

Refractive error in school children in Agona Swedru, Ghana

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Received 25 September 2009; revised version accepted 9 June 2010

Abstract

Uncorrected refractive errors remains a public health problem among different population groups. Among schoolchildren, uncorrected refractive errors have a considerable impact on learning and academic achievement especially in underserved and under-resourced communities.

A school based cross-sectional study was carried out to estimate the prevalence and distribution of refractive error among schoolchildren in the Agona Swedru municipality of Central Region of Ghana. 637 schoolchildren aged 11-18 years old were randomly selected for the study. Non-cycloplegic refraction was performed on each child who failed the reading test. Hyperopia was defined as spherical power of $\geq +0.75$ D, myopia as ≤ -0.50 D and astigmatism as a cylindrical power of ≤ -0.50 D. Of the children examined, only 13.3% had previously had an eye examination.

Visual impairment (VA of 6/12 or worse in the better eye) was present in 4.5% of the children examined. Of those who failed the reading test, 85.9% had refractive error. The prevalence of hyperopia, myopia and astigmatism was 5.0%, 1.7% and 6.6% respectively.

The study concludes that uncorrected refractive error is a common cause of visual impairment among schoolchildren in the municipality. A low uptake of eye care is also noted in the study. The study therefore recommends that the education authority in collaboration with the District Health Directorate institute appropriate measures to ensure compulsory eye examination for schoolchildren in the Agona Swedru district. (*S Afr Optom* 2010 69(2) 86-92)

Key words: Refractive errors, ametropia in schoolchildren in Ghana, visual impairment.

Introduction

Uncorrected refractive errors remains a public health problem among different population groups. Among schoolchildren, it has a considerable impact on learning and academic achievement especially in underserved and under-resourced communities. Uncorrected refractive errors in schoolchildren and its impact on academic achievement have only recently received attention. It became necessary therefore to

study the epidemiology of refractive errors among schoolchildren. A uniform protocol for this purpose has been developed¹. Several studies have been conducted in different parts of the world using this protocol²⁻⁷.

Refractive error is one of the most common causes of visual impairment and the second leading cause of blindness following cataract⁸. The significance of visual impairment due to uncompensated refractive

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error, especially in schoolchildren, derives from the fact that compared to cataract which is the leading cause of blindness, refractive error accounts for twice the number of blind-person-years as cataract⁹. There are an estimated 500 million people, mostly in developing countries including children that do not have access to eye examination and affordable correction. Many are not aware that there is a cure for their compromised vision, have no one to provide treatment, or cannot afford the appliance they need for correction¹⁰.

Children with refractive error are less likely to opt for correction until they are significantly visually impaired that they have difficulty performing specific visual tasks. This is especially so in rural and urban poor regions where there are inadequate eye care services. Regular eye screening program in schools will help in early detection and correction of refractive errors. Schools with long established tradition of engaging in vision screening have proven to be effective in detecting previously undiagnosed conditions including refractive errors¹¹. Impairment due to refractive error in any population suggests that eye care services are inadequate. This is because the treatment of refractive errors is perhaps the simplest and most cost effective healthcare interventions. Uncorrected refractive error in schoolchildren portends significant implications for a child's academic achievement as well as social interactions¹².

In the latest global estimates of visual impairment due to refractive errors, 12.8 million children in the age group 5-15 years were visually impaired from uncorrected or inadequately corrected refractive error¹³. This represents a prevalence of 0.96% globally. The highest prevalence was reported in urban and highly developed areas of South-East Asia and China¹³. Refractive error was responsible for 88.5% of poor eye sight (defined as uncorrected unilateral or bilateral visual acuity of worse than 6/12 among secondary school children in Tanzania. This represented a prevalence of 6.1%. The children were aged between 11 and 27 years¹⁴. The majority of the children (91.6%) had myopia. Among 1707 secondary school students in Nigeria, refractive errors were found in 22.5%. It was further revealed that none of the students have had any form of eye examination in the past¹⁵.

This paper presents the results of a study of refractive error among school children aged 11 - 18 years in

Agona Swedru in the Central Region of Ghana.

