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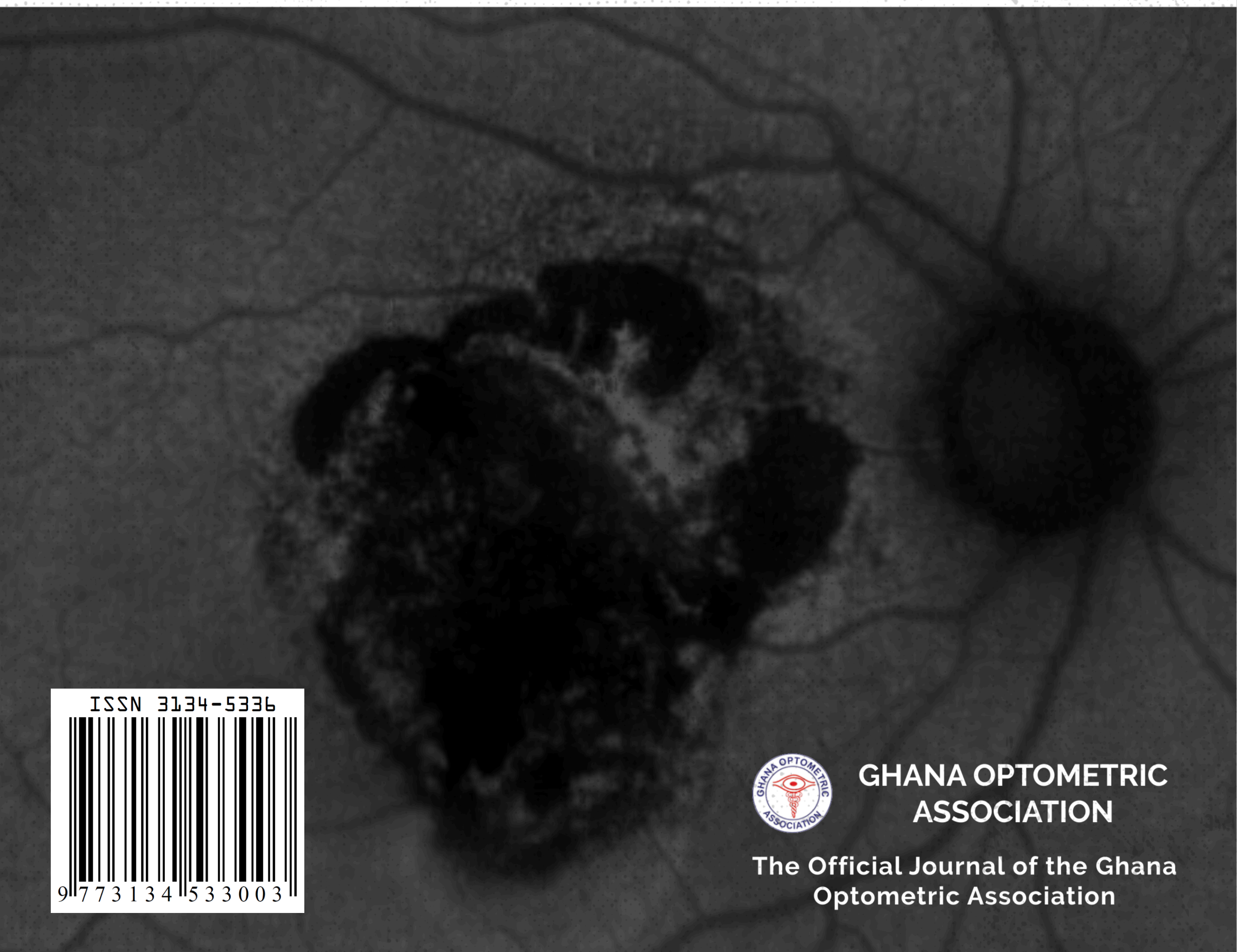

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GHANA OPTOMETRIC ASSOCIATION

The Official Journal of the Ghana Optometric Association

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Foreword

It is with profound optimism and utmost pride that we present the inaugural edition of the African Eye Health and Vision Science(AEHVSJ),the official j*ournal of the Ghana Optometric Association.*. This landmark publication signifies a very remarkable milestone in the advancement of optometry in Ghana,West Africa,Africa and the World and serves as a testament to the dedication, resilience, and intellectual rigor of Ghanaian optometrists.

The field of optometry continues to evolve rapidly, driven by scientific innovation, technological advancement, and an ever-growing understanding of the critical role of eye health in overall well-being. In Ghana, the optometric profession has made remarkable strides over the years—expanding access to eye care services, improving public awareness,contributing to eye health knowledge through impactful researches, and contributing meaningfully to the prevention and management of visual impairment and ocular diseases.

This journal has been established to provide a credible platform for the dissemination of research, clinical insights, and policy discussions that are relevant not only to Ghana but to the broader global eye care community. It is our hope that this publication will foster a culture of inquiry, encourage evidence-based practice, and promote collaboration among practitioners, researchers, educators, and policymakers.

We would commend Professor Samuel Bert Boadi-Kusi,the immediate Past President of the Ghana Optometric Association for his key role and leadership in making the dream of the GOA journal a reality.The whole journey of getting the African Eye Health and Vision Science Journal was birthed during his tenure as GOA President.We commend all authors, reviewers, and editors especially the Editor-In -Chief Professor Samuel Kyei for working tirelessly without any pecuniary motive to see to the publication of this inaugural edition.

As we turn this first page, we also look toward the future with confidence. The *Ghana Optometric Association Journal* will flourish to become a leading voice in optometric research and practice across Africa and beyond.

On behalf of the Ghana Optometric Association, I extend my sincere gratitude to everyone who has supported this vision. May this journal inspire excellence in research and clinical practice , ignite curiosity, and ultimately contribute to improved eye health outcomes for all.

Acknowledgement

The inaugural edition of the African Eye Health and Vision Science Journal (AEHVSJ) stands as a landmark milestone for the Ghana Optometric Association (GOA). This achievement was birthed during the tenure of Prof. Samuel Bert Boadi-Kusi, the immediate Past President of the association. We extend our profound gratitude to him for his visionary leadership and the key role he played in transforming the dream of an official GOA journal into a tangible reality. His dedication, alongside that of past and current executive committee members, has provided a testament to the intellectual rigor and resilience of Ghanaian optometrists.

We also wish to express our sincere appreciation to the maiden Editorial Board, led by Editor-In-Chief Prof. Samuel Kyei. The board members worked tirelessly and without pecuniary motive to ensure the successful publication of this first edition. Their commitment to establishing a credible platform for the dissemination of research and clinical insights is deeply valued.

Finally, we acknowledge the collective support of the general membership of the Ghana Optometric Association. We commend all the authors and reviewers whose contributions have fostered a culture of inquiry and evidence-based practice within the profession. It is our hope that this collaborative effort will continue to inspire excellence and ultimately contribute to improved eye health outcomes across Africa and beyond.

Editorial Board

African Eye Health and Vision Science Journal | AEHVSJ

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Visual Status among People Living with Hearing Loss in Tudun Maliki School for the Deaf and Blind, Kano, Nigeria

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Abstract

Background: Research has shown that the prevalence of ocular abnormalities among people living with hearing loss is higher than the overall population of similar age categories.

Aim: The study was carried out to probe the visual status involving people living with hearing loss in school for the deaf and blind, Kano, Nigeria.

Methods: A cross-sectional descriptive design study, conducted in Tudun Maliki, which is the only established special need school for people living with hearing loss in Kano. The participants were already diagnosed with hearing loss or impairment and met the inclusion criteria. Eighty-one participants had a thorough eye examination in the school after both ethical clearance and approval from the ministry of health and the school board respectively, were obtained.

Results: The participants were between the ages of 7 and 27 years, with a mean age of 14.72±3.92 years. Fifteen participants (18.5%) had moderate visual impairment. The Prevalence of refractive error was 77.7%, with astigmatism 31 (38.3%) as the highest type of refractive error. Thirty one (68.8%) participants had anterior segment abnormalities, while 14 (31.1%) had posterior segment abnormalities. The prevalence of visual impairment was 19.7% among participants.

Conclusion: There are high proportions of poor visual status among students attending special need schools for the deaf in Tudun Maliki in Kano, consequently recommending for thorough eye examination for every young child diagnosed with hearing loss.

Keywords: visual status, hearing loss, visual impairment, refractive error, ocular disorder.

Introduction

Visual status of the eye is the evaluation of the visual acuity (VA) [1], amplitude of accommodation, binocularity of the eyes in an uncorrected condition, and the best corrected visual acuity (BCVA) realisable using contact lens or spectacle prescription. A person with a hearing thresholds of 20dB or better in both ears is regarded to have a hearing loss [2]. It can be mild (they do not hear soft sounds), severe (at the normal level they hear nearly nothing when they are talk to) or profound (do not hear any speech, except very loud sounds) [2]. In 2018, World Health Organization (WHO) estimated the people living with disabling hearing impairment to be 466 million [3]. Researchers has reported the prevalence of Hearing disorder globally, from 1.4% in children aged 5–14 years to 9.8% in those who are 14 years or older [4].

The most common causes of hearing impairment among school children in Africa were cryptogenic deafness, convulsions, ototoxicity, neonatal jaundice, and infectious causes [5,6]. The link between the roles of the many organs of sensation has been established, especially between the ears and eyes. The retina and cochlea are formed in the 6th and 7th week of gestation from the same embryonic layers [7].

