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RESEARCH ARTICLE

THE MAGNITUDE AND CAUSES OF AMBLYOPIA IN CHILDREN ATTENDING A PAEDIATRIC TERTIARY EYE CLINIC IN DAR ES SALAAM TANZANIA

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ABSTRACT

Objective: To determine the magnitude of amblyopia among children attending the pediatric eye clinic at Muhimbili National Hospital. **Materials and Methods:** consecutive sampling of children fulfilling the case definition of amblyopia was done to recruit 140 children. Anterior and posterior segment examination, cycloplegic refraction and ocular alignment were done to determine the causes of amblyopia. Data was transferred into a computer program and analyzed with the help of the Statistical Package for Social Sciences version 20.0 software. Frequencies, means and standard deviations were used to summarize data. A P-value of <0.05 was considered statistically significant for associations. Ethical approval was granted by the Ethics committee of Muhimbili University of Health and Allied Sciences. **Results:** A total of 1953 children attended the paediatric clinic during the study period. There were 140/1953 (7.18%) children with amblyopia, where 78 (55.7%) were males and 62 (44.3%) were females. The mean age was 6.4(5.6-7.2) years. Sixty nine (49.3%) children presented early in the age group of ≤ 5 years. Refractive amblyopia was the most common type which affected 59/140 (42.2%) patients. Severe amblyopia was found in all types of amblyopia. However sensory deprivation was the leading cause of severe depth of amblyopia (78%). Esotropia was the commonest cause of strabismic amblyopia that occurred in 29/37 (78.4%) while Anisohyperopia was found in 15/59 (25.4%) patients and was the commonest cause of refractive amblyopia. Cataract was the main cause of sensory deprivation amblyopia which was found in 12/15 (80%) patients. Combined Strabismic and Refractive 18/29(65.5%) was the commonest cause of combined amblyopia. **Conclusions:** The magnitude of amblyopia in children attending the paediatric ophthalmology clinic at MNH is high where majority of affected patients present with severe depth of amblyopia. Refractive amblyopia was the most common type of amblyopia. Esotropia, cataract, anisohyperopia and combined strabismic and refractive were the commonest causes of amblyopia. Pre-school screening of children to enable early recognition and referral for appropriate management of children with refractive errors and cataract need be established to reduce the magnitude and severity of amblyopia.

INTRODUCTION

Amblyopia is a common cause of childhood and adult visual impairment, and globally it is estimated to be 0.2% and 6.2% among children and teenagers respectively (1,2). It is defined as subnormal visual acuity in absence the of demonstrable abnormality of the visual pathway (3,4).

The condition is a visual development disorder that occurs in childhood (5,6). Visual development is estimated to have reached full maturity by the age of 7- 8 years (7). Normal vision develops when the brain is stimulated by a clear retinal image from each eye. In case of an abnormal visual experience, the brain will learn to ignore images from the abnormal eye and accept the image from the eye with clear vision (3).

Thereby amblyopia develops in the affected eye. Treatment of amblyopia is not easy, thus amblyopia can cause permanent visual loss if timely corrective measures are not taken. Early diagnosis and treatment of factors that predispose to the development of amblyopia is vital in the prevention of the disorder (2). Amblyopia is classified into 3 main types depending on the cause i.e. strabismic, refractive and stimulus deprivation amblyopia. Reports show that Strabismic amblyopia is the most common type of amblyopia which develops in children with squint(8). Refractive amblyopia develops as a result of blurring of images due to a refractive error in one or both eyes, and it includes 3 subtypes i.e. anisometropic, ametropic (isometropic) and meridional (astigmatic) amblyopia. Anisometropic amblyopia, is the second most common type of amblyopia, and is due to unequal refractive status of the two eyes. A refractive error difference as small as one diopter between the two eyes can cause amblyopia (7,9). Studies in other areas of the world have also shown that stimulus deprivation amblyopias is the least common type of amblyopia that occurs as a result of occlusion of the visual axis. It is commonly unilateral and cause deeper amblyopia which is difficult to treat. Occlusion of the visual axis may be caused by congenital or early acquired cataract (7,10). Clinically, amblyopia is diagnosed when there is reduced Best Corrected Visual Acuity (BCVA) in a child in the presence of factors that cause amblyopia such as strabismus, cataract or refractive error (11). The control of blindness in children according to Vision 2020 The Right to Sight global initiative targets to eliminate corneal related blindness, provide appropriate surgery and immediate optical correction for children with cataract, screen for babies at risk of Retinopathy of Prematurity and provide glasses for significant refractive errors (12). Knowing the local predisposing factors for development of amblyopia is important in order to focus on their prevention. This study was conducted in order to determine the magnitude, types, depth, and causes of amblyopia in children attending the tertiary paediatric eye clinic at Muhimbili National Hospital in Tanzania.