Methods

Sampling

Agona Swedru is the administrative capital of the Agona Swedru district of Central Region, Ghana. It has a total land area of 540 sq. km with a population of 40 000 and an annual growth rate of 2.55%¹⁶. Children aged below 15 years accounts for 47.7% of the total population¹⁶. As of the time the study was conducted, there were 24 public schools and 18 privately owned schools. Children from affluent homes attend the privately owned schools while the majority of the children attend public schools where fees are not charged.

The study was a cross-sectional school based study. Of the 24 public and 18 privately owned schools registered in Agona Swedru, two public and two private schools were selected for the study taking into account the school enrolment figure for each school. We used a convenience sampling technique in selecting the schools. Each of the two schools selected had the highest enrolment figure in each case. All the schoolchildren aged 11-18 in the selected schools were enumerated for the study.

Field operation

Permission to conduct the study was obtained from the local education authority which assigned an officer to accompany the research team to the selected schools on the day of each examination. Institutional approval was also obtained from the Department of Optometry, University of Cape Coast for the study. The heads of selected schools were briefed on the purpose of the study and they signed an informed consent form on behalf of the schoolchildren. In addition, the purpose and procedure of the examination was explained to the children after which consent was obtained from each child before they were examined. The children were informed that they could refuse to participate in the study if they do not want to.

The examination team consisted of five sixth year clinical students and an optometrist (GO). The optometrist performed all the refractions and cross-checked the examination forms to ensure that they were accurately completed. Before the field operation, the clinical team was briefed on the purpose of the study and



was trained on carrying out clinical procedures in the field. All the clinical students had previously participated in out-of-clinic programs at least twice.

Clinical Examination

Non-cycloplegic refraction was carried out for all children. This is similar to the protocol used by Adegbehingbe *et al*¹⁵ and Mabaso *et al*¹⁷ in their respective studies of school children in Nigeria and South Africa. To ensure that accommodation was relaxed, a + 1.50 D lens was used to fog the eye monocularly during refraction.

Visual acuity was measured with the Snellen chart at a distance of 6 m. Children who wore glasses also had their VA taken while wearing their glasses. Children who read 6/9 or worse were refracted. Those who read 6/6 or better had their VA measured again with a + 1.50 D. If the VA was 6/9 or worse they were also refracted. Binocularity was investigated using cover test. Ocular health examination (including internal and external using the monocular direct ophthalmoscope and focal illumination respectively) was performed for all children examined. Retinoscopy and subjective refraction were performed using a fogging lens of + 1.50 D to relax accommodation. The final prescription and the best (corrected) VA were recorded. Medication was given for minor ocular conditions such as allergic conjunctivitis at no cost at the time of the examination while those who needed further medical or diagnostic work-up were referred to the district hospital.

The children with presenting visual acuity of 6/12 or worse in the better seeing eye whose vision improved with refraction were provided with spectacles at no cost.

Data Management and Analysis

The data forms were checked for accuracy and completeness in the field before data entry at the University. Presenting visual acuity of 6/9 or worse in the better seeing eye was considered as visual impairment. Refractive error was assigned as the cause of the visual impairment if in the absence of any obvious pathology, vision improved to 6/6 or better with refraction. Amblyopia was assigned the cause of visual impairment when, in the absence of any noticeable pathology or abnormality, there was no improvement in vision with refraction.

Hyperopia was defined as a spherical power of $\geq + 0.75$ D in both eyes or in one eye (if the other eye is emmetropic). Myopia was defined as a spherical power of $\leq - 0.50$ D in both eyes or in one eye (if the other eye was emmetropic). A cylindrical power of $\leq - 0.50$ D in both eyes or in one eye (if the other eye was emmetropic) was considered as astigmatism. Where the refractive error in each eye was different (one eye myopic and the other hyperopic, it was recorded as antimetropia). Emmetropia was defined as spherical power of between $- 0.25$ D and $+ 0.50$ D.