Vision, plays a very important role in skills possession like, facial expressions interpretation, language and those that needed hand–eye collaborations.[8] The eyes plays a great role in the growth and the child's functioning [8]. In the case of Special needs children, vision played a fundamental role in the psychosocial growth among them and account for impaired functions, mostly in children living with hearing lost [9].

A lot of knowledge and skills in children are acquired through the eyes and ear [10]. When either the eye or ear is greatly impaired, the functioning one will compensate for the other (making it more significant as the impairment worsened).[8] Oculo-visual abnormality in children with special needs that is concealed and untreated, could negatively influence their psychosocial behavior, learning potentials and development, hence increase socioeconomic burden of the family [11]. Furthermore, the perseverance of an untreated oculo-visual abnormality would complicate the effect of other forms of disability.[12] When a child is above the age of 10–12 years, with uncorrected visual deficiency, the flexibility of the visual system is lost, and the recuperation of vision can be restricted [8]. There is need for a comprehensive and timely oculo-visual evaluation among those at risk [8]. Special needs Children are at a greater risk of ocular and visual complications than their associates [9]. Nonetheless, on many occasions cannot adequately communicate symptoms [13].

Research studies have showed that the deaf and hearing impaired has a higher prevalence of ocular abnormalities than the general population of similar age group [14].

Poor visual status with hearing loss is a devastating and poorly tolerating condition to one's life and socio-economic impact but little attention has been given to it. This research work was conducted to determine the visual status of patients with hearing loss in order to bridge the gap in their care service.

Presently, there is no documented study on visual status of patients with hearing loss in Kano State (considering the peculiarity of the state), Nigeria. This study will serve to provide new information about vision and hearing loss and also serve as a guide for further research. It will help the otolaryngologist (under non-governmental organizations) that visit the school to consider routine eye checkups and eye examinations for patients presenting with hearing loss in the clinic.

Materials and Methods

This research is a cross-sectional descriptive prospective study carried out at Tudun Maliki School for the deaf and blind. The school is located at Tudun Maliki quarter of Kumbotso Local Government Area Kano, Kano State, Nigeria. The study population consists of 81out of 250 registered pupils and students living with hearing loss attending Tudun Maliki School for the Deaf and Blind from February to April 2023. The judgmental sampling technique was used in this research in order to be sure only those with hearing loss without any form of systemic condition or disability were included in the study.

The sample size was calculated using a study carried out in Ibadan, Nigeria [15].

$$n = \frac{z^2pq}{d^2}$$

n = desired sample size;

z = standard error of the mean, which corresponds to 95% confidence level (1.96);

p = visual impairment and ocular findings among deaf and hearing impaired in school children in Ghana. (6.4%) [15].

$$q = 1 - p$$

d = precision with which P is determined 0.05

$$n = \frac{1.96^2 \times 0.064 \times (1 - 0.064)}{0.05^2}$$

$$n = \frac{3.8416 \text{ X } 0.064 \text{ X } 0.059904}{0.0025}$$

n = 92. Allowing for 10% attrition, the minimum sample size becomes 9

92+9 = 101

Only pupils and students with hearing loss without any further disability attending Tudun Maliki special school for the deaf and blind, who gave their consent or returned their assent forms, were included in the study. Those students who were absent, non-consenting notwithstanding their assent form being returned, were excluded.

The data collection form comprises six parts/sections, namely, the socio-demographic data (personal information), visual acuity, preliminary examination, anterior segment assessment, near point of convergence (NPC), fundoscopy, objective and subjective refraction. Tumbling illiterate E Snellen's chart, Trial Lens Box (TLB), Ophthalmoscope (Heine), Streak Retinoscope (Welch Allyn, YZ24), Meter Rule, Occluder, pen torch, and writing materials were materials used for the study.

A designated teacher from the school who helped in interpretations and coordinating the students was assigned by the school authorities for the study. An assent forms were given to the pupils/students <18 years for their parents/guardians to sign while consent forms were issued to the students (≥18 year), and it was explained to them by their sign expert/teacher. All examinations were carried out by qualified and registered optometrists in a designated room conducive to the study. A distance illuminated visual acuity chart (E-CHART) was placed at a distance of 6 m from the patient to find out their level of visual acuity, and the test was performed monocularly with the right eye first before the left eye. Acuity values were recorded in the data sheet. A cover test was performed at 40 cm using an Occluder, and this was done monocularly in the cover-uncover test and alternatively in alternative cover tests. Deviations seen are recorded (based on the eye movement during cover and uncover tests) as either esodeviation or exodeviation in both phoria tests and tropia. Direct opthalmoscopy was performed to rule out posterior segment of the eye abnormalities while those with suspicious disc were referred to the clinic for IOP measurements (with Keeler air puff machine). The external examinations were done using a pen torch for any physically obvious abnormalities. A non-cycloplegic objective examination was performed in dim illumination in one of the classes using a streak retinoscope. Cycloplegic refraction was not done due to the same ethical considerations as using certain medications in a vulnerable population. Subjective refraction was conducted at 6 meters and was recorded.

Visual impairment (VI) was categorized with the ICD-10 classification: Category 0 (mild or no visual impairment) is better than 6/18, Category 1 (moderate VI) = 6/18, Category 2 (severe VI) = 6/60, Category 3 (blindness) = 3/60 and Category 4 (blindness) = 1/60 using the best seeing eye. Refractive error was defined as follows: astigmatism as a cylindrical power of ≥ -0.50D, hyperopia and myopia as spherical powers of ≥ +2.00D and ≥ -0.50D, respectively, and emmetropia as a spherical correction of < -0.50D.

Data was analysed using Statistical Package for Social Sciences (SPSS 17) (IBM Boston, USA). Fisher's exact test was used to assess associations between variables. P<0.05 was used for evaluating statistical significance at 95% confidence interval. Frequencies, standard deviation and percentage proportion were computed.

Ethical approval to conduct this study was obtained from the Health Research Committee in the Kano State Ministry of Health, Kano, Nigeria (SHREC/2022/3120) after an introductory letter was obtained from the department of optometry, Bayero University Kano.

Results

The school had in their register 250 (pupils and students) of those living with hearing loss, in the hearing-lost section of the school; only 81 of them participated in this study, comprising 16 (19.80%) females while the males were 65 (80.20%). The mean age and standard deviation of the participants were 14.72±3.92 years. The age distribution was between 7 years and 27 years. The senior secondary school has the highest number of participants 33 (40.74%) (Tables 1 and 2).

Table 1: Social demographic data of the participants.

	N = 81	%
Sex		
Male	65	80.20
Female	16	19.80
Total	81	100
Academic Levels		
Primary School	23	29.63
Junior Secondary School	25	30.86
Senior Secondary School	33	40.74
Total	81	100

Table 2: Age Distribution of Participants

Age groups	**Male n (%)**	**Female n (%)**	**Total n (%)**
6 – 10	7(8.64)	2 (2.47)	9 (11.11)
11 – 15	34(41.98)	-	42 (51.85)
16 – 20	17(20.99)	6 (7.41)	23 (28.40)
21 – 25	(7.41)	0 (0.00)	6 (7.41)
26 – 30	1(1.23)	0 (0.00)	1 (1.23)

Most of the participants had normal vision using the International classification (ICD) of disease and related health problems, tenth version (ICD-10). Moderate visual impairment was seen in 11 (16.9%) and 4 (25%) male and female, respectively (Table 3).

Participants with astigmatism had the highest refractive error 31 (38.3%) (Table 4). Prevalence of ocular deviations was 20.99%, exophoria 7 (8.64%) had the highest occurrence (Table 5).

Table 3: ICD-10 Classification of VA across Gender

ICD-10 Classification	Gender	
	M (%)	F (%)
6/6 to > 6/18 (Normal to Mild)	54 (83.00)	11 (68.70)
<6/18 to 6/60 (Moderate Visual Impairment)	11 (16.90)	4 (25.00)
<6/60 to 3/60 (Severe Visual Impairment)	0 (0.00)	1 (6.25)
Total	65	16

Table 4: Refractive Status and Gender

Refractive Status	Gender		Total	%
	M	F		
Astigmatism	24	8	32	39.5
Emmetropia	17	1	18	22.2
Hyperopia	18	5	23	28.4
Myopia	6	2	8	9.9

Discussion

This study assessed the visual status of students living with hearing loss in a special need school in Kano. In this study, participant's responses were an optimum of 80.2% with a male population different, from a study conducted in Benin, Nigeria [10] were more females were seen. However, it is similar to the study conducted in Ghana [16], where there were more males. The presence of more males in this study may be as a result of the socio-cultural dynamics of Kano and Northern Nigeria at large, where more males are empowered, and this may not be different from the special needs children. The average age of participants in our research was 14.72±3.92 years, with the age limit of 7 and 27. It was slightly higher than that

Table 5: Ocular Deviation among the Participants

Phoria	n (%)	Tropia	n (%)
Exophoria	7 (8.64)	Exotropia	0 (0.00)
Esophoria	6 (7.41)	Esotropia	4 (4.94)

conducted in Calabar, Nigeria [8], but less than 15.7±3.9 years from another work in northern Nigeria among deaf children [7]. The higher school age may be as a result of delay in the enrollment of these children into school [17]. The senior secondary school student has the highest number of participants followed by the junior secondary school and primary school in the study, and this may also be as a result of the late entry into school as only a few will want to stay in the lower class at their age.

