

Profile of Amblyopia Among Children Aged from 5 to 15 Years at Hawassa University Comprehensive Specialized Hospital Pediatric Eye Clinic, South Ethiopia, 2020/21

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Purpose: Functional visual impairment in children is mostly caused by amblyopia. Permanent visual impairment is caused by belated treatment of amblyopia and underlying causes, mostly due to the lack of awareness. Amblyopia affects children's school performance, social interaction and motor skills. This study was aimed to assess the profile of amblyopia among children aged from 5 to 15 years.

Methods and Materials: A hospital-based, cross-sectional study was done from November to April 2020/21. Data were collected from all children who came to Hawassa university comprehensive specialized hospital pediatric eye out patient department in the data collection period. Visual acuity measurement, slit lamp examination, cycloplegic refraction, cover test and dilated fundus examination were conducted. Data was entered in Epi-info version 7 and analyzed by Statistical Package for Social Science version 20. Descriptive statistics were conducted to estimate the proportion of amblyopia and its causes.

Results: The proportion of amblyopia was 23.8% (18.3–29.7). Most of the participants were within the age range of 5–9 years (55.4%) and males (51.5%). Anisometropia was the commonest cause of amblyopia (31.25%), followed by meridional (20.83), mixed (16.67%), isometropia (12.50%), sensory deprivation (10.42%) and strabismus (8.33%).

Conclusion: The proportion of amblyopia was 23.8%. Anisometropia, meridional, sensory deprivation, isometropia, mixed type and strabismus were the identified causes of amblyopia.

Keywords: amblyopia, anisometropia, children

Introduction

During the first decade of life, there is continuous vision development due to changes in the visual system.¹ Amblyopia is a snellen visual acuity (VA) difference of greater than or equal to two lines between the two eyes, or it is a reduction in VA below 6/9 in either eye after the best possible correction.^{2,3} It occurs when there is a deficient stimulus to the eye during the first decade of life.^{1–3}

When there are different images in the two eyes, one eye with better VA is preferred but the other eye is suppressed.^{4–7} Amblyopia causes unilateral or bilateral visual impairment, which can be due to sensory deprivation or faulty binocular vision interaction. Visual impairment due to amblyopia persists even after the best possible corrections.⁸

The causes of amblyopia can be abnormal binocular vision interaction and/or any conditions that can disrupt the formation of a clear image during the critical period of vision development.⁹ More than fifty percent of children having anisometropia and/or strabismus in their critical vision development period develop amblyopia.¹⁰ The degree of visual impairment due to amblyopia depends on the age of onset and the type/severity of amylogenic factors. Based on the degree, amblyopia can be classified as mild (best corrected visual acuity (BCVA) 6/9–6/12), moderate (BCVA 6/12–6/30), and severe (BCVA 6/30–3/60).¹¹

If amblyopia is not identified and treated in the critical period of vision development, it will cause permanent visual reduction and, finally, it will affect children's school achievement and social life.¹² In later life, if there is eye trauma on the better eye, amblyopia can also cause total blindness.¹³

The clinical features of amblyopia comprise reduced VA, easily affected by crowding effects,^{14,15} poor spatial distortions,¹⁶ unsteady and inaccurate monocular fixation,¹⁷ poor eye tracking ability,¹⁸ reduced contrast sensitivity,¹⁹ inaccurate accommodative response and poor binocularity.^{20,21} Amblyopia only develops in children up to the age of 8 years and if it is left untreated, it can persist throughout life.²² In the age group of 20–70+years, amblyopia is the leading cause of unilateral visual impairment exceeding cataract, diabetic retinopathy, glaucoma and macular degeneration.²³

Early detection and treatment of amblyopia is the key for the prevention of visual impairment caused by it. However, there were no amblyopia studies done in South Ethiopia. This study was conducted to estimate the proportion of amblyopia and its causes in the hospital. The finding will help policy makers to design early prevention mechanisms and will also stimulate them to conduct community-based studies.