The occupations of parents were used to classify the children into socio-economic status (SES). Parental education, occupation and employment status have been employed as a proxy for estimating the SES of children¹⁸. Professional occupations like engineering, medicine, accounting, *et cetera* were considered to be in high SES while occupations within governmental sector that are not professional occupation like the civil service, the police and teachers were considered to be in the medium SES. Other occupations like farming, trading, drivers and artisans were considered to be in the low SES. The occupations of both parents were considered in assigning the SES or of either parent depending on which is higher.

The data was analyzed using the Statistical Package for Social Sciences (SPSS version 10).

Results

Study Population

There were 637 children in the four selected schools for the study. However, 604 children were present at school for the study and were examined. One child refused to participate in the study resulting in a participation rate of 94.7%. The records of six students who were older than 18 years were excluded in the analysis. The records of two other children who were reported to have psychological difficulty who could not respond appropriately to the tests were incomplete and were also excluded. Thus the results of 595 children were valid and are presented.

There were 317 females representing 53.3% and 278 males representing 46.7% (M: F = 1:1.14). The children were aged between 11-18 years (mean = 14.52 ± 1.50 years). The mean age for the females was 14.55 ± 1.47 years (95% CI = 14.38 - 14.70) while the mean age of the males was 14.48 ± 1.55 years



(95% CI = 14.30 - 14.66). This difference between the mean ages of males and females was not significant ($t = 3.852, p = 0.797$). The majority of the children were aged 14 and 15 years (Figure 1).

Most of the parents of the children examined were in the medium SES. Only 59 (9.9%) of the children were in the high SES with 285 (47.9%) and 251 (42.2%) of the children belonging to the medium and low SES respectively. The mean ages of the children in the high, medium and low SES was 14.14 ± 1.46 years), 14.16 ± 1.38 years) and 15.01 ± 1.51). The difference in the ages of the children in the three SES groups was significant (ANOVA $F = 25.587, p = 0.0000$).

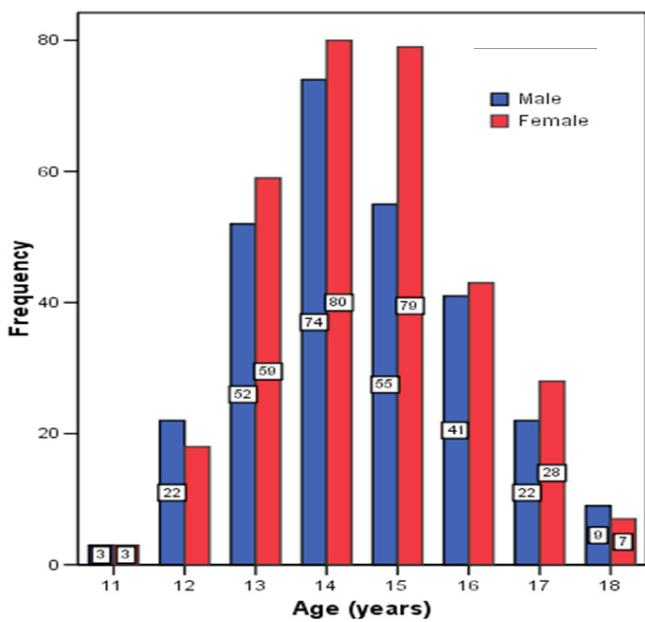


Figure 1: Distribution of children by age and gender

Of the 595 children examined, only 79 (13.3%) had previously had an eye examination (Figure 2). Most of these children who had previously had an eye examination had it in their churches by outreach groups. Most of them had parents in the high and medium SES. Whether a child had previously had an eye examination was dependent on the parent's SES ($\chi^2 = 7.943, p = 0.019$).

