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Prevalence and Distribution of Refractive Amblyopia Among School Children in Owerri Municipal Council, Imo State, Nigeria

Augustine U. Akujobi, PhD*

Department of Optometry, Imo State University, Owerri, Nigeria.

***Corresponding Author:** *Augustine U. Akujobi, PhD, Department of Optometry, Imo State University, Owerri, Nigeria.*

Abstract

The prevalence and distribution of refractive amblyopia in Owerri Municipal Council, Imo State, Nigeria were investigated. One hundred and ninety two (192) primary school pupils and 192 secondary school students aged 6-19 years were examined in a cross-sectional population-based study. Examinations included corrected and uncorrected visual acuity, external examinations, direct ophthalmoscopy; cover test at far and near, cycloplegic, non-cycloplegicand subjective refractions. The diagnostic endpoint was a best-corrected visual acuity (BCVA) of≤ 6/9 or 2-line inter-ocular optotype acuity difference. Among primary school children, a prevalence rate of 12% was recorded, refractive amblyopia was most prevalent (64.3%) among the 6-7 years age group, least prevalent among the 10-11 years age category (9.5%) and more males (56.5%) hadrefractive amblyopia than females (43.5%). At the secondary school level, 6.8% prevalence rate was observed, the 12-13 years age group had the highest prevalence (30.7%) and more males (61.5%) hadrefractive amblyopia than females (59.5%). The morbidity burden of refractive amblyopia among pupils and students did not correlate significantly with age and gender (p>0.05).Sustainable vision screening programmesare advocated for early detection and management of refractive amblyopia among school children.

Keywords: *Refractive amblyopia, distribution, prevalence, schoolchildren, Owerri Municipal, Nigeria.*

Introduction

Amblyopia is a unilateral or rarely a bilateral condition, developing mostly during childhood, in which the best corrected visual acuity (BCVA) is poorer than 6/6 (20/20) in the absence of any obvious structural anomalies or ocular disease [1]. It is the leading cause of visual impairment in children and adults, with early detection and treatment being very paramount in averting the consequences of visual morbidity and blindness.

The visual cortex requires clearly and sharply focused visual impulses to develop normally from birth, but when visual impulses of defocused images are consistently presented to it, the eye with untreated amblyogenic risk factors become vulnerable to functional reduction of visual acuity leading to amblyopia [2,3]. Amblyopia has both ocular and non-ocular risk factors; the ocular risk factors include refractive error (anisometropia, isoametropia), strabismus, cataract, ptosis, corneal opacity, hemangioma and congenital nasolacrimal duct obstruction (CNLDO) which may lead to amblyopia due to the blurry vision secondary to constant epiphora and intermittent discharge, while the non-ocular risk factors include maternal smoking during pregnancy, prematurity, Apgar score, and neonatal intensive care unit hospitalization [4]. It has been shown that early recognition and management of the amblyopic risk factors will decrease the vision loss in children and increase the quality of life of the adults [5].

In adults, the disorder is estimated to affect 1-5% of the population [2] and has been reported to be the leading cause of monocular vision loss in the 20-70 years age-group, surpassing diabetic retinopathy, glaucoma, macular degeneration and cataract [6]. The prevalence

of amblyopia worldwide is estimated at approximately 1%–5% [7,8,9,10] and the World Health Organization (WHO) has estimated that 19 million children less than 15 years of age are visually impaired; of those, 12 million are impaired due to uncorrected refractive errors and amblyopia. Thompson *et al*. [11] had shown that refractive (anisometropic) error and strabismus were present in 21% of all cases of amblyopia, while a previous study[12] reported that these causes were found in 35% of cases. Furthermore, a systematic review conducted, mostly in the WHO-Western Pacific Regional Office, showed that the pooled prevalence of amblyopia was 1.25%, with the highest estimate in European Regional Office (3.67%) and the lowest in African Regional Office (0.51%), while the most common cause of amblyopia was refractive error (anisometropia) (61.64%) [13].

The prevalence of amblyopia varies with geographical locations, for example; In Iran, the prevalence of amblyopia was put at 4.6%, with refractive amblyopia having the highest prevalence of 45.24% [14], while other studies [15,16] reported prevalence rates of 2.3% and 0.74% respectively, with refractive amblyopia being most common. It affects 2-4% of the general population in North America and 2-2.5% in the United Kingdom [17].According to a study [18], the prevalence rate of amblyopia among schoolchildren in Jos, Plateau State, Nigeriawas found to be 1.1%. Asimilar prevalence rate was found in South Western Nigeria where amblyopia accounted for 1% of the visual problems in primary school pupils and 2% in secondary school students [19].Another study[20] in Enugu, Enugu State, Nigeria found amblyopia in only 0.1% of the children.