The visual impairment prevalence was 19.7% in our work, and this is similar to 19% found in Lagos, Nigeria [18], yet higher than 10.3% in Ghana [16]. This may be as a result of the classification of visual impairment used by the authors. In this study, 1.2% and 18.5% of the students were found to have severe and moderate visual impairment, respectively. However, one (female) of the students was found to have severe visual impairment, and moderate visual impairment was seen more among the male students. About 64% of global blindness is women as a result of these different perspectives: risk factors, life expectancy, and access to services [19]. These may be broken down further into social, economic, cultural, and biological (hormonal) differences that exist between men and women. Uncorrected refractive error accounts for 77.7% of the prevalence of visual impairment among the participants examined in our work; indicating that people living with hearing loss struggle or have challenges with learning and communication since they rely on visual cues. The prevalence of refractive error

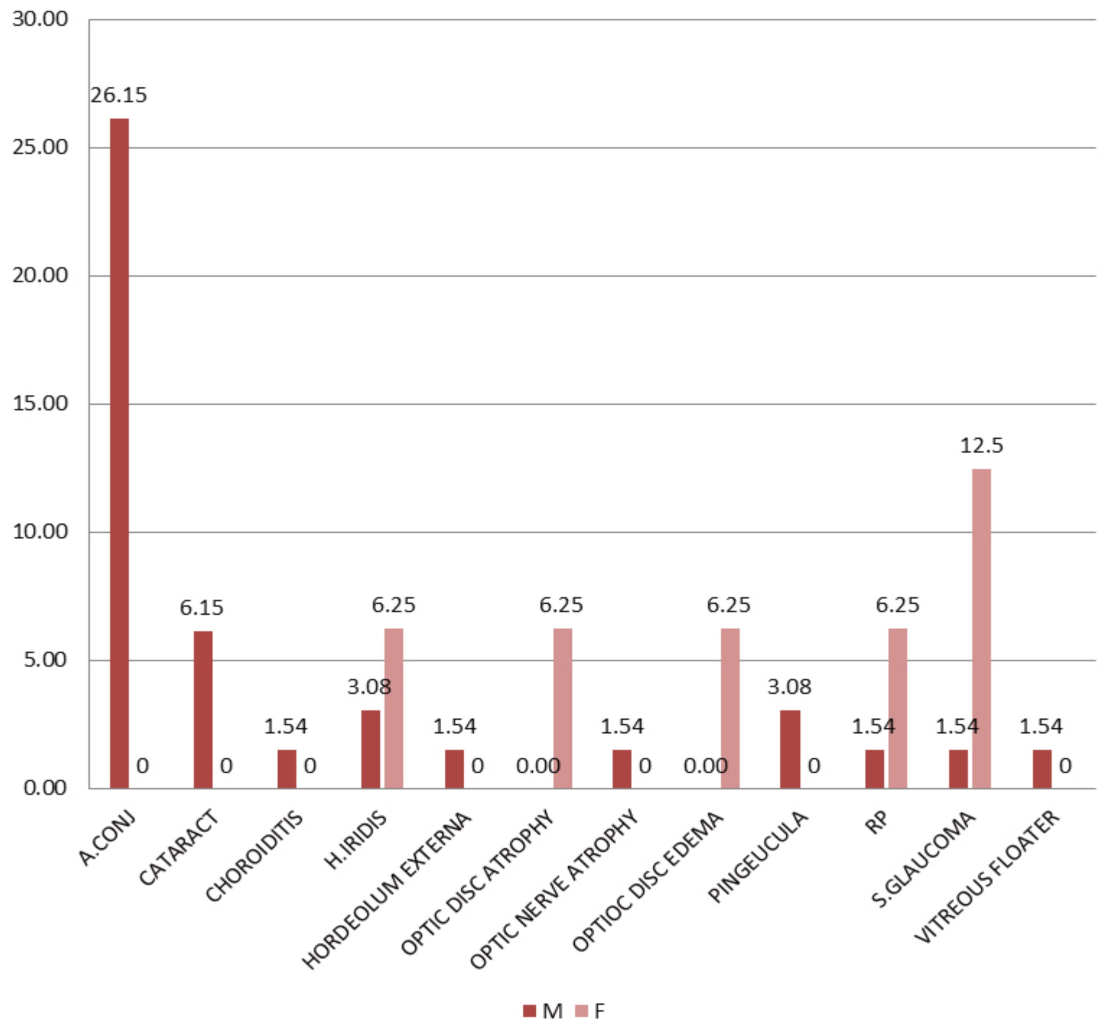

Figure 1: Prevalence of Ocular Disorders across Gender

found in our work was similar to the result of 73.26% recorded in sub-Saharan Africa [20] and in Benin City, Nigeria [10]. The commonest refractive error in the work was astigmatism, which was in contrast to another work in Nigeria [7] which had hyperopia as the highest refractive error and myopia in the work in India [21]. However, it was similar to a research conducted in Ghana [16]. The differences in environmental conditions as well as genetic reasons and residential status of the participants may have contributed to astigmatism being the most prevalent refractive error in this work [19]. The prevalence of ocular deviations was 20.99% and it was similar to the study conducted in Ghana [16] where exophoria has the highest occurrence.

The association linking gender and refractive error distribution in the work was not significant (P > 0.05). While this work is in agreement with the research carried out in Dow University, Karachi, and Pakistan [22]. The prevalence of ocular disorder in this study was found to be 44.4%, which was similar to 40.4% found in the study conducted in Turkish [23]. This also agreed with other studies in Nigeria, that the occurrence of visual disorders among the people living with hearing loss is between the range of 20.9 – 73.3% [7,10]. The frequency of ocular disorders evaluated in the work could have been underreported taking into consideration that eye examinations were carried out with direct ophthalmoscope, which could have limited the discovery of other disorders. There was a statistical association (P<0.05) linking gender and ocular disorders. This could also be as a result of these three perspectives: risk factors, life expectancy and access to service.

Limitation of Study

The major limitation faced during the research was absenteeism among the school children leading to prolongation of the period of data collection; this led to the response rate recorded in this study.

Conclusion

There are high proportions of poor visual status among students attending special needs schools for the deaf in Tudun Maliki in Kano. However, little or no frequency of ophthalmic evaluation is conducted among these students attending the special need school for the deaf and blind, as there was no record of that by the school authority. There is a need for greater attention to these disorders, which poses serious educational and social problems for these children. Since deaf and hearing-impaired children have difficulty conveying their vision problems and need to compensate for their poor hearing with an enhanced sense of sight, eye screening examinations are paramount in these children at the point of admission into the school.

Conflict Interests

The authors declare that they have no conflict interests.

Financial support and sponsorship

Nil.

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Assessment and Management of Ocular Envenoming: A Case Report in a Rural Setting in Ghana

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Abstract

Purpose: This report presents a case of venom spit ophthalmia, an uncommon but serious ocular emergency caused by snake venom contacting the eye.

Case Presentation: A 31-year-old carpenter presented with venom spit ophthalmia in the right eye (RE) after a cobra spat venom into his eye. The patient received timely irrigation with normal saline and intravenous hydrocortisone in the emergency unit, followed by antibiotic and antifungal eye drops to prevent further infection. Despite a 2-hour delay in treatment, the patient achieved complete visual recovery with minimal scarring located outside the visual axis, preserving his vision.

Discussion: This case emphasizes the effectiveness of early intervention, including copious eye irrigation, to mitigate venom-induced ocular damage.

Conclusion: The positive outcome underscores the need for readily available ophthalmic care in rural settings, where snake encounters are common, to prevent severe complications in similar cases. Protective eyewear is highlighted as a critical preventive measure, especially in high-risk environments.

Keywords: Venom spit ophthalmia, cobra venom, ocular emergency, eyewear.

Introduction

Venom spit ophthalmia is an uncommon but serious ocular emergency caused by snake venom contacting the eye. Spitting cobras have been known since ancient times to spit venom into human eyes, with records dating back to the pharaonic period [1]. Historical reports from the Gold Coast (modern-day Ghana) describe a stonemason who was blinded instantly after a snake spat venom into his eyes [2]. More recently, a case in the Volta Region of Ghana was reported, though it did not result in blindness [3].

Globally, about 5.4 million people are attacked by snakes every year, leading to 2.7 million cases of snake envenoming [4]. Overall, 95% of snake attack cases occur in tropical and low-income countries.[5] The majority of attacks occur among people with low socioeconomic status and are linked to occupations such as farming, fishing, animal rearing, and hunting [6,8]. A study in Ghana reported a snake attack incidence of 82.8 per 100,000, with Bole and Kintampo recording incidences of 110 per 100,000 and 74 per 100,000 populations, respectively [9,10].

Snake venom is a complex mixture of toxins primarily used for prey capture and self-defense when the snake feels threatened. The venom of spitting cobras can travel varying distances, with reports indicating that it can reach between 2 and 5 meters [11,12] and it is typically precise enough to aim at the eyes of perceived threats [13]. The toxins in spitting cobra venom are believed to cause damage due to their membrane-damaging properties [14,15]. When venom contacts the eye, a cascade of enzymatic reactions occurs, causing ocular injury and inducing inflammatory reactions, primarily affecting the anterior segment of the eye, which has been known to cause intense pain, conjunctival injection and chemosis, eyelid and corneal edema, blepharospasm, epiphora, and in some cases, blepharitis, corneal opacity, punctate keratitis, uveitis, and even blindness if not treated promptly [16-18].

