Prevalence of Ocular Comorbidity among Students with Hearing Impairment

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Abstract

Objective: To assess the magnitude of ocular comorbidity among hearing impaired students in Hosanna Boarding School for Hearing Impaired.

Methods: A descriptive cross-sectional study was conducted at Hossana Boarding School for Hearing Impaired. The study took place from April 1 to May 3, 2023. Socio-demographic information, ocular complaints, co-morbidity details, and previous ophthalmic service utilization were collected through semi-structured questionnaires with the assistance of a sign language interpreter. A comprehensive ophthalmic examination was conducted. Cycloplegic refraction was performed for visually impaired students under the age of 10 while those 10 and above years of age underwent auto-refraction. Subjective refraction was performed. Data analysis was performed using SPSS software version 26.0.

Results: A total of 218 hearing impaired students were included in the study, 50% being female. Their ages ranged from 7 to 25 years. Ocular comorbidity was observed in 43 (19.7%) students, while visual impairment was found in 22 (10.1%) students. Only 2.3% of the students had prior ophthalmic service utilization. Out of the 13 students with refractive error, only one student wore spectacles, which accounted for spectacle correction coverage of 7.7%. There was no ocular screening conducted before enrollment for any of the students.

Conclusions: prevalence of ocular comorbidity and visual impairment was higher among hearing impaired students. Implementing regular screening programs, raising awareness, improving accessibility to eye care services, and fostering collaboration among relevant stakeholders can contribute to better eye health outcomes for hearing-impaired students.

Key Words: Ocular Comorbidity, Visual Impairment, Hearing Impairment, Refractive Error, Ethiopia

1. Introduction

Hearing impairment is the most common sensory disability worldwide, and it is a growing concern. The World Health Organization estimates that globally there are about 466 million people with disabling hearing loss(DHL), corresponding to a global prevalence of 6.12%, of who children accounts 34 million. It is estimated that by 2050 over 900 (9.6%) million people will have DHL.(1) Sub-Saharan African(SSA) is one of the regions with large number of people with DHL with estimated prevalence of 4.55%, next to South Asia and East Asia, which has prevalence of 4.57% & 6.85%, respectively.(1)

Systematic review and meta-analysis of childhood hearing impairment in SSA found pooled prevalence of childhood hearing impairment was 10%. (2)There is scarcity of data on hearing impairment in children at national level in Ethiopia. Hearing impairment was the most common reported disability in children in eastern rural Ethiopia (1.93%) .(3)

Sensory inputs are critical in children's development of higher functions. Hearing and vision are the most important in this regard because they provide approximately 95% of all collected information, with touch, smell, and taste playing a minor role in comparison.(4)

There is now clear evidence of a close connection between the functions of multiple sensory organs, especially between the eyes and ears. This is typical because between the sixth and seventh weeks of gestation, the cochlea and the retina both develop from the same embryonic layers. (5)

Among prevalent of additional disabilities to hearing impairment, visual impairment was the second most common co-morbidity (4-57%) in hearing-impaired populations, following speech-language impairment(61-88%) .(6) The hearing-impaired population may compensate by using more visual-perceptual cues than their normal hearing peers; thus, even a mild refractive error may reduce the visual cues available to the hearing impaired person.(7)

This descriptive cross-sectional study explores the prevalence and causes of ocular comorbidity among students attending a hearing impaired school in Ethiopia. The researchers collected socio-demographic information, ocular history, and conducted a comprehensive ophthalmic examination on participating students. The study aims to provide valuable data for planning and evaluating preventive and curative services, as well as special education on dual sensory deficit and low vision services for hearing-impaired students.

2. Method

Method & setting: The study was conducted at Hossana Boarding School for Hearing Impaired, which is a full cycle boarding school at Hosanna Town, found 231 kilometer South East to Addis Ababa, Ethiopia. The study involved 218 participants, with the majority being primary (Grade 1 – 8) school students (n=131), followed by secondary (Grade 9-12) school students (n=69) and preschool (Grade 0) students (n=18). All students in the school were included in the study, regardless of the severity of their hearing impairment.

Ethics: The study conducted was approved by the Research and Ethical Committee of the Department of Ophthalmology, School of Medicine, College of Health Science of Addis Ababa University, and the study followed the principles outlined in the Declaration of Helsinki. Additionally, necessary approvals were obtained from local district authorities and boarding school authorities, a legal guardian for the students. Students provided their verbal consent during the examination process.