In Nigeria, the prevalence of amblyopia has been put at 0.23% [21,22,23] with refractive amblyopia being the most common type of amblyopia [23] with a prevalence rate of 58.4% [24]. Variation in geographical location, study design and diagnostic endpoint definition/classification reasonably account for differences in empirical findings among different scholars. However, the diagnostic criterion of best corrected visual acuity (BCVA) of ≤ 6/9 in one or both eyes is apparently popular among scholars.

Refractive amblyopia usually occurs when there isa significant difference in refractive error (anisometropia) or a large but same degree of refractive error (isoametropia) in both eyes. When the former occurs, the visual cortex ignores the visual impulse (image) from the eye with the greater refractive error. Although anisometropia andisoametropia predispose children to the development of amblyopia, there have been discordances among scholars and professionals on the acceptable baseline that could elicit amblyopia [25].

Nonetheless, some scholars have postulated that the significant refractive error causing isoametropic amblyopia falls within a minimum of approximately 6D to 8D of myopia, 4D to 5D of hyperopia and 2D to 2.5D of astigmatism in both eyes, while patients with 3D of myopic anisometropia or more, 1.5D to 2D of astigmatic anisometropia and only 1D of hyperopic anisometropia are considered at risk for developing refractive amblyopia(26,27,28).

It has been shown that the most effective treatment for refractive amblyopia, especially among children 3-≤ 10 years, is the optimal correction of refractive error, with the visual acuity improving to 20/25 or better within one year [29]. However, in certain cases, occlusion therapy or atropine penalization may be administered concomitantly with refractive correction, especially when the refractive error isasymmetric after standard refraction. Atropine penalization has not proved very effective when the better eye is shortsightedor when the degree of amblyopia is severe [30], therefore, occlusion therapy remains a frontline adjunct to refractive correction in the treatment of refractive amblyopia.

Available reports suggest that the prevalence of refractive amblyopia has not been sufficiently investigated in Nigeria; especially in the Southeastern part where the only known survey conducted in a proximate state was criticized by scholars for adopting a flawed study design which excluded vital examinations for the diagnosis of refractive amblyopia. Moreover, there are no known documented evidences of studies on the prevalence of refractive amblyopia in Imo State, Southeast, Nigeriadespite the increasing number of schools and school-enrolment spike which foregrounds the development and manifestation of refractive errors and amblyopia.

Furthermore, extant studies on the prevalence of refractive amblyopia did not consider the age and gender trendsconsistent with prevalence studies,

hence, did not provide complete data for the studies. Therefore, the present study fills this gap; generating novel data on the prevalence, age and gender distributions of refractive amblyopia in the study-area.

Materials and Methods

Study-Area

Owerri Municipal Council is a local government area in Imo State, Southeast, Nigeria with its headquarterslocated in the city of Owerri. Owerri Municipal Council is made up of five villages namely; Umuororonjo, Amawom, Umuonyeche, Umuodu and Umuoyima (collectively known as OwerriNchiIse). With British influence and colonization in the early 1900s,Owerri town became the headquarters ofOwerri Division and later old Owerri Province. Upon creation of Imo State on the 3rd of February 1976, Owerri city became its capital and on the 15th of December, 1996 Owerri city attained the municipal status.

It has an area of approximately 58km^{2}and an estimated population of 125,337 with a population projection growth rate of 3.25% yearlybased on the 2006 census exercise.

Owerri Municipal Council has a postal code of 460 and serves as the nexus of Port-Harcourt, Onitsha, Aba and Umuahia.Solid mineral deposits such as phosphatelimestone, kaolin, galena, stones, granites and silica sandabound all over the council area, in addition to agricultural products like cassava, yam, maize and livestockfruits such as Orange, Pineapple, Banana and Pawpaw which provide raw materials for agro-based industries. The native language of Owerri indigenes is Igbo.

Owerri Municipal Council has geographical co-ordinates of 5.4682° N, 7.0176° E and a tropical climate with the least amount of rainfall occurring in January, averaging up to approximately 17mm. In June, the precipitation reaches its peak, with an average of 363 mm, while the average temperature and annual rainfall standat approximately 26.4^{0}c and 2219mm respectively.