MATERIALS AND METHODS

Study setting and Design: A hospital based descriptive cross-sectional study was conducted from June 2021 to January 2022 at the Paediatric Ophthalmology clinic of Muhimbili National Hospital (MNH) in Dar es Salaam. The clinic was established in 2008 and it provides tertiary eye care services including medical, optical, surgical, and low vision to children with eye conditions from the commercial city of Dares Salaam which is populated by 6 million inhabitants and from other regions across the country.

Study population: All children less than 16 years attending the paediatric ophthalmology clinic were eligible for the study

Inclusion criteria: Children <16 years of age who were diagnosed with amblyopia at the Paediatric eye clinic during the study period.

Exclusion criteria: Children in whom visual acuity assessment was not possible.

Data Collection Procedures: Patients fulfilling the case definition of amblyopia were registered on each clinic day. Cycloplegic refraction was performed in all patients with a visual acuity of <6/12 using a retinoscope. A detailed history related to the age of onset as noticed by parents or guardian, age of presentation to the hospital and any previous modalities of treatment taken were inquired from patients whose Best Corrected Visual Acuity (BCVA) was ≤6/12. Thorough anterior and posterior segment examination by slitlamp biomicroscopy and indirect ophthalmoscopy to rule out corneal opacities, cataract and posterior segment pathology that are potential to cause visual loss was done. Children found to have causes of visual loss were excluded. Ocular alignment by cover-uncover test and ocular motility were performed to ascertain patient with strabismic amblyopia. Refractive amblyopia was defined as any patient with BCVA of ≤6/12 in either one or both eyes caused by any type of refractive error in absence of

other amblyogenic factors. Strabismic amblyopia was defined as any abnormal eye deviation due to strabismus with a BCVA of ≤6/12. Sensory deprivation amblyopia was defined as any BCVA of ≤6/12 caused by any type of sensory deprivation factors in absence of any other amblyogenic factors. Mixed amblyopia was defined as BCVA of ≤6/12 associated with multiple amblyogenic factors. Moderate depth of amblyopia was defined as a BCVA of 6/12 to 6/30 or Log MAR of 0.3 to <0.7. Severe depth of amblyopia was defined as a BCVA of ≥6/30 to 6/126 or Log MAR of ≥0.7 to 1.3.

Data analysis: Data were analyzed with the help of the Statistical Packages for Social Sciences (SPSS) version 20 for Windows (SPSS Inc, Chicago, IL, USA) for data cleaning and analysis. Descriptive statistics were used to summarize data, proportions for categorical variables and mean or median with their respective measures of dispersion for continuous variables. Tables were used for pictorial presentation of findings. Chi Square test (χ^2) was used to compare association of groups/categorical variables. Differences between variables and associations were considered statistically significant if $p < 0.05$.

Ethical considerations: Ethical approval to conduct the study was granted by the Ethics and Research Committee of Muhimbili University of Health and Allied Sciences. Permission to conduct the study was granted by the Executive Director of MNH. Parents and caretakers consented for their children to take part in the study. Confidentiality and privacy was maintained throughout the study. Data was stored safely and used for the purposes of the study only.

RESULTS

Demographic characteristics of the study population: A total of 1953 children attended the pediatric clinic during the study period and 140 (7.18%) children were found to have amblyopia. The mean age of patients was 6.4 (5.6-7.2) years and the mean age at presentation to the hospital was 4.7 (4.1-5.4) years. The mean hospital presenting age for male and female patients was 4.2(3.4-5.0) and 5.4(4.3-6.4) years respectively.

Table 1. The Socio-demographic characteristics of the study population (n=140)

Characteristics	No. (%)	
Region of residence		
Dar es Salaam	70(50.0)	
Others	70(50.0)	
Sex		
Male	78(55.7)	
Female	62(44.3)	
Current age group (years)		
≤5	69(49.3)	
6-10	38(27.1)	
11-16	33(23.6)	
Age at First Presentation		
≤5	89(63.6)	
6-10	39(27.9)	
11-16	12(8.6)	

Table 2. Types and causes of amblyopia (n=140)

Type of Amblyopia	Causes	No. (%)
Strabismic Amblyopia		37(26.4)
	Esotropia	29(78.4)
	Exotropia	7(18.9)
	Hypertropia	1(2.7)
Refractive Amblyopia		59(42.2)
	Anisometropia	
	Anisoastigmatism	2(3.4)
	Anisohyperopia	15(25.4)

