

Corneal disease profile and transplant eligibility at a tertiary hospital in Dar es Salaam, Tanzania

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ABSTRACT

Objective: To determine the profile of corneal diseases and assess eligibility for corneal transplantation among patients attending the Eye Department at Muhimbili National Hospital (MNH), Tanzania.

Methods: This was a hospital-based cross-sectional study conducted from July to December 2021, consecutively enrolling all patients with corneal diseases. Data were collected via interviewer-administered questionnaire. Ocular examinations (including B-scan when indicated) were performed. Transplant eligibility was assessed based on BCVA and lesion characteristics. Data were analyzed using SPSS version 23, and chi-square tests assessed associations between transplant eligibility and sociodemographic characteristics.

Results: A total of 243 participants, contributing 268 affected eyes were recruited and analyzed. Half (50.6%) were aged between 0-20 years. The median age was 20 years (IQR 8–46), and 56% were male. Traumatic corneal injuries (32.5%) and infectious keratitis (29.9%) were the most common diagnoses. Among the affected eyes, 52 (19.4%) met criteria for corneal transplantation. The leading indications were advanced infectious keratitis (44.2%) and traumatic perforations (23.1%). Most eligible eyes (71.2%) had severe visual impairment. Optical keratoplasty was indicated in 57.7% and therapeutic in 21% of eyes. Higher education level was significantly associated with transplant eligibility ($p = 0.037$).

Conclusions: About one in every five patients with corneal disease required corneal transplantation, mostly young individuals with severe visual impairment, primarily due to trauma and advanced infectious keratitis. These findings underscore the urgent need to establish corneal transplant services, promote development of policies to support corneal and eye donation, establish a functional eye bank, and implement preventive strategies against ocular trauma and infection.

Key words: Corneal diseases, Corneal transplantation, Visual impairment, Traumatic injury, Infectious keratitis

INTRODUCTION

Corneal diseases are a significant cause of visual impairment and blindness worldwide. They arise from multiple etiologies including infections, trauma, hereditary dystrophies, degenerations, and nutritional deficiencies, all of which compromise corneal transparency and optical function¹⁻⁴. Globally, corneal blindness ranks third after cataract and glaucoma, accounting for about 7% of the estimated 39 million blind individuals in 2010, with the overwhelming majority (98%) residing in low-income regions⁵⁻⁷. Beyond vision loss, corneal blindness has profound socioeconomic consequences, leading to dependency, loss of productivity, and reduced quality of life.

Corneal transplantation remains the definitive treatment for many irreversible corneal conditions. It restores visual function, alleviates pain, and treats severe infections⁸. Eligibility for cornea transplantation may be classified according to surgical purpose, including optical keratoplasty for visual rehabilitation, therapeutic keratoplasty for controlling of an active, non-resolving

infectious keratitis or when cornea ulcer progress despite maximum medical therapy and tectonic keratoplasty to preserve globe integrity in cases of globe perforation or severe thinning with impending perforation⁹.

Globally, it is estimated that about 12.7 million people are eligible for corneal transplantation, however; only approximately 1.43% undergo surgery each year, and most procedures are concentrated in high- and middle-income countries such as the USA, India, and Brazil⁸⁻¹⁰. In low-income countries, donor shortages, inadequate eye banking systems, and limited numbers of corneal surgeons severely restrict access¹¹. In sub-Saharan Africa, only a few countries operate eye banks, and supply remains far below demand^{12,13}. As in other low-income countries, corneal transplantation services in Tanzania are extremely limited, with only two private facilities offering the services. These services are costly and often inaccessible to many patients, and the scarcity of donor corneal tissue further results in prolonged waiting times even for those who can afford treatment.