Study Population, Sample Size and Sampling Technique

The population of school children in Owerri Municipal Council was estimated at about 10,000 based on available records from the Ministry of Education. The sample size of 384 school children was determined by the Taro Yamane's formula and drawn using the convenience sampling technique. Out of the 384 school childrenexamined, 192 pupils were drawn from the primary schools while 192 students were selected from the secondary schools. The selection of the schools investigated was randomly executed.

Ethical Clearance

The study conformedto extant protocols of the Helsinki Declaration on Human Experiments. Written approvals for the study and surrogate consent for school children <18 years were obtained from the schools, while written informed consents were extracted from studyparticipants'≥18 years.

Procedure for Data Collection

The corrected and uncorrected visual acuities of participantswere examined at far and near using the Snellen's alphabet and near visual acuity charts respectively.Standard method was applied in evaluating the ocular adnexia to rule out external ocular pathologies, while direct ophthalmoscopy ruled out internal pathologies.

Cover test was performed at far and near to detect and exclude participants with tropia. Non-cycloplegic, cycloplegic (using static retinoscopy technique under 1% tropicamide) and subjective refractions were performed to determine refractive errors.Refractive error was defined as myopia ≥ −0.50DS, hyperopia≥ +0.50DS and astigmatism ≥ −0.50DC. School children who had refractive errors with best corrected visual acuities(BCVA) of ≤ 6/9 in one or both eyes or a 2-line inter-ocular optotype acuity difference with no pathologywere diagnosed as refractive amblyopes.

Statistical Analysis

Data were analyzed using Chi-square (X^2) at 95% confidence level.

Results

A total of 192 primary school children were enrolled into the study. The 10-11 years category had the highest number (74;38.5%), followed by the 8-9 years group(55; 28.6%) and the 12-13 years group (39; 20.3%), while the 6-7 years group had the least number of participants (24; 12.5%). The 10-11 years group had the highest number of female (38) and males (36) participants, while the 6-7 years group had an equal number of males and females (12).

Table 1. *Age and gender distribution of primary school participants in Owerri Municipal Council.*

Age (Years)	Gender		Frequency	% Frequency
	Males(% freq.)	Females(% freq.)		
6-7	12(13.3)	12(11.8)	24	12.5
8-9	26(28.9)	29(28.4)	55	28.6
10-11	36(40.0)	38(37.1)	74	38.5
12-13	16(17.8)	23(22.5)	39	20.3
Total	90(46.9)	102(53.1)	192	100

One hundred and ninety two (192) secondary school students participated in the study. The 18-19 years age group had the highest number of participants (59; 30.7%), followed by the 16-17 years group (53; 21.6%) while the least was the 10-11 years group (13; 6.8%). There were more females (30) than males (29) in the 18-19 years group, while there were also more female participants (7) than males (6) in the 10-11 years age category.

Table 2. *Age and gender distribution of secondary school participants in Owerri Municipal Council.*

Age (Years)	Gender		Frequency	% Frequency
	Males(% freq.)	Females(% freq.)		
10-11	6(6.9)	7(6.8)	13	6.8
12-13	10(11.5)	18(17.1)	28	14.6
14-15	15(17.2)	24(22.9)	39	20.3
16-17	27(31.0)	26(24.8)	53	21.6
18-19	29(33.3)	30(28.6)	59	30.7
Total	87(45.3)	105(54.7)	192	100

Among primary school children, more males (13;56.5%) had refractive amblyopia than females (10; 43.5%). The 6-7 years age group recorded the highest prevalence among males (30.8%) and females (50%), while the 12-13 years group had the least prevalence of refractive amblyopia among males (15.4%) and females (10%). On the overall, the prevalence of refractive amblyopia among primary school children was found to be 12%.

Table 3. *Age and gender distribution of refractive amblyopia among primary school children in Owerri Municipal Council.*

Age (Years)	Gender		Frequency	% Frequency
	Males(% freq.)	Females(% freq.)		
6-7	4(30.8)	5(50)	9	39.13
8-9	3(23.1)	2(20)	5	21.74
10-11	4(30.8)	2(20)	6	26.09
12-13	2(15.4)	1(10)	3	13.04
Total	13(56.5)	0(43.5)	23	12

Among secondary school children, more males (8; 61.54%) had refractive amblyopia than females (5; 38.46%). The 12-13 years group recorded the highest prevalence rate (37.5%) among the male participants, while the 14-15 years age category had the highest prevalence (40%) among the female subjects. On the overall, a prevalence rate of 6.8% was observed among secondary school children.