This report details a case of venom spit ophthalmia in the right eye of a 31-year-old carpenter, emphasizing the importance of timely intervention in preventing severe ocular damage.

Case Presentation

A 31-year-old male carpenter was referred to the eye clinic from the emergency unit due to severe pain, photophobia, and tearing in his RE, following exposure to cobra venom. The patient reported that a black cobra had spat venom into his eye while he was working on a roof. The incident occurred two hours before presentation. Upon arrival at the emergency department, he was treated with intravenous hydrocortisone (200 mg), and his eyes were copiously irrigated with normal saline by the attending medical officer. His medical history (MHx)was unremarkable.

Ophthalmic Examination:

- Entrance Visual Acuity (VA):
  - RE: Counting fingers at 3 meters (CF @ 3m)
  - LE: 6/6
  - Pinhole Acuity: Not assessed in the RE due to pain and photophobia.
- Conjunctiva: The conjunctiva in the RE showed moderate hyperemia, with mild redness graded 2 on the Efron scale, but no chemosis.
- Palpebral Aperture: The RE palpebral aperture was slightly narrowed as the patient was attempting to keep the eye closed due to photophobia and discomfort.
- Pupil Examination: The pupil in the RE was slightly smaller than the LE, likely due to ciliary spasm before administering cyclopentolate. Both pupils were reactive to light.
- Corneal Examination: A penlight examination, combined with a magnifying loop, revealed a grey mark on the cornea approximately 2 mm below the visual axis in the RE. Fluorescein dye staining was positive, confirming it was an ulcer. Due to equipment limitations, a slit-lamp examination

could not be performed, and the depth of the ulcer could not be fully appreciated.

- Other Ocular Structures: There were no signs of uveitis, hypopyon, or stromal edema. The anterior chamber was quiet, and the examination of other ocular structures using a penlight and direct ophthalmoscope (with the +8 dial at 1 meter) was unremarkable. The lens and vitreous of both eyes were found to be clear. The fundus background of both eyes appeared orange in color with the optic disc yellow and round in both eyes. Margins of both eyes were distinct. Optic disc cupping exhibited Elschnig type II with a C/D ratio of 0.2 in both eyes. A cup depth of 1D was measured in both eyes. The retinal blood vessels were normal and healthy. AV crossing appeared to be 2/3 with no spontaneous venous pulsation present in both eyes. Foveal reflexes were present in both eyes. There were no pathologies present in the macula or the periphery of both eyes.

Initial Management:

After instilling a drop of cyclopentolate 1% in the RE, the patient reported reduced pain. The patient was prescribed Gutt ciprofloxacin 0.3% hourly on the first day, then every two hours for the next two days, and Gutt fluconazole 0.3% four times daily for three days. Ciprofloxacin ointment 0.3% was applied at night.

First Follow-up:

A follow-up appointment was carried out after three days. The patient reported a significant reduction in pain and photophobia. His primary complaint had improved, and the conjunctival hyperemia had reduced significantly. Upon examination, pinhole acuity in the RE showed no improvement over the unaided visual acuity, which had improved to 6/9 in the RE and remained 6/6 in the LE. Fluorescein staining was showed few inferior punctate stains. A 2 mm inferior corneal scar was also noted, located below the visual axis. The remainder of the ocular examination was unremarkable. The patient was advised to continue using Gutt ciprofloxacin 0.3% and Gutt fluconazole 0.3% four times daily. A follow-up review was scheduled for one week later to monitor further progress.

Second Follow-up:

The patient reported no discomfort or new complaints. His visual acuity was 6/6 in both eyes. An ocular examination revealed no signs of inflammation, and the inferior corneal scar remained stable. Fluorescein staining was negative. The remainder of the ocular examination was unremarkable. The patient was prescribed Gutt methylcellulose Eye 0.5% to be used four times daily to maintain corneal hydration and was instructed to return for a final review in one month.

Discussion

Venom spit ophthalmia, while rare, poses a significant risk of ocular damage, particularly in rural areas where snake encounters are more common [19], due to greater natural habitats, agricultural lifestyles, increased outdoor activities, and less infrastructure, which brings humans into closer contact with snake populations.[20,21] Unlike venom bite ophthalmia, which introduces venomous toxins into the host's body and reaches the retina and choroid, which are rich in blood vessels and lead to ocular complications like venom-induced retinal hemorrhages that may require surgical interventions [22,23], venom spit ophthalmia generally has better visual outcomes [24]. The cornea and conjunctiva are the primary structures affected in venom spit ophthalmia, as these tissues are most exposed and vulnerable to injury from venom [16]. Snake venom toxins and enzymes can cause direct ocular damage and trigger an inflammatory response, leading to symptoms such as pain, photophobia, foreign body sensation, and reduced vision, as observed in this patient [25]. The severity of ocular damage depends on several factors, including the volume of venom, the time between exposure and treatment, and the effectiveness of follow-up care to prevent complications [21].

In this case, the patient identified the snake as a black cobra, likely *Naja nigricollis*, which is known for its ability to penetrate the corneal epithelium and bind to the stroma, resulting in severe corneal damage [16]. The presence of a corneal scar in the RE, despite treatment, suggests that the venom had penetrated deeply into the corneal stroma. Studies have shown that after 30 minutes to 12 hours of binding to the ocular tissues, it can cause severe corneal damage [16]. The patient received treatment 2 hours after exposure, at which point the damage had already occurred.

The pH of snake venoms ranges from 5.49 to 7.4, including *Naja nigricollis* venom which has an average pH of 5.60, which makes it acidic [26]. While the acidic nature of the venom may contribute to chemical injury to the cornea, the venom's proteolytic and cytotoxic components are the primary agents of damage, leading to epithelial disruption, stromal inflammation, and coagulative necrosis [27]. Immediate irrigation with normal saline helps slow down the seeping of venom into the deeper structures of the cornea, thus minimizing ocular injury and reducing the risk of permanent damage from venom exposure. In fact, 77% of ocular complications are alleviated by copious irrigation [24]. The positive prognosis in this case highlights the importance of prompt irrigation and appropriate ophthalmic care. Had treatment been delayed further, the patient might have experienced more severe complications, including permanent vision loss, as reported in other cases of venom spit ophthalmia. Additionally, the positioning of the scar, 2 mm below the visual axis, spared the patient's vision. Had it been on the visual axis, the patient may not have had the same favorable visual outcome. The use of antifungal and antibiotic treatment also prevented further complications. For example, in Nigeria, a case of permanent blindness was documented after venom spit ophthalmia [28].

Treatment typically includes topical vitamin C, mydriatics, antibiotics, and antihistamine eye drops, depending on the clinical presentation [29]. The use of intravenous hydrocortisone in the emergency department was aimed at preventing severe systemic allergic reactions to the venom. While there is some controversy regarding the use of systemic corticosteroids as first-line treatment for venom ophthalmia, their role in preventing systemic complications cannot be ignored [30]. Topical or intravenous antivenom treatment is generally not necessary for venom spit ophthalmia [28,31].

One limitation in the management of venom spit ophthalmia is the lack of well-established, evidence-based guidelines in humans, especially in cases involving significant corneal compromise. In the absence of such guidelines, treatment must be aggressive in cases of severe complications, particularly in settings where microbial infections pose a high risk of blinding people. The decision to use both antifungal and antibiotic agents reflects a cautious and comprehensive approach to managing a case with multiple risk factors for infection. This approach was particularly warranted given the two-hour delay in treatment, during which the cornea remained vulnerable to microbial invasion. Lorch et al. [32] documented cases of fungal diseases in snakes. Although it is unlikely that snake venoms are contaminated with fungal pathogens, the patient's corneal defects might have been exposed to fungal organisms, increasing the risk of fungal keratitis. The decision to use both antifungal and antibiotic agents was a cautious and comprehensive approach aimed at preventing secondary infections in a high-risk case. The patient's corneal ulcer, resulting from venom exposure, created vulnerable entry points for opportunistic infections. Given the rural environment, where exposure to soil and organic matter increases the risk of fungal contamination, fluconazole 0.3% eyedrops were administered as a precautionary measure to prevent fungal keratitis, a serious complication that could lead to significant visual impairment. Simultaneously, ciprofloxacin 0.3% eyedrops, a broad-spectrum antibiotic, was employed to prevent bacterial colonization of the compromised corneal tissue. This dual therapy addressed the multiple infection risks posed by both fungal and bacterial pathogens, ensuring comprehensive protection during the delayed treatment window. The patient was given cyclopentolate 1%, a cycloplegic to alleviate discomfort caused by ciliary muscle spasms.