Methods and Materials

A cross-sectional hospital-based study was conducted from November to April, 2020/21. The study was conducted at Hawassa university comprehensive specialized hospital (HUCSH), south Ethiopia. This hospital is the biggest and the only tertiary eye care hospital in the region, and it serves around 16 million people from Southern nations and nationalities, people's regional state (SNNPRS), Sidama regional state and the neighboring Oromia region. It is located at 275kms south of Addis Ababa, the capital city of Ethiopia. In the hospital, there is one pediatric eye out patient department (OPD). Most pediatric patients presented at the hospital pediatric eye OPD were children seeking eye examination secondary to different ocular disorders, referred from primary and secondary eye care units for further ocular evaluations and/or parents/teachers notice child's poor visual performance. All children aged 5 to 15 years presented at HUCSH pediatric eye OPD were a source population. Children with visually significant fundus disorders and/or with penetrating eye injury involving the visual axis were excluded from the study.

We made the following assumptions to calculate the sample size:- Level of confidence taken to be 95%, margin of error (d) 5%, according to the study done at ophthalmology clinic of Menilik II Hospital, the prevalence was 9.1%, $p = 0.091$.²⁴ Based on the above assumption, the sample size was calculated as follows:

$$n = \frac{(z\alpha/2)^2 p(1-p)}{d^2}$$

Where n = sample size calculated

Z = level of significance

d = margin of error

$$n = (1.96)^2 * (0.09 * 0.91) / (0.05)^2$$

$$n = 125.85 \approx 126$$

By taking the non-respondent rate of 10% = 12.6, our sample size was $n = 138.6 \sim 139$. But the sample size was small; therefore, we prefer to take all children who fulfilled the inclusion criteria in the study period and that was $n = 205$.

Operational Definitions

Pediatric

Age group of population ≤ 15 years.

Amblyopia

Best corrected visual acuity of poorer than 6/9 in either one or both eyes in the absence of any pathological ocular disorders.

Refractive Error

Child having $\geq +1.50$ DS hyperopia, ≥ -0.75 DS myopia and/or $\geq \pm 1.50$ DC astigmatism in either one or both eyes.

Degree of Refractive Error

- Mild hyperopia defined as $\leq +2.00$ DS, Moderate hyperopia defined as $+2.25$ DS- $+5.00$ DS, High hyperopia defined as $> +5.00$ DS.²⁵
- Mild myopia defined as ≤ -3.00 DS, Moderate myopia defined as -3.25 DS- $(-6.00$ DS), High myopia defined as > -6.00 DS.²⁶

Strabismic amblyopia

Amblyopia in the presence of manifest ocular misalignment but in the absence of refractive error.²⁷

Anisometropic Amblyopia

Amblyopia occurs when there is uncorrected refractive error in which the difference between the corresponding major meridians is greater than -3.00 DS myopia, greater than or equal to $+1.00$ DS hyperopia and greater than ± 1.50 astigmatism.²⁷

Isometropic Amblyopia

High refractive error in both eyes, for myopic greater than -6.00 DS, for hyperopic greater than $+5.00$ DS and for astigmatism greater than ± 2.50 DC.²⁷

Sensory Deprivation Amblyopia

Amblyopia occurs when there is known ocular diagnosis like ptosis, cataract, or corneal opacity.²⁷

Meridional (Astigmatism) Amblyopia

Amblyopia occurs when there is a regular astigmatism of >1.5 DC on any meridian.²⁴

Mixed Amblyopia

Amblyopia caused by both strabismus and refractive error.

Data Collection Procedure

During the study period, data collectors examined all children who came to pediatric eye OPD. Written consent from parents was obtained. Demographic data and detailed patient history were collected from the parents by using structured questions on the initial patient presentation.

A full ocular assessment was conducted, including VA measurement, ocular alignment, assessment of anterior segment and posterior segment disorders. The assessment of refractive error was conducted by cycloplegic refraction using cyclopentolate 1% eye drops.

Finally, BCVA was obtained using an appropriate snellen VA chart for a child's age. When his/her BCVA fulfills the amblyopia definition, then the diagnosis was recorded as amblyopia. The BCVA for deprivational amblyopia was taken after one month of eye surgery.

Data Collection Tools

Questionnaires

The parents and children were interviewed using a structured questionnaire to obtain information on children's demographic data.