Muhimbili National Hospital (MNH), the national referral and tertiary health facility, manages a substantial

number of patients with corneal diseases each year. The majority of these patients are young and of working age, highlighting the potential social and economic consequences of untreated corneal conditions. Despite this high patient load, corneal transplantation is not currently performed at MNH. Patients who require corneal transplantation, such as those with severe keratitis at risk of perforation, are often managed with conjunctival flaps, while those with perforated ulcers frequently undergo evisceration. Patients with traumatic corneal perforations involving the visual axis typically undergo corneal repair. Although these interventions are critical for preserving the structural integrity of the eye, they often fail to restore functional vision in cases of severe corneal disease.

Currently, there is a lack of data on the magnitude and types of corneal conditions eligible for transplantation at MNH. Generating such evidence is crucial to inform policy decisions, advocate for the establishment of corneal transplant services, promote eye donation, and guide service planning. This study was therefore designed to determine the proportion and characteristics of patients eligible for corneal transplantation, providing evidence to support the initiation of transplant services at MNH and to expand access to corneal transplant services in Tanzania. Ultimately, such interventions aim to reduce the burden of corneal blindness and improve the quality of life of affected individuals.

MATERIALS AND METHODS

Study design and study period: This hospital-based descriptive cross-sectional study was conducted at MNH from July to December 2021.

Study setting: The study was conducted in the Eye Department of Muhimbili National Hospital (MNH), Dar es Salaam, Tanzania, a national referral, teaching, and research hospital affiliated with Muhimbili University of Health and Allied Sciences. The department provides general adult and paediatric outpatient eye services, as well as inpatient care for admitted patients. It manages several patients with corneal diseases daily, admitting approximately 170–190 patients with corneal conditions annually and seeing 2–3 affected patients in outpatient clinics each day. The study included participants from both outpatient clinics and inpatient wards.

Study population: All paediatric and adult patients presenting with corneal diseases to the eye department during the study period were eligible for inclusion.

Sampling: Participants were consecutively recruited until the required sample size was achieved.

Data collection: Demographic and clinical data were collected via an interviewer-administered questionnaire.

Visual acuity was measured using age-appropriate methods. Refraction was done when refractive error was suspected. Visual acuity was categorized according to the World Health Organization classification as normal vision ($\geq 6/12$), mild visual impairment ($< 6/12$ – $6/18$), moderate visual impairment ($< 6/18$ – $6/60$), severe visual impairment ($< 6/60$ – $3/60$), and blindness ($< 3/60$ to no light perception).

Ophthalmic examinations included intraocular pressure (IOP) measurement using the I-Care tonometer, slit-lamp evaluation of anterior segment structures, and assessment of corneal lesions for size, depth, location, and configuration. Fluorescein staining was performed when keratitis was suspected. Posterior segment evaluation was performed after pupil dilation using slit-lamp funduscopy with a 90D lens or indirect ophthalmoscopy with a 20D lens; B-scan ultrasonography was used in the presence of dense media opacities obscuring posterior segment examination. Functional tests included light projection and color discrimination. All examinations were done in the presence of one ophthalmologist.

Indications for corneal transplantation were classified as optical (to improve vision), tectonic (to preserve corneal integrity), or therapeutic (to remove infected tissue unresponsive to treatment). Eligibility criteria included VA worse than 6/18 in the affected eye, uncorrectable by medical or optical means, corneal pathology within the optical zone ≥ 3 – 5 mm or full-thickness involvement, and absence of significant anterior or posterior segment comorbidities. Lesions were further categorized by size (< 3 mm small, 3 – 5 mm moderate, > 5 mm large), location (central, paracentral, peripheral, extensive), and depth (epithelial, stromal, endothelial, or full-thickness).

Data analysis was performed using SPSS version 23. Descriptive statistics, including frequencies, proportions, and medians with ranges, were computed. The proportion of eyes eligible for corneal transplantation was calculated using the number of eligible eyes as the numerator and the total number of eyes with corneal diseases as the denominator.