The patient could have prevented the venom from entering his eyes by wearing protective eyeglasses while working on the roof. This emphasizes the critical importance of using protective eyewear in work environments, particularly where there is a risk of exposure to harmful substances. Proper eye protection serves as a barrier, safeguarding the ocular surface from potential injuries and hazardous materials (21)

In this case, we were unable to utilize a slit lamp because the facility did not have one, which may have led to the oversight of certain ocular abnormalities, constituting a limitation of this case presentation. Despite this, the situation underscores the importance of clinicians adapting to the lack of specialized instrumentation to provide the best possible care for their patients. This highlights the need for flexibility in clinical practice, especially in resource-limited settings. Furthermore, it is crucial for health initiatives to prioritize the provision of essential ophthalmic instruments in rural areas, as these regions are often at greater risk of ocular diseases and injuries (33,34).

Conclusion

This case of venom spit ophthalmia in a rural Ghanaian setting illustrates the critical importance of prompt and appropriate management in preventing severe ocular damage from snake venom exposure. Despite a two-hour delay in treatment, the patient achieved full visual recovery with minimal scarring outside the visual axis, thanks to immediate irrigation, topical antibiotics, and antifungals. This outcome highlights the effectiveness of early intervention, particularly copious irrigation, in mitigating venom-induced ocular injury. Additionally, it underscores the importance of accessible ophthalmic care and protective eyewear in high-risk environments to prevent similar incidents. Such measures are essential in rural areas with limited healthcare resources, where snake encounters and ocular injuries are prevalent.

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Early Detection and Comprehensive Management of Ocular Hypertension Secondary to Blunt Trauma

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Abstract

Purpose: This case report discusses the early detection and comprehensive management of ocular hypertension (OHT) secondary to blunt trauma in a 28-year-old male.

Case Presentation: The patient experienced ocular pain, blurred vision, and elevated intraocular pressure (IOP) following a blunt trauma to the LE during a sports-related accident. An initial IOP reading of 31 mmHg was noted. A treatment plan involving topical antihypertensive eye drops, steroids, pain management, and lubricants was initiated, leading to significant recovery, including normalization of intraocular pressure and visual acuity.

Discussion: OHT secondary to blunt trauma poses a significant risk for progression to glaucoma. Early detection and a tailored treatment plan are essential in preventing permanent vision loss.

Conclusion: Highlighting the critical need for early detection, immediate intervention, and sustained patient education and follow-up, this case reflects on the meticulous management required to prevent OHT secondary to trauma from advancing to secondary glaucoma, a leading cause of irreversible blindness globally.

Keywords: ocular hypertension, blunt trauma, intraocular pressure, trauma management, visual acuity

Introduction

Ocular hypertension (OHT) secondary to trauma is a critical condition that poses a risk of progressing to secondary glaucoma and irreversible vision loss. It is characterized by elevated intraocular pressure (IOP) without the concurrent presence of glaucomatous optic neuropathy [1,2]. Prompt diagnosis and appropriate management are essential to prevent such outcomes. This case report presents the clinical management of OHT in a young male following a sports-related blunt ocular trauma, highlighting the importance of early intervention and continuous follow-up to safeguard vision.

Case Presentation

First visit - 15/02/2023

Mr. B, a 28-year-old Ghanaian male small-scale farmer, visited our clinic on February 15, 2023, due to persistent discomfort, pain, red eye, swollen eyelids, and reduced visual clarity in his LE following a local sports-related accident a week prior. He described experiencing a moderately strong blunt accidental impact on the LE, which led to ongoing symptoms that significantly hindered his daily functioning. The chief complaint included a constant ache in the affected eye, episodes of blurred vision, increased light sensitivity, and an inability of these symptoms to resolve with his personal choice of home remedy of using a warm wet towel on the eye, prompting him to seek professional medical attention. There was no mucous discharge, fever, chills, headache, nausea, or vomiting when questioned. Mr. B reported no medical or surgical histories. Past ocular, family ocular, and family medical histories were unremarkable. Mr. B had not been on any medications for several months except for 1 gram of paracetamol he took 1 hour prior to his visit to the clinic. There were no known allergies, and the patient did not use corrective lenses or had any known chemical exposures that could exacerbate his ocular condition.

Clinical Evaluation

Vital signs were stable with a pulse of 72 bpm, blood pressure at 120/75 mmHg, and a temperature of 37.0°C. A comprehensive ocular examination was conducted to assess the severity of the trauma and its effects on his ocular health, comprising the following assessments:

- Visual Acuity (VA) Testing: Using a 3m Snellen chart, VA was measured, revealing 6/6 in the right eye (RE) and VA of 6/18 in the LE.
- Slit Lamp Examination (SLE): The upper and lower eyelids of the LE were mildly swollen. The examination of the anterior segment of the LE revealed mild conjunctival hyperemia, along with mild central corneal cloudiness but no corneal abrasions and no foreign bodies. The anterior chamber seemed quiet, with no signs of hyphema in the LE. There were no adhesions of the iris to any structure and no lacerations. RE angles were open with a Van Herrick estimation of grade 4 but the LE angle was not estimated due to the cloudy cornea so as to avoid inaccurate angle estimation. The pupils were both equal, round, and reactive to light and there were no lens opacities. Anterior segment exam of the RE was unremarkable.
- Ocular Motility Testing: His ocular motilities tested using the broad H test were smooth, accurate, full, and extensive. This was done to assess the integrity of the ocular motor nerves or the extraocular muscles themselves and to rule out the possibility of an orbital floor fracture.
- Intraocular Pressure (IOP) Measurement: The IOP was measured at 9 am using the Topcon CT-80 non-contact tonometer. The LE exhibited an elevated IOP of 31 mmHg, significantly higher

than the normal range. The RE's IOP was within normal limits at 15 mmHg, serving as a baseline for comparison.

- Confrontational Visual Field (CVF): Upon conducting the CVF examination for Mr. B, it was observed that his visual field responses were within normal limits.
- Fluorescein Staining: Staining of the LE with 1% fluorescein eye drop was negative both for the cornea and conjunctiva.
- Gonioscopy: This was postponed to the next visit due to mild cloudy cornea, and patient challenging cooperativeness.
- Fundoscopic Examination: Ophthalmoscopy with the Welch Allyn 3.5v direct ophthalmoscope revealed no posterior segment abnormalities, and a cup/disc (C/D) ratio of 0.3 in both eyes.

Diagnosing OHT secondary to trauma presents unique challenges due to the variety of potential underlying causes and its symptom overlap with other ocular conditions. The differential diagnoses considered in this context include:

1. Traumatic Iritis
2. Angle Recession Glaucoma
3. Hyphema
4. Lens Dislocation
5. Scleral Rupture
6. Corneal Foreign body
7. Corneal Abrasion
8. Chemical Injury

In Mr. B's case, the absence of visible iris inflammation or synechiae discounted Traumatic Iritis as a primary cause. Angle recession glaucoma was a significant consideration given the trauma history; however, an initial gonioscopic evaluation could not be performed. Hyphema was ruled out due to the absence of blood in the anterior chamber. Lens dislocation and scleral rupture were unlikely, considering the intact anterior chamber depth and SLE showed intact crystalline lens and funduscopy showed no posterior segment anomaly. Although the patient's symptoms were consistent with a corneal foreign body and corneal abrasion, the SLE did not reveal any retained foreign body or scratched cornea. Lastly, chemical injury was not supported by the patient's history.

Based on the case presentation and clinical evaluation of Mr. B, the initial diagnoses are as follows:

1. Ocular Hypertension Secondary to Trauma: The primary diagnosis is supported by the elevated IOP in the LE (31 mmHg), which is significantly higher than normal, and the baseline measurement of the RE (15 mmHg). This condition is likely a direct result of the blunt trauma sustained during the sports accident, causing a disruption in the aqueous humor dynamics and leading to increased intraocular pressure. This may pose a risk for glaucomatous changes if not managed promptly.
2. Corneal Contusion: The presence of mild central corneal cloudiness without abrasions or foreign bodies, following a blunt impact, is characteristic of a corneal contusion. The localized cloudiness and the context of trauma support a diagnosis of corneal contusion.

The following interventions were initiated:

1. Antihypertensive Eye Drops: Timolol 0.5% was started. Mr. B was instructed to administer one drop in the affected LE twice daily.
2. Steroid Therapy: To combat post-traumatic inflammation that could contribute to elevated IOP, Prednisolone acetate 1% eye drops were prescribed. Mr. B was directed to apply one drop to the LE three times daily. The therapeutic effect of steroids on reducing inflammation and

preventing the formation of synechiae was balanced against the potential risk of steroid-induced IOP elevation, warranting close monitoring.

3. Pain Management: A regimen of Acetaminophen (Paracetamol), 1g, was prescribed to be taken twice daily at 8 am and 8 pm for three days.
4. Topical Lubricants: Preservative-free artificial tears [Refresh Optive (0.5% Carboxymethylcellulose Sodium and 0.9% Glycerin as active ingredients] were suggested to provide symptomatic relief, enhance ocular surface lubrication, and facilitate corneal healing. Mr. B was advised to apply the lubricating drops every 4 hours during waking hours.
5. Cycloplegic Agents: To reduce discomfort associated with ciliary muscle spasms and promote corneal relaxation, 1 drop of Cyclopentolate (1%), was recommended for use in the LE two times daily for 5 days (12-hour intervals between applications).
6. Patient Education: A significant focus was placed on educating Mr. B about the criticality of adhering to the medication regimen to avert complications. He was informed about recognizing signs of escalating OHT and the potential risk of developing secondary glaucoma.
7. Review: The patient was advised to visit a week later.