Clinical Tools

Snellen visual acuity chart, trial lens and frame, retinoscopy, slit lamp bio-microscope, direct ophthalmoscope and 90D lens, cyclopentolate 1% eye drops, prism bar and cover test occluder were used.

Data Quality Assurance

Training was given to the data collectors/optometrists. Data was collected after checking for consistency and completeness of questionnaires and clinical examinations on a daily basis.

Data Management and Analysis

Data cleaning and coding was first performed; then, data was entered in Epi-info version 7 and analyzed by SPSS version 20. Descriptive statistics were computed for all variables.

Ethical Considerations

Before the commencement of the study, ethical clearance was obtained from Hawassa University College of Medicine and Health sciences institutional review board with Ref.No.IRB/032/13 in accordance with the declaration of Helsinki.²⁸

A written consent from parents/guardian was taken. The purpose and procedure of the examination were explained to the children and their parents.

Table 1 Socio-Demographic Characteristics of Children Aged from 5 to 15 Years at HUCSH Pediatric Eye OPD, South Ethiopia from November to April, 2020/21 (n = 202)

| Variable | Category | Frequency | Percent |
|--------------|----------|-----------|---------|
| Age in years | 5–9 | 112 | 55.4 |
| | 10–15 | 90 | 44.6 |
| Sex | Male | 104 | 51.5 |
| | Female | 98 | 48.5 |

Table 2 Cross-Tabulation of Amblyopia with Different Variables Among Children Aged from 5 to 15 Years at HUCSH Pediatric Eye OPD, South Ethiopia from November to April, 2020/21 (n = 202)

| Variables | Category | | Amblyopia | |
|------------------|----------|-----|-----------|----------|
| | | n | Yes | Prev.(%) |
| Age | 5–9 | 112 | 31 | 27.67 |
| | 10–15 | 90 | 17 | 18.88 |
| Sex | Male | 104 | 24 | 23.07 |
| | Female | 98 | 24 | 24.49 |
| Refractive Error | Yes | 99 | 41 | 41.41 |
| | No | 103 | 7 | 6.79 |
| Anisometropia | Yes | 33 | 25 | 75.75 |
| | No | 169 | 23 | 13.61 |
| Strabismus | Yes | 23 | 13 | 56.52 |
| | No | 179 | 35 | 19.55 |
| Media Opacity | Yes | 16 | 6 | 37.50 |
| | No | 186 | 42 | 22.58 |