	Anisomyopia	6(10.4)	
	Ametropic/ Isometric		
	Astigmatism	1(1.7)	
	Hypertropia	10(16.9)	
	Myopia	10(16.9)	
	Meridional /Astigmatic		
	Meridional Astigmatic Amblyopia	15(25.4)	
Sensory Deprivation		15(10.7)	
	Cataract	12(80.0)	
	Congenital/ptosis	1(6.7)	
	Hyphema	2(13.3)	
Combined Amblyopia		29(20.7)	
		Combined Strabismic and Refractive 18(65.5)	
		Combined Sensory deprivation and Refractive (27.6)	
		Combined Strabismic, Refractive and Sensory deprivation 2 (6.9)	

The most common type of amblyopia was refractive caused mainly by anisohyperopia. Esotropia was the commonest cause of strabismic amblyopia while cataract was the leading cause of sensory deprivation amblyopia (Table 2). Type of amblyopia was significantly ($p=0.001$) associated with region of residency, where most children with strabismic amblyopia came from other regions, while those with refractive amblyopia came from Dar es Salaam. The type of amblyopia was also significantly ($P=0.001$) associated with the age at first presentation where a higher proportion (34.8%) of patient with strabismic amblyopia presented at an early age of ≤ 5 years compared to refractive type where most (83.3%) children first presented at 11-16 years (Table 3). There were 204/280 eyes with amblyopia. Most (71.6%) of the eyes had severe depth of amblyopia. Sensory deprivation amblyopia comprised the highest (78%) proportion of eyes with severe amblyopia (table 4).

DISCUSSION

Amblyopia can lead to lifelong and profound visual impairment if it remains untreated. The prevalence worldwide is estimated to range between 0.2% to 6.2% depending on the population studied and the definition used. Results of this study found a magnitude of amblyopia of 7.2%. This is in agreement with another hospital based study which was done in Ethiopia (13) where 9.1% of the examined children had amblyopia. In the current study, the proportions of male and female patients was almost equal. This finding is similar to that of Woldeyes *et al*(13) in Ethiopia. In this study, refractive amblyopia was the most common type, followed by strabismic amblyopia and sensory deprivation amblyopia. This is contrary to reports from various literatures (7,13–15) where strabismic amblyopia was reported to be the most common type. The difference in the study setting with the current study being hospital based may account for this. Children who have poor vision due to refractive errors especially when they're in school age are likely to visit health facilities than those who have strabismus. Additionally, in our setting, strabismus is not regarded by many as a pathological eye condition due to lack of awareness. Cultural beliefs regarding squint in the community may cause parents to accept the condition and manage to cope with it rather than seek treatment in hospital. On the other hand, it is not uncommon for an amblyopia study to find high proportions of refractive amblyopia compared to strabismic amblyopia: The prevalence and etiology study by Ganekal *et al.* (16) in India showed results which are similar to this study in that a large proportion of eyes had refractive amblyopia and few had strabismic. Furthermore, Sharma *et al* (17) in India and Høeg *et al.* (18) in Denmark found similar results. Chia *et al.* (2) in Singapore found refractive amblyopia to be the most common type of

amblyopia followed by strabismus. Among the subtypes of amblyopia anisometropia was the commonest. The high proportion of refractive amblyopia in this study is suggestive of a high prevalence of uncorrected refractive errors in the population, mainly related to poor awareness and limited access to eye services. A previous study on causes of severe visual impairment and blindness in one district in Southern Tanzania found refractive errors to be the second leading cause of severe visual impairment and it was found in older children (19). In our study most refractive errors were diagnosed late as preschool children are unlikely to complain of poor vision and parents may not notice that their children have difficulty in seeing. A screening program would therefore be useful in this age group. The main causes of amblyopia vary between studies depending on the characteristics of the study sample and how amblyopia is defined. In our study, majority of patient with strabismic amblyopia had esotropia. This is comparable to a study done by Sethi *et al.* (20) in Pakistan who found that 83 (75%) patients with strabismic amblyopia had esotropia.