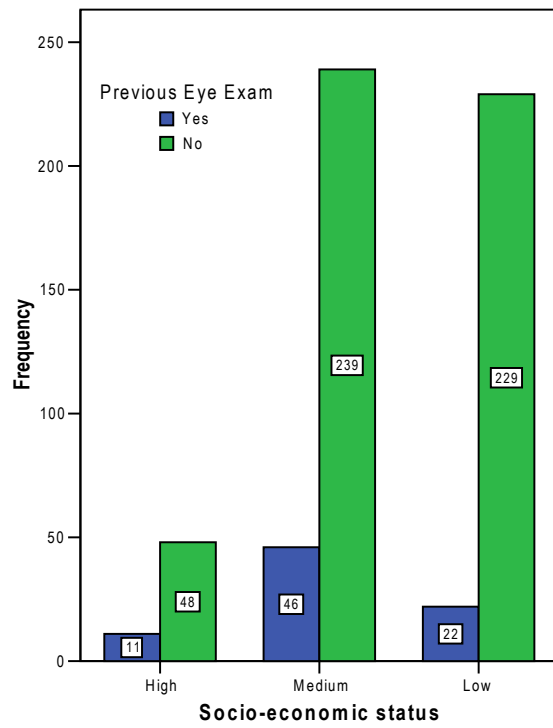


Figure 2: Distribution of Previous Eye Examination with Parental SES

Visual Acuity

Presenting visual acuity of 6/6 or better in at least one eye was found in 545 (91.6%) of the children. Visual impairment (VA = 6/12 or worse in the better eye) was present in 27 (4.5%) of the children. The prevalence of low vision (VA = 6/18 or worse in the better eye) was 2.5%. Three of the children had a VA of 6/60 while one each had hand movement and light perception in the worse eye. Table 1 shows the presenting visual acuity in the better seeing eye.

Table 1: Distribution of Presenting Visual Acuity in the Better Seeing Eye.

Visual Acuity	Frequency (%)
6/3-6/6	545 (91.6)
6/9	23 (3.9)
6/12	12 (2.0)
6/18	(0.7)
6/24	(0.8)
6/36	(1.0)
Total	595 (100)



Two (0.3%) of the children who were wearing their spectacles had their presenting visual acuity in the better eye as 6/12 and 6/24 respectively.

Refractive Errors

Of the 595 children, 92 (15.5%) failed the vision test and had refraction. seventy-nine (85.9%) of those who failed the vision test and had refraction

were found to have refractive errors. This represents a prevalence of 13.3%. Out of the children with refractive errors, 30 (38.0%) had hyperopia, 10 (12.6%) had myopia while 39 (49.4%) had astigmatism. Thus the prevalence of hyperopia, myopia and astigmatism among the children was 5.0%, 1.7% and 6.6% respectively. More females have refractive errors than males. Table 2 shows the distribution of the refractive errors by gender.

Table 2: Distribution of Refractive Errors by Gender showing the Prevalence of Myopia, Hyperopia and Astigmatism

Gender	Emmetropia (%)	Myopia (%)	Hyperopia (%)	Astigmatism (%)	Total (%)
Male	248 (41.68)	3 (0.50)	14 (2.35)	13 (2.18)	278 (42.7)
Female	268 (45.05)	7 (1.17)	16 (2.69)	26 (2.37)	317 (53.3)
Total	516 (86.7)	10 (1.7)	30 (5.0)	39 (6.6)	595(100.0)

Myopia ranged between -0.50 D to -2.25 D, hyperopia ranged between $+0.75$ D to $+1.75$ D while astigmatism ranged between -0.50 D to -4.50 D. The mean spherical equivalent was 0.09 ± 1.1037 D, (95% CI = -0.1523 to $+0.3297$). Of the 79 children who had refraction, visual acuity improved to 6/9 or better in 76 (96.2%).

Ocular Deviation

Heterotropia and heterophoria was present in 98 (16.5%) of the children at 40 cm fixation distance and in nine (1.5%) at 6 m fixation distance. The distribution of ocular deviation is shown in Table 3.

Table 3: Distribution of Ocular Deviation

Ocular Deviation	Fixation Distance	
	40 cm	6 m
Esophoria	2 (2.0)	1 (11.1)
Exophoria	85 (86.7)	6 (66.7)
Esotropia	9 (9.2)	2 (22.2)
Exotropia	2 (2.0)	0 (0)
Total	98 (100)	9 (100)



Discussion and Conclusion

With increasing emphasis on eliminating avoidable blindness¹⁹, refractive error correction has assumed a place of prominence in the blindness prevention efforts of any nation. To sufficiently deliver eye care services to children, data on the prevalence of refractive error in children is needed. This study attempts to provide this information for the Agona Swedru Municipality of Central Region, Ghana.