Ethical consideration: Ethical approval for this study was obtained from MUHAS Institutional Review Board, and permission to conduct the study was granted by the Muhimbili National Hospital Director. The study adhered to the principles of the Declaration of Helsinki (1964). Written informed consent was obtained from all adult participants, and parents or guardians provided consent for children. For participants aged 13 years and above, the written assent was obtained in addition to parental or guardian consent. Participant identities were kept confidential, and patients were free to withdraw at any time without affecting their care.

RESULTS

Participant characteristics

A total of 243 patients with corneal disease were included, contributing 268 affected eyes. The median age was 20 years (IQR 8–46), with the youngest participant aged 2 months and the oldest 78 years. The most affected age group was 0–20 years, representing 50.6% (n=123) of cases. Males comprised 56.0% (n=136) of participants, giving a male-to-female ratio of 1.3:1. The majority resided in Dar es Salaam (72.4%, n=176). Most patients (56.4%, n=137) had primary-level education, and nearly half (48.6%, n=118) were dependents. Full demographic details are shown in Table 1.

Table 1: Demographic characteristics of the study participants (N=243)

| Characteristic | Frequency | |
|-------------------------|-----------|------|
| | No. | (%) |
| Sex | | |
| Male | 136 | 56.0 |
| Female | 107 | 44.0 |
| Age (years) | | |
| 0 – 20 | 123 | 50.6 |
| 21-40 | 44 | 18.1 |
| 41-60 | 52 | 21.4 |
| >60 | 24 | 9.9 |
| Median (IQR) 20 (8, 46) | | |
| Occupation | | |
| Dependents | 118 | 48.6 |
| Self employed | 110 | 45.2 |
| Employed | 15 | 6.2 |
| Address | | |
| Dar es Salaam | 176 | 72.4 |
| Other regions | 67 | 27.6 |
| Education level | | |
| Informal | 37 | 15.2 |
| Primary | 137 | 56.4 |
| Secondary | 58 | 23.9 |
| College | 11 | 4.5 |

Clinical characteristics of the affected eyes

Among the 268 eyes studied, more than one third (40.7%, n=109) had visual acuity of <3/60 to no light perception.

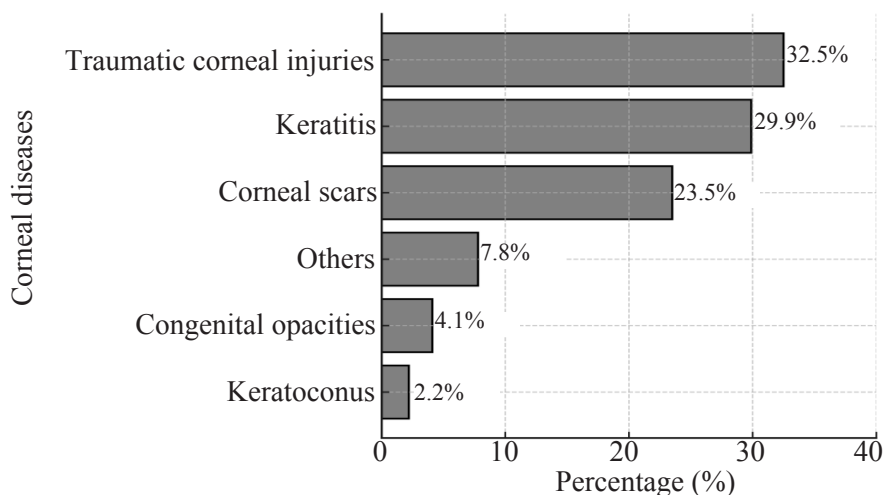
Corneal lesions were most commonly central (37.3%, n=100). Nearly half (45.1%, n=121) had lesion diameters of 3–5mm, while one-third (33.6%, n=90) exceeded 5mm. Full-thickness involvement was found in 43.3% (n=116) of cases. Most patients presented with unilateral disease (81.3%, n=218). Details are summarized in Table 2.

