb 10];**67**(1):226–251. Available from: https://europepmc.org/article/med/33992664
8. Shentu X, Tang X, Ye P, Yao K. Combined microwave energy and fixative agent for cataract induction in pig eyes. *J Cataract Refract Surg*. 2009; **35**(7):1150–55.
9. van Vreeswijk H, Pameyer JH. Inducing cataract in postmortem pig eyes for cataract surgery training purposes. *J Cataract Refract Surg*. 1998; **24**(1):17–18.

10. Ruiss M, Kronschläger M, Schlatter A, Dechat T, Findl O. Comparison of methods to experimentally induce opacification and elasticity change in ex vivo porcine lenses. *Sci Reports*. 2021; **11**(1): 23406.

11. Choi KE, Anh VTQ, Oh JH, Yun C, Kim SW. Normative data of axial length, retinal thickness measurements, visual evoked potentials, and full-field electroretinography in female, wild-type minipigs. *Trans Vision Scie Tech*. 2021; **10**(12):3.

Mucinous carcinoma of the eyelid: a case report

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ABSTRACT

Primary cutaneous mucinous carcinoma is a rare malignant tumour which arises from the eccrine sweat glands most commonly in the head and neck region and more so in the eyelid. Ever since the first description by Lennox *et al.* in 1952, most of the information available on this rare malignant tumour with an incidence of 0.1 cases per a million individuals is from a few published case reports. Due to its slow growing nature, it is often misdiagnosed as other benign lesions of the eyelid. Diagnosis is made through histological analysis which reveals malignant epithelial cells surrounded by periodic acid Schiff positive mucin. Management is through excision of the tumour and due to its high recurrence rate, excision should be done with a wide margin of healthy tissue followed by reconstruction of the eyelid. We describe the case of a 75-year-old Kenyan Caucasian man who presented with a slow growing mass on the left lower eyelid for 10 years that was excised twice before and recurred. A diagnosis of mucinous carcinoma of the eyelid was made based on histology. The patient was managed successfully through excision of the mass with a 3mm margin of healthy tissue followed by reconstruction of the eyelid using a Mustarde flap and mucoperichondrial flap from the inner lining of the nasal septum to reconstruct the inner lining of the new eyelid.

Key words: Primary cutaneous mucinous carcinoma of the eyelid, Malignant tumour, Recurrence, Mustarde flap

INTRODUCTION

Primary Cutaneous Mucinous Carcinoma (PCMC) is a malignant and rare skin appendage tumour which arises from the sweat glands[1]. Whether this tumour has its origin from the eccrine sweat glands or apocrine glands has been a contested topic of discussion but it is mostly published as originating from the eccrine sweat glands[2]. Mucinous carcinomas of the skin mostly originate in the head and neck region with the eyelid as the most common site of occurrence[3]. An analysis of 289 PCMC cases of the head and neck region reported between the years 2004 and 2016 revealed that women are most commonly affected[3]. However, mucinous carcinoma specifically originating from the eyelid is more common in male patients with a mean age of occurrence at 61.3 years[4].

Mucinous carcinoma originating from the eyelid is slow growing and has an indolent course with a low metastatic potential, however, it is locally aggressive with a high recurrence rate[5]. Due to its slow growing nature, most cases of this malignant tumour are often misdiagnosed with variable initial diagnoses such as chalazion, myxoma, and epidermoid cyst prior to resection and histology[6]. Even though the tumour seems to have an excellent prognosis, it is important to have it as a differential diagnosis for eyelid lesions to ensure early diagnosis and management to increase the chance of optimal aesthetic outcome post excision and reconstruction of this sensitive region[3]. In this case report, we describe the case of a 75-year-old male Kenyan patient who presented with a 10-year history of a growth on the left lower eyelid which was excised two times before this current presentation. Histology revealed a diagnosis of mucinous carcinoma of the eyelid.

CASE REPORT

A 75 year old male patient presented to a private surgical facility specializing in plastic, aesthetic and reconstructive surgery with a history of a growth on the left lower eyelid which he first noticed 10 years ago. It began as an itch over the left lower eyelid which developed into a small mass gradually increasing in size. First excision of the mass was done 5 years prior but the mass recurred a year later. Second excision was done one year before this current presentation at the same center but the mass recurred a few months later, bigger in size according to the patient with associated ectropion and epiphora. The patient did not have a histological report of the mass from the previous excisions. The patient is a known hypertensive patient on antihypertensive medication and a history of gout on allopurinol. He used alcohol occasionally and stopped smoking 15 years before. Review of other systems was unremarkable.