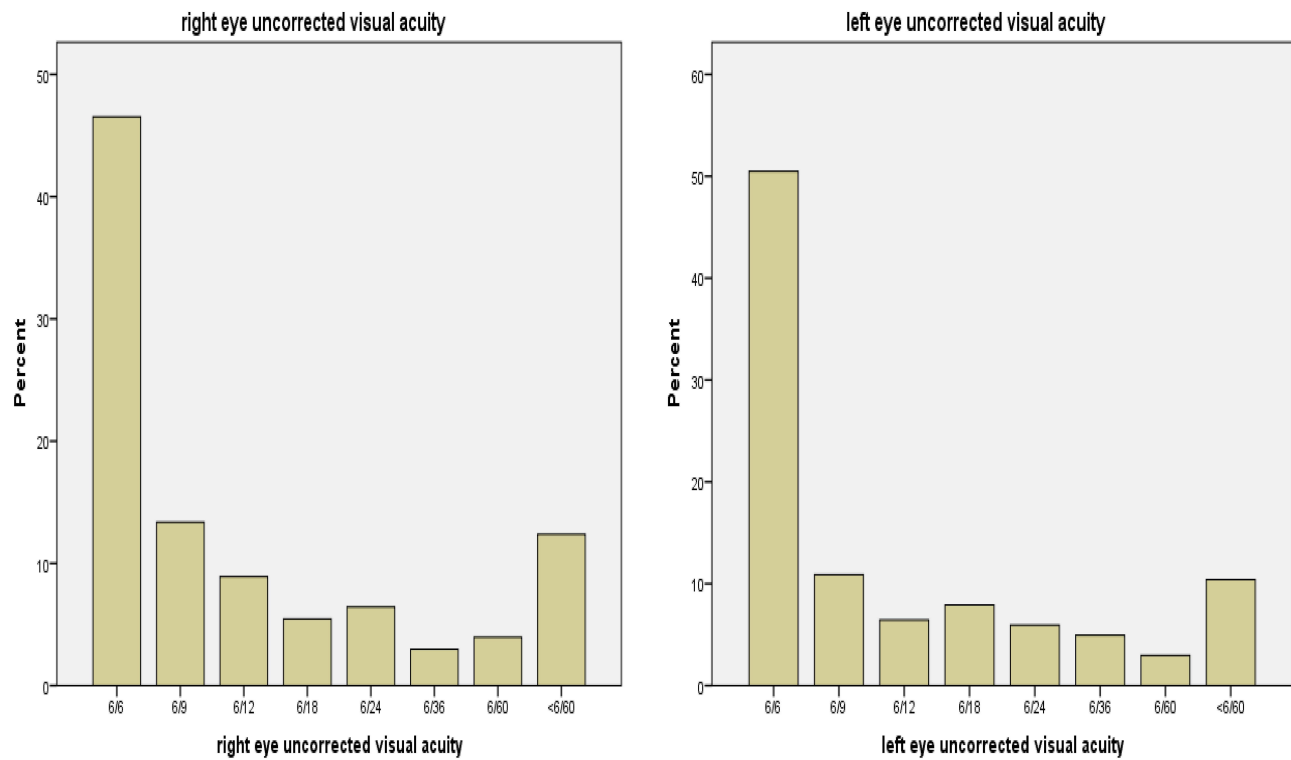


Figure 1 Unaided visual acuity of children aged from 5 to 15 years at HUCSH pediatric eye OPD, south Ethiopia from November to April, 2020/21 (n = 202).