Table 2: Clinical characteristics of study participants eyes (N=268)

| Clinical characteristics | Frequency | |
|-------------------------------------|-----------|------|
| | No. | (%) |
| Visual acuity (affected eye) | | |
| ≥6/12 | 7 | 2.6 |
| <6/12–6/18 | 50 | 18.7 |
| <6/18- 6/60 | 43 | 16.0 |
| <6/60 –3/60 | 59 | 22.0 |
| <3/60-NLP | 109 | 40.7 |
| Location of corneal lesion | | |
| Central | 100 | 37.3 |
| Paracentral | 48 | 17.9 |
| Periphery | 76 | 28.4 |
| Wide/extensive | 44 | 16.4 |
| Size of corneal lesion | | |
| <3mm | 57 | 21.3 |
| 3-5mm | 121 | 45.1 |
| >5mm | 90 | 33.6 |
| Depth of corneal lesion | | |
| Superficial | 76 | 28.4 |
| Deep | 73 | 27.2 |
| Posterior | 3 | 1.1 |
| Full thickness | 116 | 43.3 |
| Laterality of disease | | |
| Unilateral | 218 | 81.3 |
| Bilateral | 50 | 18.7 |

The leading corneal diagnoses were traumatic corneal injuries (32.5%), infectious keratitis (29.9%) and corneal scars (23.5%). Less common conditions included pterygium, ocular surface squamous neoplasia and band keratopathy (Figure 1).

Figure 1: Distribution of corneal diseases among the eyes of study participants (N = 268)



*Others: Pterygium; Ocular surface squamous neoplasm; Band keratopathy

Eligibility for corneal transplantation

Out of 268 affected eyes, 52 (19.4%) met criteria for corneal transplantation. Of these, 46 (88.5%) were unilateral and 6 (11.5%) bilateral. The indications for cornea transplantation were advanced infectious keratitis 23 (44.2%), traumatic corneal perforations 12 (23.1%), dense corneal scars 11 (21.2%) congenital cornea opacities 4 (7.7%) and keratoconus 2 (3.8%).

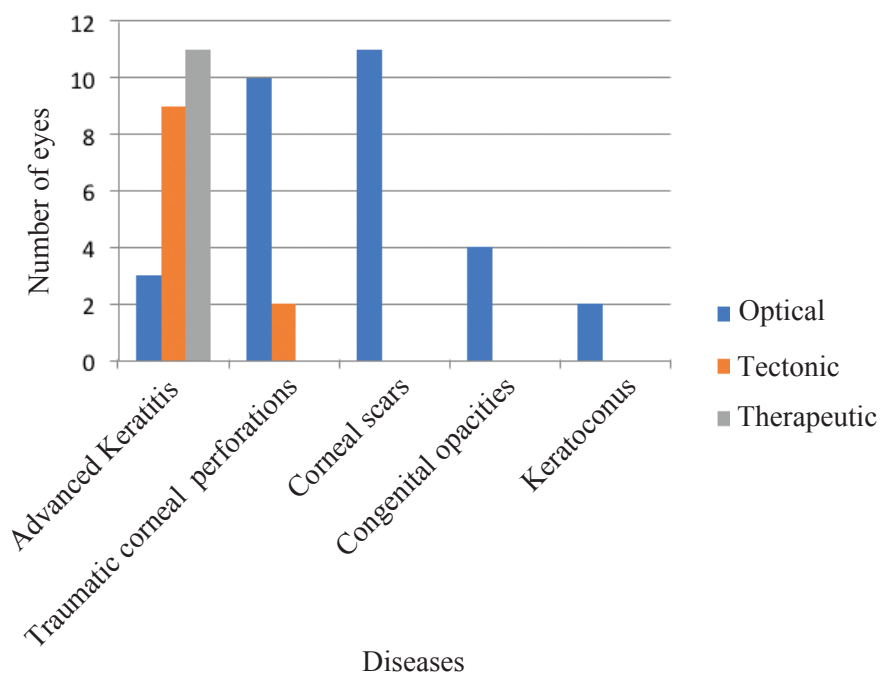
Visual acuity and the indication for transplantation in eligible eyes

Among the eligible eyes, 37 (71.2%) had BCVA <6/60 to light perception, with most 22 (59.5%) requiring

optical keratoplasty. The remaining eyes had BCVA between <6/18 and 6/60, nearly equally divided between therapeutic and tectonic indications.