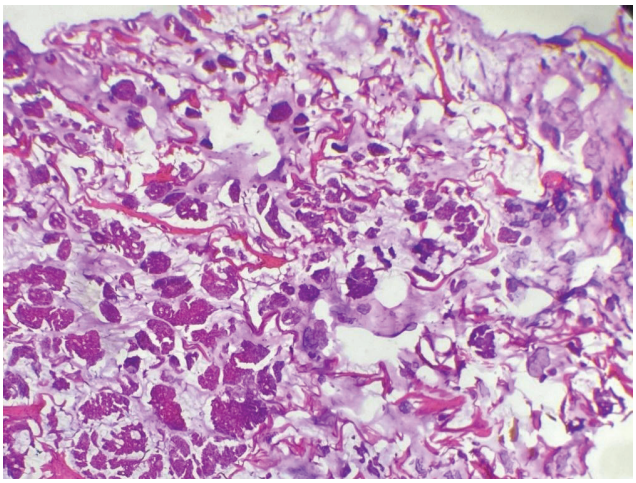
On examination, there was a fungating mass measuring 2cm by 2cm and covering almost the entire length of the left lower eyelid but did not encroach into the conjunctiva (Figure 1). There was associated ectropion and redness of the left conjunctiva. The general as well as systemic examination findings were normal.

Figure 1: Fungating mass on the left lower eyelid diagnosed as mucinous carcinoma of the eyelid after histology

Investigation and diagnosis

Investigations done included full haemogram, uric acid levels, liver function tests and renal function tests which showed no abnormalities. Echocardiography was done that concluded aortic valve sclerosis with no gradient or regurgitation. Electrocardiography done revealed incomplete right bundle branch block but an otherwise normal ECG. A section of the mass was excised and histology done which showed skin bearing mucinous carcinoma characterized by malignant epithelial cells bathed in lakes of mucin with margins positive for tumour (Figure 2). A diagnosis of malignant skin appendage tumour consistent with mucinous carcinoma of the eyelid was thus made. Based on the histology findings and diagnosis, a decision to excise the mass and reconstruct the lower eyelid was made.

Figure 2: Magnification ×10, histology of the resected tumour showing pools of extracellular mucin and nests of malignant cells. The arrow is pointed at a lake of extracellular mucin



Management

Excision was done with a 3mm margin of healthy tissue. Mustarde flap was used in the reconstruction of the lower eyelid and a mucoperichondrial flap harvested from the inner lining of the nasal septum and used as the inner lining of the new eyelid. During the post operative review before discharge, the patient was doing well with no ectropion and was able to close the eyelid well.

Figure 3: Immediate post-operative image after excision of the tumour with 3mm margin of healthy tissue and reconstruction of the eyelid using a Mustarde flap

DISCUSSION

Primary Cutaneous Mucinous Carcinoma (PCMC) was first described by Lennox *et al.* back in 1952[7]. Since the first description in literature, most of the knowledge available on PCMC is found from case reports, series and literature reviews. PCMC is a rare malignant tumour which originates from the eccrine sweat glands. It occurs mostly in the head and neck region with the eyelid as the most commonly affected site[3]. PCMC of the eyelid is most often missed and misdiagnosed as other benign tumours due to its slow growing nature. These tumours have a low metastatic potential but unpredictable locally infiltrative growth and a high rate of recurrence[8,9]. They most often present as painless slow growing masses that sometimes may ulcerate and recur especially if wide excision with margin control was not done[10]. As seen in this case, the mass had recurred twice in our patient after excision.

Most of the patients with mucinous carcinoma present between the ages 50-70 years with eyelid carcinomas having a slightly higher male predominance[11,12]. The prevalence is higher in Caucasian patients as compared to Asians and African populations. It is important to be aware of mucinous carcinoma of the eyelid and have it as a differential diagnosis for benign appearing tumours of the eyelid. Diagnosis is made through excisional biopsy and histological analysis of the mass characterized by malignant epithelial cells surrounded by periodic acid-Schiff positive mucin[13]. Further investigation with immunohistochemical staining for CK7 and CK20 can be done with most tumours staining positive for CK7 and negative for CK20[6]. While metastasis is rare, it is possible and the most common site of metastasis is to the lymph node, so it is also important to do a proper and thorough physical examination of the patient. However, in most cases further investigations such as CT scan to rule out metastasis is not needed.

After diagnosis and when making a decision on the choice of management, consideration should be given to preventing recurrence as well as optimizing cosmetic outcomes for the patient. Management options include wide local excision of the tumour followed by meticulous reconstruction or Mohs angiographic surgery with frozen section control to minimize the amount of healthy tissue excised[14]. In our case, a decision was made to excise the mass together with a 3mm margin of healthy tissue to prevent recurrence. Reconstruction was done with a Mustarde flap to reconstruct the eyelid and a mucoperichondrial flap from the nasal cavity to reconstruct the inner lining of the eyelid.