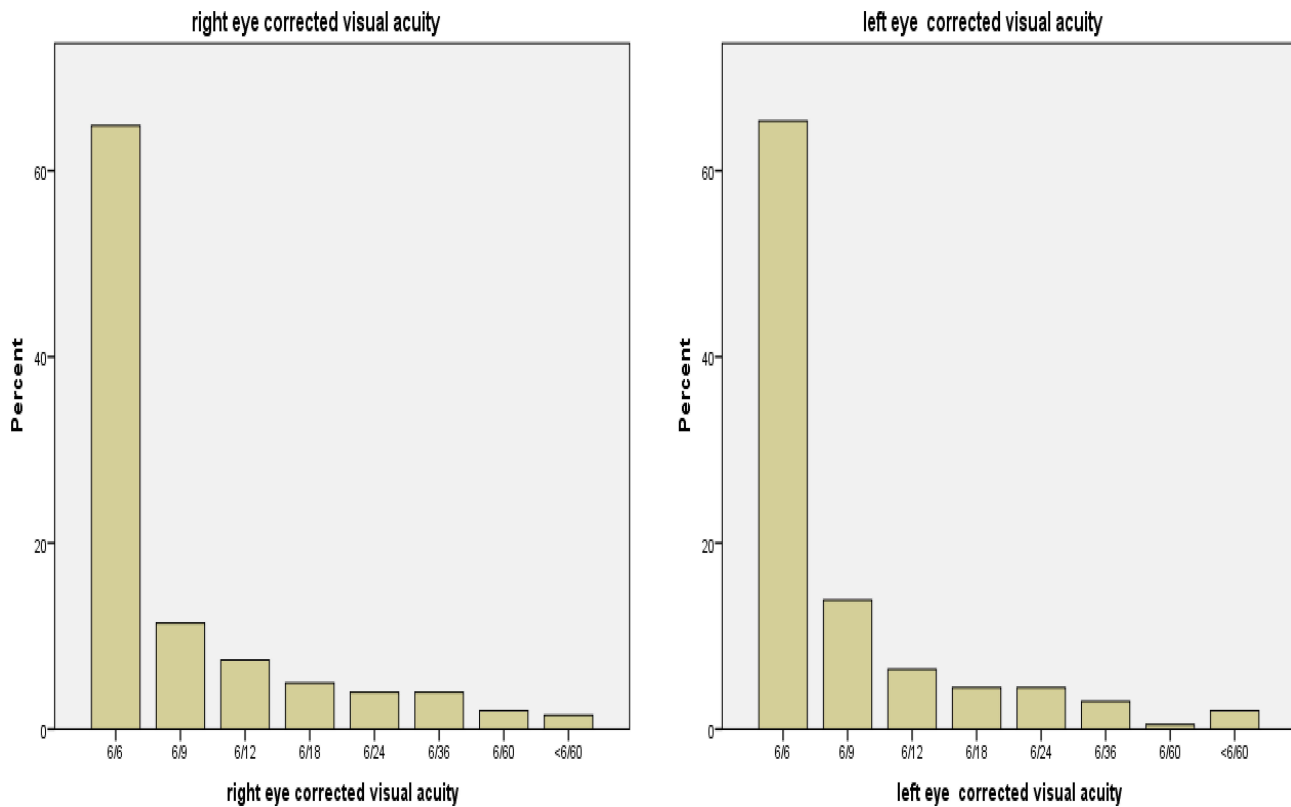


Figure 2 Best corrected visual acuity of children aged from 5 to 15 years at HUCSH pediatric eye OPD, south Ethiopia from November to April, 2020/21 (n = 202).

Results

Socio-Demographic Characteristics of Participants

A total of 202 children participated in the study. The response rate was 98.5%. Most of the participants were males (51.5%) and with an age range of 5–9 years (55.4%) (Table 1).

Proportion and Clinical Characteristics of Amblyopia

Proportion of amblyopia was 23.8% (18.3–29.7). The proportion of amblyopia was high for age group of 5–9 years (27.67%), for those having; anisometropia (75.75%), strabismus (56.52%), refractive error (41.41%) and media opacity (37.50%) (Table 2).

Most children have unaided visual acuity of 6/6 in the right eye (46.50%) and left eye (50.50%), respectively (Figure 1).

Most children have BCVA of 6/6 in the right eye (64.90%) and left eye (65.3%) (Figure 2).

The proportion of amblyopia was high for children having hyperopia and constant strabismus for both right and left eyes (Table 3).

Causes of Amblyopia

The most common and the least common causes of amblyopia were anisometropia and strabismus respectively (Figure 3).

Table 3 The Proportion of Amblyopia with Refractive Error and/or Strabismus for Children Aged from 5 to 15 Years at HUCSH Pediatric Eye OPD, South Ethiopia from November to April, 2020/21 (n = 202)

| Variables | Category | | Amblyopia | |
|---------------------------------|--------------------|----|-----------|-----------|
| | | n | Yes | Prev. (%) |
| Right eye refractive error type | Mild hyperopia | 35 | 8 | 22.85 |
| | Moderate hyperopia | 15 | 11 | 73.33 |
| | High hyperopia | 11 | 8 | 72.72 |
| | Mild myopia | 7 | 0 | 0 |
| | Moderate myopia | 3 | 0 | 0 |
| | High myopia | 8 | 3 | 37.50 |
| | Astigmatism | 18 | 10 | 55.55 |
| Left eye refractive error type | Mild hyperopia | 33 | 9 | 27.27 |
| | Moderate hyperopia | 17 | 9 | 52.94 |
| | High hyperopia | 9 | 6 | 66.67 |
| | Mild myopia | 10 | 1 | 10 |
| | Moderate myopia | 2 | 0 | 0 |
| | High myopia | 8 | 3 | 37.50 |
| | Astigmatism | 13 | 7 | 53.84 |
| Strabismus type | Constant | 12 | 10 | 83.33 |
| | Intermittent | 2 | 0 | 0 |
| | Alternative | 9 | 3 | 33.33 |