Study tool: The interviewer and examiner conducted an interview using a semi-structured questionnaire, following a specific format designed for the study. This format included sections for socio-demographic information, ocular history, prior utilization of ophthalmic care, and a comprehensive examination to record findings from unaided visual acuity to funduscopy.

Operational Definitions:

Ocular comorbidity: defined as any ocular abnormalities that might or might not affect the vision.

Visual Impairment: For the purpose of this study, visual impairment was defined as unaided distance or near visual acuity worse than 6/9 in any eye or a difference of two or more lines between both eyes and/or unaided near acuity worse than distance visual acuity.(8)

Mild visual impairment - unaided visual acuity < 6/9–6/18

Moderate visual impairment - unaided visual acuity < 6/18–6/60

Severe visual impairment - unaided visual acuity < 6/60– 3/60

Blindness - unaided visual acuity < 3/60

Refractive error: defined as unaided visual acuity < 6/9 and best corrected visual acuity 6/9 or better. (9) Classified by their subjective refraction in to: -

Myopia is defined as negative 0.5 spherical equivalent diopters or less

Hyperopia is defined as positive 2.0 spherical power diopters or more

Astigmatism is defined as greater than or equal to cylinder +/- 0.75 diopters

Amblyopia: best corrected visual acuity < 6/9 or a difference of 2 visual acuity lines between two eyes in absence of apparent organic pathology.

Spectacle correction coverage: defined as the percentage of students with RE that have spectacle correction at the time of the study.(10)

Procedure: The students communicate with the assistance of their teachers using sign language. Socio-demographic information was collected, as well as their previous ocular history and any examinations or treatments they have had. Additionally, their current ocular complaints were recorded. Visual acuity was measured for both distance and near vision using a tumbling E chart at 6 meters and 40 centimeters, respectively. Color vision was assessed using the Ishihara plate, while pupillary examination was conducted under both lit and dim conditions. Ocular alignment was checked using cover tests at a target distance of 6 meters and 40 centimeters. Anterior segment examination was performed using a magnifying loop and a pen flashlight for illumination. Each student's eyes were dilated with Tropicamide 1% eye drops, and fundus examination was completed using direct ophthalmoscope.

Objective refraction was performed using an auto-refractor for students 10 and above years old, and with wet retinoscopy for students under 10 years old for those having uncorrected visual acuity worse than 6/9. Subsequently, subjective refraction was conducted on the following day.

Students who had treatable eye conditions were prescribed medication, whereas those who required corrections were provided with spectacle prescriptions. Students who required follow-up and additional care were referred to a nearby ophthalmic center for further management.

Data analysis: After the collection of data, each data passed through a thorough review for both completion and accuracy. The validated data was then entered into a database. To conduct statistical analysis, SPSS 26.0 software was utilized. Student's t test was employed to analyze continuous variables, while the Chi-square test was used for categorical variables. Furthermore, logistic regression analysis was utilized to explore the risk factors associated with Visual Impairment (VI).

3. Results

Socio-demographic Characteristics

Two hundred and eighteen students with hearing impairment took part in the study, with an equal distribution of males and females. The age of the students ranged from 7 to 25 years, with an average age of 15.97 +/- 4.08 years.

Ocular Comorbidity

In the study, it was found that out of the total 218 students, 43 students (19.7%) had ocular comorbidity, while only 2 students had multiple comorbidities. The most common ocular comorbidity were refractive error, which was observed in 13 cases (5.96%), followed by amblyopia in 8 cases (3.7%) and non-syndromic heterochromia in 6 cases (2.8%). (Table 1)

Table 1: Prevalence of Ocular Comorbidity among Students with Hearing Impairment at Hosanna Boarding School for Hearing Impaired.

Primary Diagnosis	Frequency	Percentage
Normal	175	80.3%
Refractive Error	13	5.9%
Amblyopia	8	3.7%
Non-syndromic Heterochromia*	6	2.8%
Conjunctival Nevus	4	1.8%
Allergic Conjunctivitis	4	1.8%
Usher Syndrome**	3	1.4%
Red-green Color vision Defect	2	0.9%
Chalazion	1	0.5%
Traumatic Iridodialysis	1	0.5%
Developmental Cataract	1	0.5%
Duane's Retraction Syndrome	1	0.5%
Waardenburg Syndrome***	1	0.5%

*Non-syndromic heterochromia, no other associated findings found to name a syndrome

**One student with Usher syndrome had refractive error

***Student with Waardenburg Syndrome had refractive error

Visual Impairment

Among the total of 218 students, 186 students had 6/6 vision in both eyes, while 10 students had 6/9 vision in one eye and 6/6 vision in the other eye. Visual impairment was found in 10.1% (22) of the students. Majority of the visual impairment was mild (59%), followed by moderate, blindness and severe, 29.3%, 9.1%, and 4.5%, respectively. (Table 2)

Table 2: Prevalence and Severity of Visual Impairment among Students with Hearing Impairment at Hosanna Boarding School for Hearing Impaired.