This is due to the fact that patients with unilateral constant non-alternating esotropia fail to achieve binocular single vision and present with double vision. Consequently the brain deletes any information from the abnormal eye very early as compared to other forms of squint such as exotropia where binocular single vision is possible. In this study the leading cause of deprivation amblyopia was cataract. Majority of our patients came early to the hospital but they already had severe depth of amblyopia. Sharma *et al.* (17) in India had the same findings. The combination of delayed identification and referral of these children for surgery causes deep deprivation amblyopia. The study done by Mwendu *et al* (21) in Tanzania found that the visual outcome of surgery and management of amblyopia in such children is usually poor. The critical period when amblyopia is reversible with treatment is estimated to be up to 7 – 8 years (9,22,23). In the current study, more than 50% of patients with amblyopia presented before the age of 8 years. Majority of these had strabismic and combined amblyopia.

This finding could be explained by the presence of an obviously visible manifestation of disease (e.g. squint, cataract, and ptosis) which prompted parents to seek help. This is also encouraging information because with early diagnosis of amblyopia the outcome of management is good. On the other hand most children with refractive amblyopia presented after the age of 8 years which would make their treatment less effective. Pure refractive amblyopia does not have any visible manifestations therefore it may take a while for parents, guardians and teachers to notice the poor vision in affected children. Additionally young children do not complain of poor vision especially in the case of anisometropia. Moreover, refractive amblyopia tends to be moderate rather than severe and therefore may be easily missed (24). The finding that majority of participants presented with severe depth of amblyopia where more than 3 quarters of those affected by sensory deprivation had deep amblyopia, is comparable to findings by Sharma *et al* in India (17). In that study more than 50% of patients with sensory deprivation had severe depth of amblyopia. This can be explained by the fact that, sensory deprivation due to congenital or traumatic cataract especially during the critical period, hyphema, corneal opacities and congenital ptosis are associated with complete occlusion of light stimulation to the fovea. This leads to occurrence of deeper amblyopia in a very short period of time (9). Visual acuity assessment in preverbal children was challenging, however different methods appropriate for age (Cardiff acuity cards, Kays pictures, Lea symbols, HOTV tests and Sheridan Gardiner) were used by an experienced personnel to ensure proper results. Moreover there were only 3 children who were less than 2 years and could not affect the overall results.

Table 3. Association between demographic factors and type of Amblyopia

Characteristics	Total, No. (%)	Strabismic, No. (%)	Refractive, No. (%)	Sensory Deprivation, No. (%)	Combined, No. (%)	Chi-square, P-value
Region						
Dar es Salaam	70(50.0)	7(10.0)	33(47.1)	13(18.6)	17(24.3)	12.109; 0.001
Others	70(50.0)	30(42.9)	26(37.1)	2(2.9)	12(17.1)	
Sex						
Male	78(55.7)	21(26.9)	31(39.7)	8(10.3)	18(23.1)	0.220; 0.639
Female	62(44.3)	16(25.8)	28(45.2)	7(11.3)	11(17.7)	
Current age group(years)						
≤5	69(49.3)	25(36.2)	17(24.6)	10(14.5)	17(24.6)	0.722; 0.396
6-10	38(27.1)	8(21.1)	17(44.7)	2(5.3)	11(28.9)	
11-16	33(23.6)	4(12.1)	25(75.8)	3(9.1)	1(3.0)	
Age at First Presentation						
≤5	89(63.6)	31(34.8)	25(28.1)	12(13.5)	21(23.6)	0.001; 0.981
6-10	39(27.9)	6(15.4)	24(61.5)	2(5.1)	7(17.9)	
11-16	12(8.6)	0(0.0)	10(83.3)	1(8.3)	1(8.3)	

Table 4. Depth of Amblyopia in different types of Amblyopia (n=204 eyes)

Type of amblyopia	Moderate No. (%)	Severe No. (%)	Total No. (%)
Strabismic	10(27)	27(73)	37(100)
Refractive	29(32)	61(67.8)	90(100)
Sensory Deprivation	6(22)	21(78)	27(100)
Combined	13(26)	37(74)	50(100)
Total	58(28.4)	146(71.6)	204(100)

CONCLUSION AND RECOMMENDATION

Conclusions

The magnitude of amblyopia among children attending MNH is high with most patients presenting with severe depth of amblyopia. Refractive amblyopia is the most common type and these patients present late to hospital. Strabismic amblyopia was mainly caused by esotropia. Cataract was the main cause of sensory deprivation amblyopia. Anisohyperopia was the commonest causes of refractive amblyopia. Pre-school vision screening programmes are recommended for early diagnosis and timely treatment of refractive errors in children since they do not have obviously visible signs. Effort to create awareness in the community and among health care providers on early identification and referral of children with cataract are necessary. Incorporation of routine eye check up in the Reproductive Child Health (RCH) card for early detection and treatment of eye conditions which cause visual impairment need to be explored.

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