Causes of amblyopia

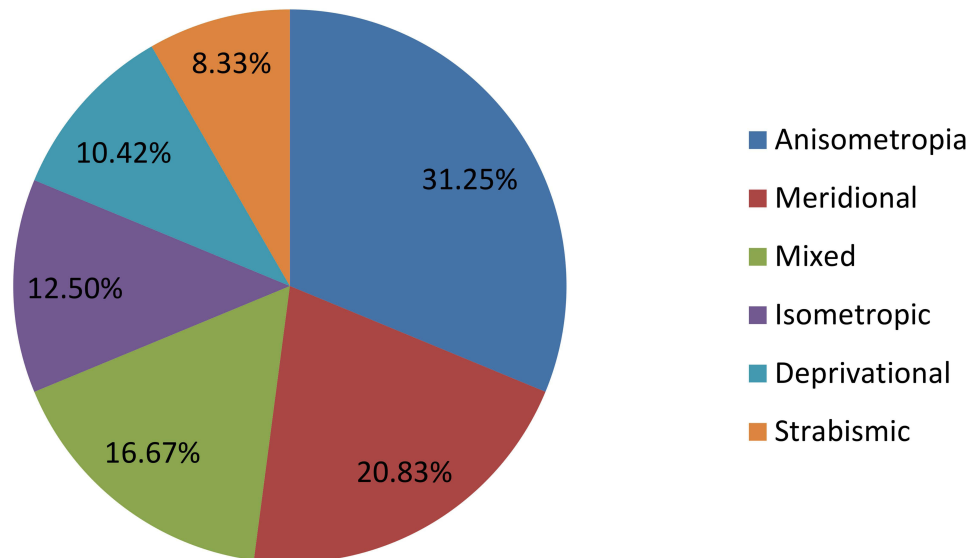


Figure 3 Causes of amblyopia for children aged from 5 to 15 years at HUCSH pediatric eye OPD, south Ethiopia from November to April, 2020/21 (n = 202).

Discussions

In this study, the proportion of amblyopia was 23.8% (18.3–29.7). This finding is larger than study finding in India,^{29,30} Canada,³¹ Nepal,^{32,33} Saudi Arabia,³⁴ and Ethiopia.²⁴ This discrepancy might be due to differences in source population and study design. Many pediatric patients referred to our study area from primary and secondary eye care units for further ocular evaluations. Strabismic patients and those who need cycloplegic refraction were among the referral cases. This shows, in this study, the study population were more exposed to amylogenic factors relative to the above studies. This would have increase the proportion of amblyopia. Difference in timing of refractive amblyopia diagnosis and amblyopia definition cut-off point can be also other reasons for discrepancy.

In this study, most of the children had anisometropic amblyopia 15 (31.25%) followed by meridional 10 (20.83%), mixed 8 (16.67%), isometropic 6 (12.5%), deprivational 5 (10.42%) and strabismic 4 (8.33%). Anisometropic amblyopia was the largest in studies conducted in India,²⁹ Nepal,³² Saudi Arabia,³³ and Ethiopia.²⁴ A higher proportion of amblyopic patients have refractive error. It is supported by many other studies, showing uncorrected refractive error as one of the major causes of visual impairment.^{35,36} Anisometropia causes amblyopia due to the retina of the more ametropic eye failing to get a clear image and stimuli for accommodative effort. Whereas, the image formed on the retina of the good eye is focused, clear and sharp.³⁷ On the contrary, in studies done in India³⁸ and Pakistan,³⁹ most of the children had strabismic amblyopia. This discrepancy is most likely due to differences in the source population. The above studies included all children who visited the hospital, but in this study we only included school-aged children (5–15 years).

According to this study, compared to children with no strabismus, the proportion of amblyopia was high for children with strabismus. When there is ocular misalignment in one eye of the child, he/she complains about double vision. But, this will not persist for a longer duration due to the brain's capability mechanism to avoid diplopia by suppressing the cells in the visual pathway of the misaligned eye. This adaptive mechanism decreases the sensitivity of cortical cells in the visual system, which will finally cause amblyopia.³⁷

The proportion of amblyopia was also high for children with media opacity. Appropriate vision development needs enough light stimulus. However, when there is deprivation in the critical period of vision development, light stimuli will not be reached the retina. This will affect the normal visual process and lead to amblyopia.³⁷

Limitation of the Study

In this study, the refractive correction adaptation period was not considered for refractive amblyopia diagnosis and this may cause slight over estimation of amblyopia.

Conclusion

The proportion of amblyopia was 23.8%. Anisometropia, meridional, sensory deprivation, isometropia, mixed type and strabismus were the identified causes of amblyopia.

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Disclosure

The authors report no conflicts of interest in relation to this work.

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