CONCLUSION

Mucinous carcinoma of the eyelid is slow growing which makes it often misdiagnosed as other benign lesions of the eyelid. It is important for physicians to have mucinous carcinoma as a differential diagnosis for eyelid tumours as the tumour is locally infiltrative and has a high rate of recurrence. Management poses a challenge as to finding the balance between wide excision of the tumor while also preventing adverse cosmetic outcomes for the patient.

Declaration

Ethical consideration: Consent to publish these findings and use the photos was obtained. However, no personal identifiers have been used in the report and the images have been anonymized.

Conflict of interest statement by authors: None.

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REFERENCES

1. Wallace CE, Heath C, Olsen S. Painless eyelid nodule. *JAAD Case Rep* [Internet]. 2022 Oct 27 [cited 2024 Oct 20];**30**:99. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC9679271/
2. Durairaj VD, Hink EM, Kahook MY, Hawes MJ, Paniker PU, Esmaeli B. Mucinous eccrine adenocarcinoma of the periocular region. *Ophthal Plast Reconstr Surg*. 2006; **22**(1):30–35.
3. Behbahani S, Pinto JO, Wassef D, Povolotskiy R, Paskhover B. Analysis of head and neck primary cutaneous mucinous carcinoma: An indolent tumor of the eccrine sweat glands. *J Craniofac Surg*. 2021; **32**(3):e244–247.
4. Segal A, Segal N, Gal A, Tumuluri K. Mucinous sweat gland adenocarcinoma of the eyelid - current knowledge of a rare tumor. *Orbit Amst Neth*. 2010; **29**(6):334–340.
5. Chauhan A, Ganguly M, Takkar P, Dutta V. Primary mucinous carcinoma of eyelid: a rare clinical entity. *Indian J Ophthalmol*. 2009; **57**(2):150–152.
6. Saito Y, Ota K, Sumita Y. Primary mucinous carcinoma of the skin arising from the upper eyelid: A case report and literature review. *JPRAS Open*. 2020; **25**:18–23.
7. Lennox B, Pearse AGE, Symmers WStC. The frequency and significance of mucin in sweat gland tumours. *Br J Cancer* [Internet]. 1952 Dec [cited 2024 Oct 12];**6**(4):363-368.5. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2007852/
8. Scholz IM, Hartschuh W. Primary mucinous eccrine carcinoma of the skin – a rare clinical tumor with many differential diagnoses. *JDDG J Dtsch Dermatol Ges* [Internet]. 2010 [cited 2024 Oct 23];**8**(6):446–8. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1610-0387.2009.07291.x
9. Marra DE, Schanbacher CF, Torres A. Mohs micrographic surgery of primary cutaneous mucinous carcinoma using immunohistochemistry for margin control. *Dermatol Surg.* 2004; **30**(5):799-802.
10. Papalas JA, Proia AD. Primary mucinous carcinoma of the eyelid: A clinicopathologic and immunohistochemical study of 4 cases and an update on recurrence rates. *Arch Ophthalmol* [Internet]. 2010 Sep 1 [cited 2024 Oct 11];**128**(9):1160–65. Available from: https://jamanetwork.com/journals/jamaophthalmology/fullarticle/1103765
11. Mendoza S, Helwig EB. Mucinous (Adenocystic) carcinoma of the skin | *JAMA Dermatol* | *JAMA Network* [Internet]. [cited 2024 Oct 23]. Available from: https://jamanetwork.com/journals/jamadermatology/article-abstract/531961
12. Kamalpour L, Brindise RT, Nodzenski M, Bach DQ, Veledar E, Alam M. Primary Cutaneous mucinous carcinoma: A systematic review and meta-analysis of outcomes after surgery. *JAMA Dermatol* [Internet]. 2014 Apr 1 [cited 2024 Oct 13];**150**(4):380–384. Available from: https://doi.org/10.1001/jamadermatol.2013.6006
13. Sanft DM, Zoroquiain P, Arthurs B, Burnier MN. Primary mucinous adenocarcinoma of the eyelid: A case-series. *Hum Pathol Case Rep* [Internet]. 2017 Sep 1 [cited 2024 Oct 23]; **9**:19–23. Available from: https://www.sciencedirect.com/science/article/pii/S2214330016300530
14. Krishnakumar S, Rambhatla S, Subramanian N, Mahesh L, Biswas J. Recurrent mucinous carcinoma of the eyelid. *Indian J Ophthalmol*. 2004; **52**(2):156–157.