Follow-Up 1 - 22/02/2023

Mr. B returned for his first follow-up visit after receiving initial treatment for OHT secondary to trauma and corneal contusion. Mr. B reported significant relief from discomfort and pain in his LE, along with improved vision. Episodes of blurred vision and light sensitivity had decreased. His VA in the LE improved from 6/18 to 6/9, indicating a positive response to the treatment, particularly in resolving the corneal contusion. Examination revealed reduced eyelid swelling, less conjunctival hyperemia, and clearer central cornea, with no signs of inflammation in the anterior chamber.

The reassessment of IOP showed a reduction from 31 to 25 mmHg in the LE. Gonioscopy confirmed an open angle with no signs of angle recession. Although financial constraints prevented automated perimetry, confrontational visual field testing revealed no defects, suggesting intact peripheral vision.

Based on the improvement, the treatment plan was adjusted by continuing Timolol 0.5%, modifying Prednisolone acetate 1% to twice daily for a week before tapering, and maintaining lubricating eye drops. Ocular hygiene and activity restrictions were emphasized. A follow-up visit was scheduled in two weeks to monitor further IOP reduction and complete corneal recovery.

Follow-Up 2 - 08/03/2023

Two weeks after the previous appointment, Mr. B returned for his second follow-up to assess recovery and monitor the healing.

Mr. B reported significant improvement, noting that discomfort, pain, and blurred vision in his LE had completely resolved. He expressed satisfaction with his recovery and the ability to resume daily activities without any ocular issues. VA in the LE improved to 6/6, matching the RE, indicating successful management of the corneal contusion. The slit-lamp examination showed complete resolution of conjunctival hyperemia, corneal cloudiness, and swelling, with no signs of inflammation.

The IOP in the LE further decreased to 22 mmHg, while the RE remained stable. Gonioscopy revealed no angle recession, confirming that angle recession glaucoma was not a concern. Ocular motility and confrontational visual field tests showed normal, unrestricted movements and intact peripheral vision. Fundoscopy revealed no glaucomatous damage, with a consistent cup/disc ratio of 0.3 in both eyes.

Based on these improvements, the steroid dosage was tapered, and Timolol 0.5% was continued. Mr. B was counseled on ocular hygiene and the importance of protective eyewear to prevent future trauma.

Follow-Up 3 - 15/03/2023

Mr. B attended his third follow-up visit one week after the previous appointment. This visit was important to confirm the stability of his intraocular pressure (IOP) and ensure the complete resolution of OHT secondary to trauma.

Mr. B reported continued improvement with no ocular discomfort or visual disturbances. He expressed satisfaction with his progress, noting excellent visual quality and comfort since the last visit. His VA remained at 6/6 in both eyes and slit-lamp examination revealed no abnormalities. The IOP in the LE decreased to 15 mmHg, returning to normal levels, with the RE maintaining 14 mmHg. The optic nerve and retinal health were stable, with a cup/disc ratio of 0.3, indicating no complications from the OHT.

Given Mr. B's complete recovery and stable IOP, Timolol 0.5% was discontinued, and steroid tapering therapy with Prednisolone acetate 1% was concluded appropriately. Lubricating eye drops were adjusted to "as needed" for comfort. Mr. B was advised to maintain good ocular hygiene and use protective eyewear during risky activities. No further follow-up for OHT was necessary, but annual comprehensive exams were recommended.

This visit marked the successful completion of Mr. B's treatment, ensuring long-term vision preservation and ocular health.

Discussion

The management of OHT secondary to trauma, as demonstrated in Mr. B's case, highlights the need for a comprehensive and multifaceted approach in ophthalmic care. This approach is especially crucial in managing conditions like OHT, which, if not promptly and effectively treated, can progress to secondary glaucoma and result in significant visual impairment [3]. Initiating antihypertensive therapy, specifically with Timolol 0.5%, is pivotal for controlling elevated intraocular pressure (IOP), aligning with existing literature that supports the use of beta-blockers in such clinical scenarios [4].

Incorporating steroid therapy via Prednisolone acetate 1% eye drops targets the inflammation often accompanying ocular trauma, which if left unchecked, could exacerbate IOP elevation [5]. The strategic application of steroids to mitigate inflammation, balanced against the vigilant monitoring for potential steroid-induced OHT, illustrates the nuanced nature of managing OHT secondary to trauma [2].

The use of bandage contact lenses (BCL) emerges as an innovative adjunct in the therapeutic arsenal [6]. BCLs not only serve as a protective barrier facilitating corneal healing but also play a crucial role in pain management and in maintaining a stable ocular surface environment, which is essential for the healing process [7]. While the application of BCLs was not explicitly mentioned in Mr. B's treatment plan, their inclusion could potentially offer significant therapeutic benefits, particularly in managing corneal contusions by preserving tear film integrity and enhancing epithelial recovery [8].

However, the deployment of such advanced treatments and technologies in Ghana faces notable challenges. Financial constraints, limited availability of specialized diagnostic and treatment modalities, and the broader issue of healthcare accessibility can significantly impact the management of ophthalmic conditions [9]. The reliance on foundational diagnostic and therapeutic interventions, such as slit-lamp examination and the judicious use of pharmacological agents, becomes even more crucial in such settings. Moreover, the role of patient education and regular monitoring is amplified in importance, given the potential barriers to accessing care and the necessity of preventing complications that could lead to irreversible vision loss [10].

The case report on Mr. B provides an exemplary model of managing OHT secondary to trauma within the constraints typical of resource-limited settings, like many parts of Africa. It underscores the critical importance of a comprehensive case history and clinical evaluation in formulating a precise diagnosis and crafting a tailored management plan. This case highlights treatment and management strategies that adapt to the patient's specific needs and circumstances, particularly noting the socioeconomic factors that might affect treatment adherence and outcomes.

Key to this case report is the emphasis on patient education and empowerment, demonstrating the optometrist's role in ensuring patients understand their condition, the treatment regimen, and the importance of follow-up care. This aspect is particularly salient in African contexts, where health literacy levels may vary, and emphasizes the necessity of communication in improving healthcare outcomes [11].

Conclusion

This case showcases a holistic method that incorporates a detailed case history, thorough clinical evaluations, precise diagnosis, timely and suitable therapeutic interventions, alongside continuous patient education and regular follow-ups. Mr. B's experience demonstrates the effective management strategy in averting the potential progression of OHT secondary to trauma into secondary glaucoma. It accentuates the paramount importance of prompt detection, early intervention, and comprehensive treatment plans in safeguarding ocular health and maintaining vision after traumatic ocular events.

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Comparing Visual Acuity amongst Preschool Children using HOTV Letter Chart and Broken Ring Chart

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Abstract

Background: Measuring visual acuity is a critical component of optometric examinations, particularly for preschool children. Accurate measurement of visual acuity in this age group is essential, as it helps assess their ability to see clearly. This study aimed to compare the visual acuity of preschool children aged 3 to 5 years using two different charts: the HOTV and Broken Ring charts.

Method: The study was conducted among 153 preschool children between the ages of 3 to 5 years (mean age 4.21 ±0.80 SD), in Ikpoba-Okha Local Government Area, Benin City, Edo State, Nigeria. The visual acuity of the participants was measured using both the HOTV and Broken Ring charts. Data analysis was performed using the Wilcoxon signed-rank test to evaluate statistical difference between variables.

Results: Mean visual acuity measured with the HOTV chart was -0.045 ± 0.202, while the mean visual acuity with the Broken Ring chart was 0.014 ± 0.223. The Wilcoxon Signed-rank test revealed a statistical difference between VA obtained with the two charts ($p<0.00001$). The study also found a statistically significant difference with age (p= 0.0184 and 0.003) for HOTV and Broken Ring charts respectively. However, there was no statistically significant difference between genders (p = 0.749 for HOTV chart and 0.447 for Broken Ring chart).

Conclusion: The findings suggest that preschool children produced more reliable visual acuity results with the HOTV letter chart compared to the Broken Ring chart. Therefore, it is crucial to consider the type of visual acuity chart used when assessing the vision of preschool children to ensure accuracy in measurement.

Key words: Preschool children; Visual acuity; HOTV Chart; Broken rings Charts; Optotype.

Introduction

Visual acuity plays a pivotal role in a child's development, influencing their social interactions, cognitive growth, motor skills, and spatial awareness [1]. Children with uncorrected visual impairments face significant challenges that can affect their academic performance and overall quality of life [2]. Refractive errors, which impact around 448 million children and adolescents, are a leading cause of visual impairment in young children [3]. In the United States, it is estimated that 7% of preschool-aged children remain undiagnosed with refractive errors, largely due to their limited ability to communicate vision problems [4]. Early visual acuity testing is therefore not merely a routine check but a crucial step toward ensuring that children receive timely interventions towards the treatment of visual problems [5].

To accurately assess visual acuity in pre-schoolers, several visual acuity charts have been developed. The Snellen chart, created in 1862, remains widely used, but its reliance on alphabetic letters makes it unsuitable for preliterate children [6]. Alternatives like the Lea Symbols, HOTV chart, and Broken Ring (Landolt C) chart have been introduced to overcome these limitations. The HOTV chart uses familiar letters (H, O, T, and V) that require minimal verbal communication [7], making it suitable for younger children. The Broken Ring chart, on the other hand, relies on a child's ability to identify gaps in circular optotypes, allowing for non-verbal assessment [8].