Table 4. *Age and gender distribution of refractive amblyopia among secondary school children in Owerri Municipal Council.*

Age (Years)	Gender		Frequency	% Frequency
	Males(% freq.)	Females(% freq.)		
10-11	2(25)	1(20)	3	23.08
12-13	3(37.5)	1(20)	4	30.77
14-15	1(12.5)	2(40)	3	23.08
16-17	0(0)	0(0)	0	0
18-19	2(25)	1(20)	3	23.08
Total	_8(61.54)	5(38.46)	13	608

Discussion

The age distribution of refractive amblyopia among primary school children posited by this studywas apparently notsystematized; however, the 6-7 and 10-11 years groups recorded the highest prevalence rate (30.8%) among the male participants, while the 6-7 years group showed the highest morbidity (50%) among the female primary school pupils. Although the 6-7 years age group recorded the highest prevalence across gender and the 12-13 years age group had the least prevalence rate among male (15.4%) and female (10%) participants, the study did not show a significant age trend (p>0.05). In addition, more males (56.5%) than females (43.5%) had refractive amblyopia, albeit the gender predilection was not significant (p>0.05). The high and low prevalence rates observed among the 6-7 years and12-13 years age groups respectively show refractive amblyopia to be more predominant among youngerchildren as suggested by Jefferis*et al.* [1], hence, the need to ensure comprehensive eye examinations for school children within the at-riskage group.

The prevalence rate of 12% recorded among primary school pupils is enormous compared with the estimated global amblyopia prevalence (1-5%). Although the global prevalence of 1-5% was amblyopia-specific, it could be extrapolated to refractive amblyopia based on previous studies [13,14,15,16,23,24]which had shown that refractive error was the most common cause of amblyopia. The resultcould also be approximative, to a large extent, of a surge in number of schools, school-enrolment spike and the non-existence of coordinated vision screening programs for school children to forestall academic-related visual anomalies such as refractive errors and amblyopia.

The overall prevalence (12%) observed in this study was far below that reported by a previous study [24] (58.4%). The discordant findings could be attributed to the huge discrepancy in sample sizes of both studies and the lower age predilection of the pupils (4-16 years) examined in their study compared with the pupils sampled in this study (6-19 years); while 384 children were sampled in this study, theirs examined 1,702 pupils. Inage and gender distributions, both studies did not show any significant correlation (p>0.05) with refractive amblyopia burden, although there was an inverse trend between age and refractive amblyopia.

The result reported by this study disagrees with that of another study[13]. It is likely that different study designs adopted by both studies could be responsible for the discordance ofstudy outcomes. While the present study adopted a cross-sectional design, the previous study [13] was a systematic review and meta-analysis which apparentlycalculated the pooled prevalence rather than the point prevalence.

Among secondary school students, the 12-13 years group recorded the highest prevalence (37.5%) of refractive amblyopia within the male category, followed by the 10-11 years group (25%) and the 16-17 years group (0%). Female students within the 14-15 years group had the highest prevalence (40%), followed by the10-11, 12-13 and 18-19 years groups (20%)and the 16-17 years group (0%). Among male and female participants, the age trends of refractive amblyopia were similar to those of primary school pupils and no significant correlation between age and refractive amblyopia (p>0.05) was found. More males (61.54%) had refractive amblyopia than females (38.46%), gender did not correlate significantly with refractive amblyopia burden (p>0.05) and on the

overall, the study recorded a prevalence of 6.8%. It was observed that the morbidity burden was higher in males (61.54%) than females (38.46%) despite a higher number of female participation. This could imply that more males had refractive errors.

The morbidity burden found in this study (6.8%) was higher than that reported by another study [19] (2%). The discrepant outcomes may most likely be because the present study was conducted in an urban setting, unlike theirs, with more preponderance for school enrolment and academic activities which are predisposing factors for refractive errors and amblyopia. Moreover, the ethnic and cultural differences between the study-areas may have influenced the incongruent results of both studies; while the residents of the study-area of this work are more cosmopolitan and educated with attendant positive health-seeking behaviors;the residents of their settingappear to be more inclined to unorthodox health practices, with likely negligence to diagnostic pre-school and school vision screening programs.

Conclusion

The study underscores the need to prioritizeschool vision screening programs to facilitate timely diagnosis and prompt treatment of refractive errors and refractiveamblyopia.

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