Visual status	Number of Students	Percentage
Normal vision	196	89.9%
Mild visual impairment	13	5.9%
Moderate visual impairment	6	2.8%
Severe visual impairment	1	0.5%
Blindness	2	0.9%
Total	218	100%

Among causes of visual impairment in our study, 13 (59.1%) students had refractive error, 8(36.4%) students had amblyopia, and 1(4.5%) student had an untreated bilateral developmental cataract. (Table 3)

Among the group of 13 students who had refractive error, the majority (11 students) had a single ocular comorbidity, refractive error. Within this subgroup, 8 students were diagnosed with myopia, 2 students had astigmatism, and 1 student had hypermetropia. In addition, 2 students with syndrome had refractive error - one with astigmatism in Usher syndrome and the other with hypermetropia in Waardenburg syndrome.

Out of the cases of amblyopia, 6 were caused by anisometropia, 1 was caused by strabismus, and 1 was caused by deprivational, treated congenital cataract.

Binary logistic regression analysis was performed to identify risk factors for visual impairment, age, sex and grade had no significant association with visual impairment.

Table 3: Causes of Visual Impairment among Students with Hearing Impairment at Hosanna Boarding School for Hearing Impaired

Cause of impairment	Number students	Percentage
No Impairment	196	89.9%
Refractive Error Myopia Astigmatism Hypermetropia	13 8 3 2	5.9 %
Amblyopia Anisometropic Strabismic Deprivational (Treated Congenital Cataract)	8 6 1 1	3.7%
Cataract Developmental Cataract (Untreated)	1 1	0.5%
Total	218	100%

Prior utilization of ophthalmic service

In our study, we discovered that a small percentage of students had previously sought ophthalmic care services. Out of the 218 students included in the study, only 5 individuals, who accounts for 2.3%, had utilized ophthalmic services in the past. Interestingly, all five of these students had ocular comorbidities. One student had received cataract surgery for congenital cataract, one student had been diagnosed with refractive error and received spectacle correction, and the remaining three students had been diagnosed with allergic conjunctivitis and treated.

The spectacle correction coverage in our study was calculated to be 7.7%. And the main reasons in our study, to have this low coverage was lack of awareness of ocular comorbidity and absence of pre-enrollment comprehensive ocular screening.

4. Discussion

Ocular comorbidity

Our research findings indicate that ocular comorbidities were observed in 19.7% of the students, with a low rate (0.9%) of co-existing ophthalmic comorbidities. In a study conducted in Nigeria(11), a higher prevalence of ocular abnormalities was reported at 56.1%, with 22.4% having co-existing ocular abnormalities. An Indian study(12) found a lower rate of ocular abnormalities, with 15.9% of the participants affected. The highest prevalence of ocular abnormality was reported in a study conducted in Yemen(13), with 61.3% of participants affected. The variation in prevalence between these studies could be attributed to differences in methodology, definitions, populations, and the time period in which the studies were conducted.

In our study, we identified syndromic associated ocular and hearing dual sensory conditions in three students with Usher syndrome (1.4%) and one student with Waardenburg syndrome (0.5%). Similar findings were reported in the Yemen(13), with Usher syndrome being the most common syndrome association followed by Waardenburg syndrome. The Indian study(12) also found Usher syndrome to be the most common syndrome association, with a prevalence rate of 4%. It is worth mentioning that simple non-syndromic heterochromia (2.8%) was a common finding in our study, which was not reported in other studies. Furthermore, optic nerve, macular, and corneal disorders were not found in our study. These findings highlight the potential disabling nature of these ocular conditions for enrollment in special schools for the hearing impaired.