Among patients with an optical indication for transplant, the leading diagnoses were dense central scars and traumatic corneal perforations. For tectonic indications, the diagnoses included perforated corneal ulcers and ulcers with impending perforation. Therapeutic transplant indications were for aggressive corneal ulcers (Figure 2).

Figure 2: Distribution of eyes with corneal diseases by corneal transplant indication (N = 52)



Associations of sociodemographic characteristics with eligibility for cornea transplantation

Chi-square analysis showed no significant association between transplant eligibility and sex, age group,

occupation, or residence ($p > 0.05$). However, education level was significantly associated ($p = 0.037$) with eligibility (Table 3).

Table 3: Eligibility for corneal transplantation by participants' sociodemographic characteristics (N = 243)

| Factor | Total | Eligible No. (%) | Not eligible No. (%) | Chi square P-value |
|--------------------|------------|---------------------|-------------------------|-----------------------|
| Sex | | | | |
| Male | 136 (56.0) | 25 (18.4) | 111 (81.6) | 0.545 |
| Female | 107 (44.0) | 23 (21.5) | 84 (78.5) | |
| Age (years) | | | | |
| 0–20 | 123 (50.6) | 24 (19.5) | 99 (80.5) | 0.057 |
| 21–40 | 44 (18.1) | 5 (11.4) | 39 (88.6) | |
| 41–60 | 52 (21.4) | 14 (26.9) | 38 (73.1) | |
| >60 | 24 (9.9) | 9 (37.5) | 15 (62.5) | |
| Education | | | | |
| Informal | 37 (15.2) | 4 (10.8) | 33 (89.2) | 0.037 |
| Primary | 137 (56.4) | 31 (22.6) | 106 (77.4) | |
| Secondary | 58 (23.9) | 8 (13.8) | 50 (86.2) | |
| College | 11 (04.5) | 5 (45.4) | 6 (54.5) | |
| Occupation | | | | |
| Dependents | 118 (48.6) | 21 (17.7) | 97 (82.3) | 0.958 |
| Self employed | 110 (45.2) | 24 (22.0) | 86 (78.0) | |
| Employed | 15 (6.2) | 3 (20.0) | 12 (80.0) | |
| Residence | | | | |
| Dar es Salaam | 176 (72.4) | 33 (18.8) | 143 (81.3) | 0.648 |
| Other regions | 67 (27.6) | 15 (22.4) | 52 (77.6) | |

DISCUSSION

In our study, half of the patients with corneal disease were aged between 0 and 20 years. Similar observation has been documented by Chen *et al*¹¹ in Kenya and Ashaye *et al*¹⁴ in Nigeria. Children are particularly vulnerable to ocular injuries due to their limited awareness of the potentially dangerous activities, such as playing with sharp objects, which may result in accidental corneal injuries. Correspondingly, cornea injuries and infectious keratitis were the most common cornea diagnoses observed in our study population. Similar patterns, with trauma and infectious keratitis predominating, have been reported by Arunga *et al*¹⁵. The higher rate of traumatic corneal injuries observed in our study population may reflect referral patterns, as only a few regional health facilities are equipped to manage corneal injuries, leading to a high number of referrals to MNH. These findings highlight the need for public health education on preventive measures

such as proper supervision of children while playing, a safe play environment and the use of protective gear to reduce corneal injuries and their associated complications.