Both the HOTV and Broken Ring charts have advantages and limitations. The HOTV chart has proven useful in assessing visual acuity in preliterate children, offering accuracy comparable to standard letter charts [9]. However, it may give an advantage to older pre-schoolers familiar with letters [10]. In contrast, the Broken Ring chart, with its reliance on gap recognition, does not require familiarity with letters and is accessible to younger children or those with communication difficulties [11]. A drawback however, is that it may lack the sensitivity to detect subtle variations in visual acuity [12].

Hered et al compared the Lea Symbols and HOTV charts, concluding that both were effective for preschool vision screening, but the Lea Symbols chart had better testability rates, especially for 3-year-olds [13]. Moganeswari et al assessed the reliability, sensitivity, and specificity of various charts, finding HOTV to be the gold standard for visual acuity in preschool children, with Lea chart being a good alternative when HOTV was unavailable [14]. Lai et al compared the Landolt C (broken ring) and Tumbling E charts in preschool children and found that visual acuity improved with age, with the E chart showing superior results in younger children, but by ages 5-6, both charts yielded similar outcomes [15].

The existing literature on visual acuity measurement in preschool children provides extensive knowledge s into various assessment methods and chart types used in clinical practice and research. However, there are notable gaps that require further investigation. One key gap is the lack of studies directly comparing specific optotypes, particularly the HOTV letter chart and the broken ring chart. While many studies have assessed the overall efficacy and reliability of different charts, few have specifically compared the performance of these two charts.

This study aims to address this gap by comparing the effectiveness of the HOTV and broken ring charts in measuring visual acuity among pre-schoolers aged 3 to

5 years. By evaluating their precision, ease of use, and engagement with the children, this research seeks to provide valuable insights for improving early childhood vision screening practices.

Materials and Methods

Study Area

This research was conducted in Ikpoba-Okha Local Government Area, located in Benin City, Edo State, Nigeria. The study population comprised preschool children aged 3 to 5 years residing in this area.

Inclusion Criteria

Participants included preschool children whose parents or guardians provided consent, and children who were willing to participate in the visual acuity assessments.

Exclusion Criteria

1. Participants outside the age range of 3 to 5 years and residing outside Ikpoba-Okha Local Government Area.
2. Participants with any known visual impairments, eye diseases, or conditions that could affect visual acuity.
3. Participants who expressed clear refusal to participate or displayed significant discomfort during the visual acuity assessments.

Research Design

This was a cross-sectional observational study

Study materials

1. HOTV Letter Chart.
2. Broken Ring Chart.
3. Measuring tape to ensure standardized testing distances between the child and the charts.
4. Consent forms and information sheets.

Procedure

The procedure involved several key steps to create an optimal testing environment, facilitate participant understanding, and systematically record visual acuity measurements and observations. First, the testing environment was carefully prepared in a quiet, well-lit room to ensure clear visibility of the optotypes on both the HOTV letter chart and the Broken Ring chart. The setting was free from distractions to help maintain the focus of the preschool children during the assessments. Testing stations were set up within the designated room, with each station equipped with both the HOTV letter chart and the Broken Ring chart. These charts were securely placed at eye level for preschool children, ensuring consistent positioning across all stations. The distance between the child and the charts was accurately measured and maintained according to standardized testing procedures.

Before beginning the visual acuity assessments, a brief explanation of the process was provided to the children to familiarize them with the procedure. This introduction was designed to reduce anxiety, promote cooperation, and create a positive testing atmosphere. To minimize potential bias, the order in which the charts were presented was randomized for each child. The visual acuity assessments began with the child sitting at the predetermined testing distance. For each eye, the smallest identifiable line of optotypes on both the HOTV letter chart and the Broken Ring chart was recorded. Observations were made during the assessment, documenting any hesitation, confusion, or ease in identifying specific letters or symbols.

Throughout the process, the children's engagement and cooperation levels were monitored using an observational checklist. Factors such as focus, signs of frustration or boredom, enthusiasm, or refusal to participate were systematically documented. This assessment helped ensure reliable data collection by evaluating each child's overall testing experience. Visual acuity results were recorded using the logMAR equivalence, ensuring standardized and accurate reporting of visual acuity measurements.

Before the commencement of the study, informed consent was obtained from the parents or guardian of all participants, and ethical approval for this study was granted by the Department of Optometry, Research and Ethics Committee at the University of Benin, with ethical approval number: EC/UBEN/LSC.OPT/24/091.

Statistical Analysis

The data collected was analyzed using SPSS version 22.0. Descriptive statistics, including mean and standard deviation was used to summarize features of the dataset, providing an overview of the central tendency and variability in visual acuity measurements from both the HOTV and Broken Ring charts. Inferential statistics, specifically the paired T-test, was used to compare visual acuity measurements between the two charts. Comparative analyses was also used to explore potential biases or limitations specific to each chart.

Results

Table 1 presents the demographic data of the participants. The study involved 153 participants, consisting of 76 males and 77 females, aged between 3 and 5 years. The mean age was 4.21 ± 0.80 years, with an age range of 2 years (3 to 5 years).

Table 1: Demographics data of the participants

Age	Male (n = 76)	Female (n = 77)	Total (%) (n = 153)
3	17 (22.4%)	19 (24.7%)	36 (23.5%)
4	22 (28.9%)	26 (33.8%)	48 (31.4%)
5	37 (48.7%)	32 (41.5%)	69 (45.1%)
Mean (±SD)	4.23 ± 0.84	4.16 ±0.75	4.21 ±0.80
Range	3 to 5 (2)	3 to 5 (2)	3 to 5 (2)

Figure 1 illustrates the distribution of logMAR visual acuity values obtained with the HOTV chart. The modal VA findings (51) were between -0.18 (6/4) and -0.04 (6/5).

Figure 2 shows the distribution of logMAR visual acuity values obtained with the Broken ring chart. The modal VA findings (58) were between -0.18 (6/4) and 0 (6/6).

Table 2 shows the descriptive statistics of visual acuity (VA) in logMAR for both charts. The mean VA was -0.0045 (equivalent to 6/5) for the HOTV chart and 0.014 (equivalent to 6/6) for the Broken Ring chart.

Table 2: Descriptive Statistics of Visual Acuity using both Charts

Visual Acuity Charts	HOTV Chart	Broken Ring
Mean ±SD (mm)	-0.045 ±0.202	0.014 ±0.223
25th Percentile(mm)	-0.18	-0.18
Median (mm)	-0.08	-0.08
75th Percentile (mm)	0	0
Standard Error of Mean	0.164	0.018
95% confidence (Lower, Upper)	-0.077 to -0.013	-0.021 to 0.0493

Table 3 reports the results of the Shapiro-Wilk normality test, which revealed that the data for all variables followed a non-parametric distribution (i.e., they were not normally distributed).

Table 3: Test of normality using the Shapiro-Wilk-test

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	Variables	Statistics	Sample size (n)	p-value
Charts	HOTV Chart	0.6954	153	<0.001
	Broken Rings Chart	0.7756	153	<0.001
Gender	Females	0.7575	77	<0.001
	Males	0.7273	76	<0.001
Age	3 years	0.7845	36	<0.001
	4 years	0.8005	48	<0.001
	5 years	0.7221	69	<0.001

Table 4 displays the results of the Wilcoxon signed-rank test, used to assess any significant differences in VA between the two charts. A significant difference was found between the two charts ($p < 0.05$).

Table 5 presents the Mann-Whitney U test results, which were used to determine any significant gender differences in VA values. The test showed no significant differences between males and females for both charts ($p > 0.05$).

Table 4: Wilcoxon Signed-rank Test Results

	Wilcoxon Signed-rank Test Results
Test Statistics (Z-value)	5.8648
Number of Pairs (N)	153
Median Difference	0.08
p-value	P < 0.00001
S-value	27.73
Effect size (r)	0.65
Null hypothesis	Rejected