In terms of preventability and treatability, 60.5% of ocular comorbidities in our study were found to be preventable or treatable. This finding is comparable to the Indian study(12), which reported that 55% of ocular abnormalities were either preventable or treatable

Prevalence of Visual Impairment

The prevalence of ocular comorbidities among normal hearing students in various studies conducted in Ethiopia differs from the prevalence rates reported in this study, which are specific to hearing-impaired students. It is important to note that the prevalence of visual impairment among hearing-impaired students in this study (10.1%) was higher compared to studies conducted on normal hearing school students. Previous school-based studies in Gondar(14), Gurage zone(15), Addis Ababa(16), and Sekela woreda(17) reported prevalence rates ranging from 1.8% to 8%. However, the prevalence of visual impairment in this study is comparable to the study done in Assossa zone(18), which reported a prevalence of 10.4%. It is

essential to consider that the cutoff points used for defining visual impairment varied among the studies. While some studies(14), (15) used the World Health Organization's cutoff point of less than 6/12, including this study, the rest of the studies used less than 6/9 as the cutoff point per the Refractive Error Study in Children (RESC) protocol(9). Despite this variation, the findings underscore the higher prevalence of visual impairment among hearing-impaired students and the need for attention to this issue.

As this study is the first of its kind, it was not possible to directly compare it to previous studies conducted in Ethiopia. However, various studies conducted in schools for hearing-impaired students globally have reported different prevalence rates of visual impairment. For instance, in Ghana, Kwarteng et al. reported a lower prevalence of visual impairment at 6%(19), and Ovenseri-Ogbomo et al. found it to be 7.3%(20). Perehe et al. in India(12) and Salem et al. in Yemen(13) both reported a prevalence of 7.2% and 7.3%, respectively. On the other hand, higher prevalence rates were documented in Nigeria, with Abikoye et al. reporting 19% (21)and Majekodunmi et al. reporting 34.6%(11) . It is worth noting that there were variations in the cutoff points used for defining visual impairment among these studies, with some using the World Health Organization's cutoff point of less than 6/12, while other(21), like our study, used less than 6/9 as the cutoff point.

Causes of visual impairment

The main contributing factors to visual impairment in our study were uncorrected refractive errors (59.1%), amblyopia (36.4%), and untreated bilateral developmental cataracts (4.5%). These findings align with similar studies conducted in Nigeria (11) (21), Ghana(20), Yemen(13), and India(12), where uncorrected refractive errors were also identified as the leading cause of visual impairment ranged from 47.4 % to 61.1%. Amblyopia was found to be the second main cause of visual impairment in our study, which is consistent with the results of a Nigerian study(21). However, a study conducted in India identified retinitis pigmentosa as the second main cause of visual impairment(12). Amblyopia also reported second causes of visual impairment in normal hearing students in Ethiopia(15), (16) while corneal opacities second causes of visual impairment in study done in Amhara region where trachoma prevalence is high(17).

In terms of refractive errors, myopia (61.5%) was the most common in our study, followed by astigmatism (23.1%) and hyperopia (15.3%). It is important to note that different studies have reported varying patterns of refractive errors, with no uniform trend. Similar findings have been reported in other studies, where myopia was also found to be the most prevalent refractive error. However, some studies have reported different patterns, with hyperopia being the most common(11) or astigmatism being more prevalent(20,21). Myopia has also been reported as the

most prevalent refractive error in studies conducted among normal hearing students in Ethiopia(14) (15) (16).

The severity of visual impairment in our study was predominantly mild, followed by moderate, blindness, and severe. These findings are similar to those reported in a study conducted in Nigeria by Abikoye et al(21). It is worth noting that all causes of visual impairment in our study were treatable, which is higher than the reported treatable cases in an Indian study(12).

Prior ophthalmic care service utilization

In our study, we found that a small number of students had sought ophthalmic care services in the past. Out of the 218 students included, only 5 individuals (2.3% of the sample) had utilized such services. The spectacle correction coverage in our study was 7.7%. These rates are lower than those reported in a similar study conducted in Nigeria(11), where the prior ophthalmic evaluation rate was 8% and the spectacle correction coverage was 11%. Majekodunmi et al. reported a much higher ophthalmic service utilization rate of 43.9%(22), which may be due to the living conditions of the students in their study, who live with their parents unlike the students in our study, who attend boarding school for 11 months of the year. The low rates of ophthalmic service utilization and spectacle correction in our study attributed to a lack of awareness, absence of pre-enrollment comprehensive ocular screening, and limited involvement of stakeholders, both governmental and non-governmental.

We found none of our participants had ophthalmic screening before joining the school, similar reported studies in India(12) and in Nigeria (11).