Non-cycloplegic refraction was used to determine the refractive error of children in this study as in some studies^{15, 17} that have been reported in literature. The choice of non-cycloplegic refraction was made so as not to interfere with the academic activity of the schoolchildren.

The prevalence of refractive error in this study was 13.3%. This is higher compared to figures reported from other parts of Ghana - 5.4% in the Ashanti, Eastern, Volta and Greater Accra Regions²⁰, 3.1% in four districts in Ghana²¹ and 6.2% throughout the country²². This data are for the general population and used different measurement and classification criteria. The prevalence in this study is however lower than the prevalence of 55% found in Cape Coast Municipality in Central Region of Ghana which use children aged 1 - 19 years²³, 50.4% in a study involving children from four ethnic background²⁴, 22.1% among schoolchildren in Cairo aged 7 - 14 years¹⁸ and the 18.5% reported for Californian children aged 6 - 7 years²⁵. Differences in ethnic background, age group of subjects in the studies and method of classifying refractive errors may account for the differences among these studies. For example, in the Cape Coast study²³, cycloplegic refraction was performed to measure the refractive error. This will result in detecting low-grade refractive error that could be missed with non-cycloplegic refraction. Besides the children were aged 1 - 19 years while the ages for the children in this study was 11 - 18 years at which age low-grade hyperopia in the younger age group would have become emmetropic.

The prevalence of refractive error reported in this study is similar to the 11.6% reported for schoolchildren aged 6 - 9 years in Kampala²⁶ and 13.5% among Junior and Senior Secondary School children in Ile-Ife, Nigeria¹⁵.

The prevalence of myopia (1.7%) in this study was similar to 1.7% in Mopani district, South Africa¹⁷ and

comparable to 1.2% in rural Nepal⁷ but lower than 7.4% in New Delhi²⁷, 6.8% in Chile³, 16.2% in China⁵ and 4.1% in rural India². These studies defined myopia as less than - 0.50 D.

Also the prevalence of hyperopia (5.0%) found in this study is higher than the 3.5% reported for China⁵, 1.4% reported for Nepal⁷ and 0.8% reported in rural India² but lower than 7.7% in New Delhi²⁷.

Refractive error was the cause of 88% of the visual impairment while amblyopia accounted for 6 % of the cause. This indicates that with appropriate refractive error services for children, up to 88% of visual impairment can be prevented. Also instructive is the fact that up to 96.2% of those with refractive errors had their vision improved by simple refraction. The study further revealed that 13.3% had previously had an eye examination with only 0.3% of the children wearing spectacles which under-corrected their refractive error. The prevalence of spectacle use is similar to 0.58% reported in rural India². It is considerably less than 30.3% among students in Tanzania¹⁴ 42.3% in Egypt²⁴ and 2.7% in South Africa⁶. None of the 1707 children examined in a study in Ile-Ife, Nigeria had previously had an eye examination¹⁵. Because of the relative ease of obtaining refractive error services, low uptake of refractive error services is said to reflect the poor state of eye care services in particular and health care in general. Factors responsible for poor uptake of refractive error services could be social and economic. Wearing of spectacles is sometimes associated with blindness and individuals abhor the social stigmatization associated with blindness. Furthermore, there are a number of misconceptions regarding the wearing of spectacles by children. Parents believe that if children start wearing spectacles at an early age, they might become blind later in life. In addition, refractive error services are expensive to procure in most developing countries. This is because refractive error services in developing countries are still being provided as a business model rather than a service model. This is further compounded by the inadequate and mal-distribution of the few personnel available to provide refractive error services in developing countries.

From our study, we can conclude that refractive error is a common cause of visual impairment among schoolchildren in Agona Swedru district. Furthermore, there is a low uptake of refractive error services among schoolchildren in the municipality. With ap-



appropriate refractive error services, visual impairment could be significantly reduced among schoolchildren. We therefore advocate for the relevant education authority in liaison with the district health directorate to include eye screening for refractive error for schoolchildren in the school health program of the government of Ghana.

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