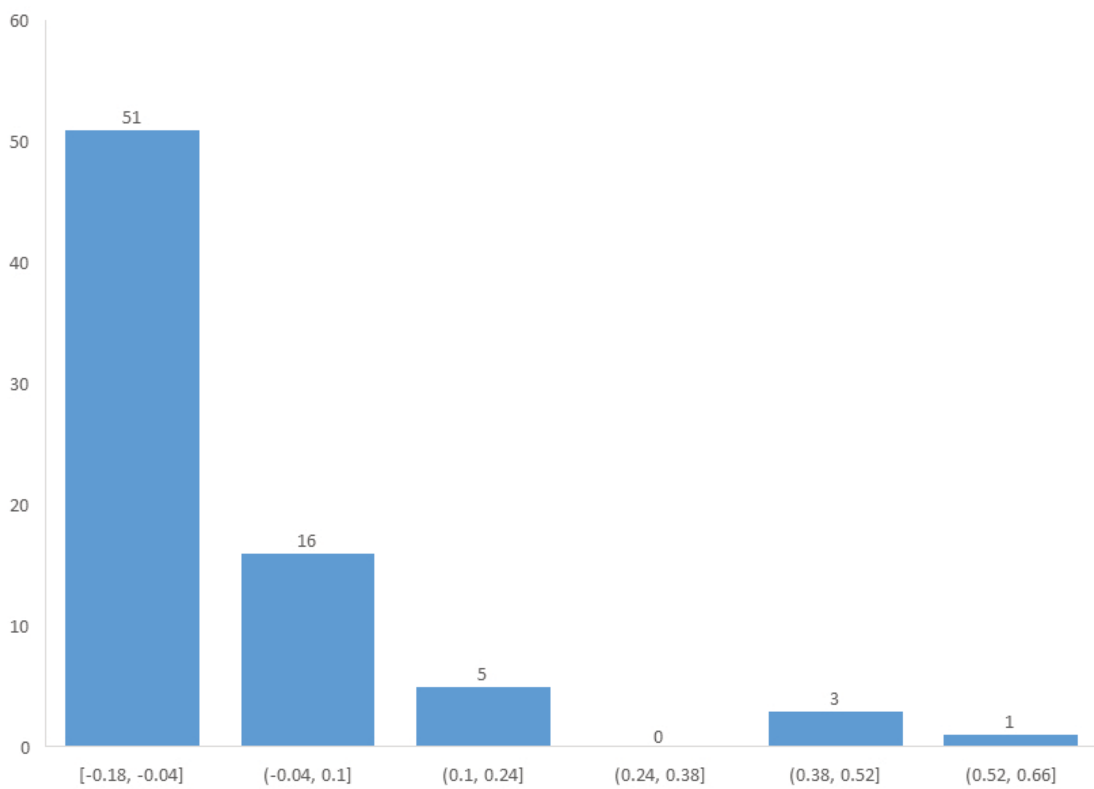

Figure 1: Distribution of VA taken with the HOTV Chart.

Table 6 shows the results of the Kruskal-Wallis test with a post-hoc Dunn test, revealing a significant age difference in VA measurements between the two charts ($p < 0.05$).

Table 5: Mann-Whitney U Test Results

Chart Type	Gender	N	U Statistics	p-value
HOTV Chart	Females	77	2836.5	0.749
	Males	76		
Broken Rings Chart	Females	77	2717	0.447
	Males	76		

Discussion

This study assessed visual acuity measurements using two different charts, the HOTV and Broken Ring charts, to determine if there are statistically significant differences between their effectiveness. Factors such as age and gender were also considered to assess their influence on visual acuity outcomes using the two charts.

The descriptive statistics revealed that the mean visual acuity was slightly better with the HOTV chart (-0.045 ± 0.202) compared to the Broken Ring chart (0.014 ± 0.223). Although the median and percentiles for visual acuity were similar between the two charts, the mean values suggested a potential differences. This finding aligns with the results of Moganeswari et al, which reported better reliability with the HOTV chart for visual acuity measurement in preschool children [14]. However, in contrast to both their results and those of the current study, Hered et al found that while both the Lea symbols and HOTV charts were effective for preschool screening, the Lea Symbols chart had higher testability rates, especially for 3-year-olds [13]. Although previous studies have compared the HOTV chart with other charts, direct comparisons cannot be

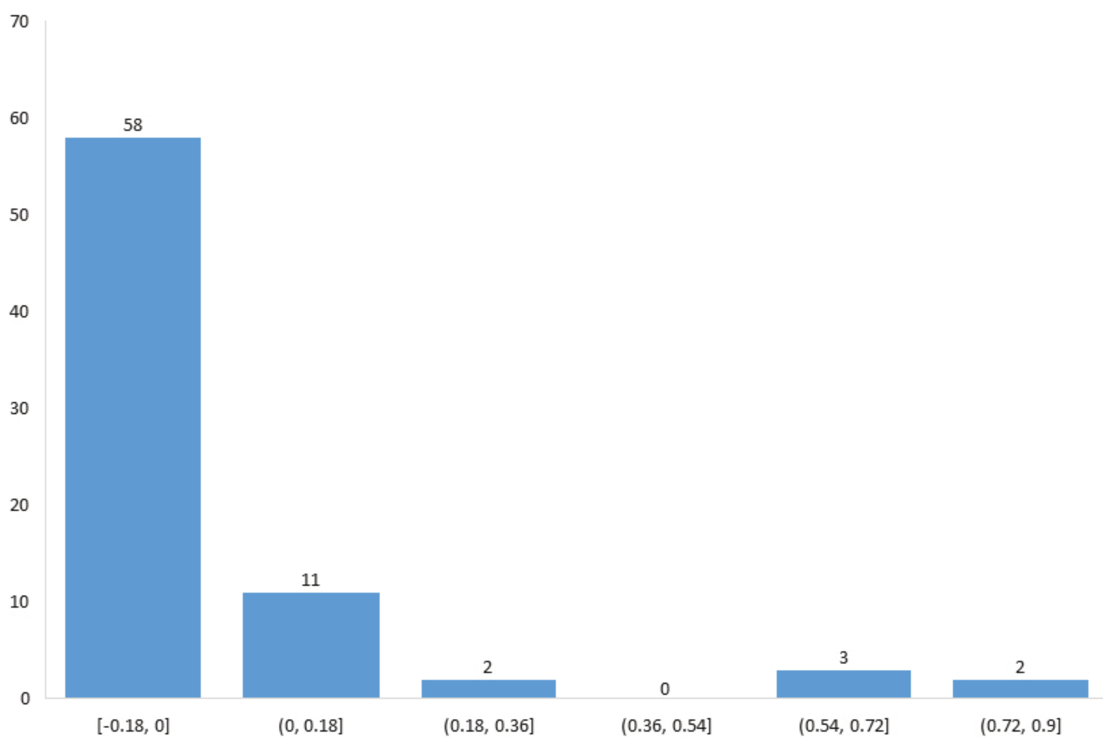

Figure 2: Distribution of VA taken with Broken Rings Chart

Table 6: Kruskal-Wallis Test with the Post-hoc Dunn's Test Result

Chart Type	Age	Rank Score	df	Alpha value	H statistics	Effect Size (η2)	p-value
HOTV	3 years	86.69	2		7.9864	0.04 (Small)	0.0184
	4 years	84.71					
	5 years	66.58					
Broken Ring	3 years	86.08	2	0.017	11.818	0.07	0.003
	4 years	89.13					
	5 years	63.83					

fully drawn with the current study, as we compared the HOTV chart with the broken ring chart, and no prior research has directly examined these two specific charts together.

To determine the most appropriate test to be conducted, test of normality was conducted to determine whether or not the data were normally distributed. This was done for both charts (HOTV and broken rings), for age and for gender. The results of showed a statistically significant deviation from normality across all points ($p < 0.001$), indicating that the data were non-parametric and do not follow the normal distribution. Based on the findings of the normality test, the most suitable statistical test to satisfy the objectives and hypotheses of the study was determined.

The Wilcoxon signed-rank test, used for comparing two paired samples, showed a significant difference in visual acuity measurements between the HOTV and Broken Ring charts ($p < 0.05$). The effect size ($r = 0.65$) further highlighted the practical importance of this difference

To explore gender differences, the Mann-Whitney U test was employed. It revealed no significant differences in visual acuity between males and females for either chart ($p > 0.05$). This is consistent with the findings of Osaiyuwu and Atuanya, which found no significant gender difference, but found a significant difference in both charts and age [16]. This implies that gender may not play a substantial role in determining visual acuity outcomes in preschool children when using these specific charts. To further support this study's findings, the work by Obajolowo et al., found no significant gender difference but found a significant difference in specificity across different age groups [17].

With regard to the influence of age on difference between the two charts, the Kruskal-Wallis test was used. The Kruskal-Wallis test with post-hoc Dunn's test showed significant differences in visual acuity measurements among different age groups ($p < 0.05$). Specifically, both charts demonstrated variations in visual acuity scores across different age groups. This suggests that age is a crucial factor to consider when interpreting visual acuity measurements in preschool children. The observed significant difference due to age is consistent with the findings of Lai et al.[15] which observed an improved visual acuity with age, particularly between ages 3-4 and 5-6 years. Similarly, Sanker found variations in visual acuity results between preschool children aged 3-4 years and 5-6 years [18]. These findings suggest that age-related developmental factors play a crucial role in shaping visual acuity outcomes in preschool children, highlighting the importance of age-specific considerations in visual acuity assessments.

Overall, these findings highlight the importance of careful selection when choosing visual acuity measurement charts for preschool children. The broken ring chart may provide slightly different outcomes compared to the HOTV chart, which could have implications for clinical assessments and interventions. Additionally, age should be taken into account when interpreting visual acuity results in this population.

Conclusion

This study compared visual acuity measurements in preschool children using the HOTV letter chart and the broken ring chart, finding that the HOTV chart produced more reliable results. The study highlighted significant differences between the two charts and emphasizes the importance of selecting the right chart in clinical practice. While no significant gender differences were found, age was identified as an important factor affecting visual acuity, aligning with previous research. We recommend that clinicians should carefully select visual acuity charts based on design, age-appropriateness, and clinical context, as the study suggests both the HOTV letter chart and broken ring chart are effective but may vary in suitability. Establishing age-specific norms for visual acuity is crucial. This will aid in the creation of targeted screening protocols and interventions for preschool children.

Ethics approval and consent to participate:

Ethical approval for this study was obtained from the Research and Ethics Committee of the Department of Optometry, University of Benin, Benin-City, Edo State, Nigeria. All procedures performed in this study was in accordance with the Tenets of the Declaration of Helsinki for human subjects.

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Abbreviations: VA: Visual Acuity

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