Strength of the study

The strength of this study lies in its unique contribution to the field as the first of its kind to assess the prevalence and causes of ocular comorbidities among hearing-impaired students in Ethiopia. The researchers conducted a comprehensive examination of all students included in the study, ensuring that all ocular comorbidities were identified and addressed.

Limitation of the study

One limitation of the study is its small sample size, as it only included 218 students from a single boarding school for hearing-impaired students in Ethiopia. It is important to acknowledge that this study cannot be considered a comprehensive representation of ocular comorbidities and visual impairment among all hearing-impaired children in the community. This is particularly true for those who were unable to attend a hearing-impaired school or those with severe dual sensory deficits, which may have led them to remain at home. Moreover, the study did not examine the severity and causes of hearing impairment, which could potentially impact the

prevalence and causes of ocular comorbidities. Therefore, caution should be exercised when generalizing the findings of this study to the broader population of hearing-impaired students.

Conclusion

In conclusion, this study highlighted the high prevalence of ocular comorbidity and visual impairment among students attending a school for hearing impaired. The findings emphasize the need for increased attention and interventions to address these issues. Implementing regular screening programs, raising awareness, improving accessibility to eye care services, and fostering collaboration among relevant stakeholders can contribute to better eye health outcomes for hearing-impaired students.

Further research is needed to explore at community level, in preschool hearing impaired children, who might left home due to disabling visual impairment and a critical period for early detection and interventions.

Authors Contribution

All the authors contributed in the conception and design, acquisition, analysis, and interpretation of data.

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Declaration of competing interest

None

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Information Sheet for Students

(With Sign Language Interpreter)

Dear Student,

We are conducting a study to assess the prevalence of ocular comorbidities among students with hearing impairment at Hosanna Boarding School for Hearing Impaired. We would like to provide you with some important information regarding the study.

Study Purpose: The purpose of this study is to understand the occurrence of eye-related conditions among students with hearing impairment and to determine the level of access to eye care services. By conducting this study, we hope to improve eye health outcomes for students like you.

Study Procedures: If you choose to participate in this study, you will be asked to undergo a comprehensive eye examination. This examination will include various tests to assess your vision, eye health, and any existing eye conditions. These tests may involve measuring your visual acuity, conducting a color vision test, and examining the structure of your eyes using special instruments. The examination will be conducted by trained healthcare professionals.

Confidentiality: We want to assure you that all information collected during the study will be kept strictly confidential. Your personal information will be coded and stored securely to protect your privacy.

Voluntary Participation: Participation in this study is entirely voluntary. You have the right to refuse to participate or withdraw from the study at any time without facing any consequences or negative impact on your education or relationship with the school.

Benefits and Risks: While there may not be any immediate direct benefits to you, your participation will contribute to improving eye health services for students with hearing impairment. The risks associated with participating in this study are minimal and include temporary discomfort during the eye examination procedures.

Consent: Your participation in the study requires your verbal consent. By undergoing the eye examination, it will be assumed that you have provided your consent to participate in the study.

Contact Information: If you have any questions or concerns regarding the study, you can contact the research team at the following contact details: Muluken Goshime, phone number +251 920934161, email muluken.goshime@aau.edu.et or mulukengoshime82@gmail.com

Thank you for considering participation in this study. Your involvement is essential in helping us understand and improve eye health outcomes for students with hearing impairment

Data Collection Sheet

Code No.___

PART I: Socio-demographic and History

1. Socio-demographic: **Age** (in years) _____ **Sex** – I. F II. M **Grade**_____
2. Ocular History : Current visual complaint/s _____

   Past ocular illness: I. Traumatic II. Non-traumatic (specific) III. None

   Prior ophthalmic visit and/or treatment A. No B. Yes,

   If Yes, Medical… Eyeglass Prescription… Surgical…
3. Systemic comorbidity: _____

PART II: Ocular Examination

1. VA Distance- UCVA : OD: ___ OS: ____ BCVA: OD: ____ OS: ____

   Near
2. Cover Test: I. Orthophoria II. Non-Orthophoria(Specific)_____
3. IOP(I-care): OD_____ OS_____
4. Pupillary Exam- OD_____ OS_____
5. Ishihara test- OD_____ OS_____
6. External Eye Exam Findings: _____
7. Anterior Segment Findings: _____
8. Posterior Segment (Direct Ophthalmoscope) _____
9. Primary diagnosis/s: _____

Part III: Ophthalmic Service Utilization

1. Pre-enrollment school visual screening: I. Yes II. No
2. Use of spectacle correction of students with RE I. Yes II. No, If No reason _____