We found that 19.4% of eyes with corneal disease were eligible for corneal transplantation, a significant proportion given the absence of local services. Most eyes eligible for corneal transplant in this study had Best-Corrected Visual Acuity (BCVA) $<6/60$. This aligns with findings from Lartey *et al*¹¹, in Ghana, Chen *et al*¹⁶ in Kenya, and Sharma *et al*¹⁷ in India. The consistently high proportion of patients presenting with severe visual impairment emphasizes the urgent need for local transplant services. Without intervention, the growing burden of corneal blindness will continue to fuel dependency, socioeconomic hardship, and reduced quality of life for affected individuals and their families.

In our series, the majority of eyes required transplantation for optical purposes, primarily to restore vision secondary to dense central corneal scars and traumatic perforations involving the visual axis.

Tectonic transplantation was indicated in the eyes to restore globe integrity secondary to perforated corneal ulcers/descemetocelles and traumatic perforations, while therapeutic transplantation was required to halt progressive, aggressive corneal ulcers. This represents a substantial burden, with patients requiring transplantation for varied but equally vision and life-quality impacting reasons. In the absence of transplant services, these patients face long-term disability, social isolation, and poverty. Our results are comparable to other studies which show that the majority of corneal transplants were performed for optical purposes and a few for tectonic and therapeutic purposes¹⁷⁻²⁰.

Regarding the specific indications for cornea transplantation, infectious keratitis was the most common cause (44.2%) consistent with findings by Sharma *et al.*¹⁶ in India, where 43% of eyes underwent corneal transplantation for the same reason. The similarity may reflect comparable settings in developing countries, where infectious keratitis remains common. A major challenge contributing to this burden is delayed hospital attendance due to over-the-counter medications, inadequate initial treatment, and late referrals from primary care facilities. Consequently, many patients present with advanced corneal ulcers requiring urgent transplantation either to restore vision or to preserve the globe. In contrast, keratoconus accounted for only 3.8% of transplant indications in our study, markedly lower than in Asia, Europe and East Africa, where it is reported as the leading indication ranging from 41–66.1%^{11,21,22}. This discrepancy may reflect referral patterns, as patients with keratoconus are often directed to established transplant centers elsewhere. Although keratoconus has a high prevalence in Africa²³, population-based studies are needed to clarify this disparity.

In this study, higher education level was significantly associated with eligibility for corneal transplantation. This may be explained by the fact that education influences health-seeking behavior and disease awareness, making individuals more likely to seek appropriate care in a timely manner. Furthermore, education is often linked with better economic capacity, which can increase the likelihood of accessing eye care services at earlier stages of disease when transplantation is still a viable option. Similar findings have been reported elsewhere, where individuals with higher levels of education were more likely to seek eye care early, before complications occurred²⁴⁻²⁶. These results highlight the need for targeted community eye health education and awareness programs, particularly for populations with low literacy, to reduce inequalities in access to timely and sight-restoring interventions.

Study limitations

This study has several important limitations. Being hospital-based, the findings may not be fully generalizable

to the wider Tanzanian population, as patients attending Muhimbili National Hospital (MNH) are likely to differ from those in community or primary care settings. Additionally, as MNH is a tertiary referral center, there is potential for referral bias, with more severe or advanced cases disproportionately represented. These factors should be considered when interpreting the findings, and future population-based or longitudinal studies are warranted to provide more comprehensive insights.

CONCLUSION

About one in every five patients with corneal disease required corneal transplantation, mostly young individuals with severe visual impairment, primarily due to trauma and advanced infectious keratitis. These findings underscore the urgent need to establish corneal transplant services, promote development of policies to support corneal and eye donation, establish a functional eye bank, and implement preventive strategies against ocular trauma and infection

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Competing interests: None to declare.

Authors' contributions: Masuki H, Baynity K, Mosenene S and Mafwiri M participated in conception, research design, data collection, data analysis and interpretation as well as drafting of this manuscript.

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