

Academic Implications of Uncorrected Refractive Error: A Study of Sokoto Metropolitan Schoolchildren

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Abstract

Background: The Sustainable Development Goal 4 ensures that all children have an inclusive and equitable quality education. However, uncorrected refractive errors (UREs) have been a major cause of limitations with regard to quality education as vision plays a vital role in child learning and development. Thus, any problem affecting the child's vision could adversely affect the quality of the child's education. **Aims:** The aim of this research was to assess the quality of education of the children with URE in Sokoto metropolis, Sokoto State, Nigeria. **Methods:** A cross-sectional survey of schoolchildren in four randomly selected primary schools within Sokoto metropolis was carried out from July 2016 to October 2016 using the illiterate "E" chart and a pinhole. Relevant history and basic ocular examinations were done using a multistage sampling technique. **Statistical Analysis:** Data were analyzed using the Statistical Package for Social Sciences (IBM SPSS) version 20. **Results:** A total of 113 students were surveyed; 56 (49.6%) males and 57 (50.4%) females. The age range was between 5 and 15 years, and the mean age was 10.89 ± 2.27 years. The prevalence of URE was 9.7%, with more than half of the students within the age group of 10–12 years ($P = 0.018$) and more common in females (54.5%) than males (45.5%) ($P = 0.775$). More than 90% of the respondents had never had a prior eye examination. The average mean academic performance of the pupils with URE ($49.54\% \pm 10.49\%$) was statistically significantly lower than those without refractive error (71.08 ± 10.09), mean difference = 21.55 (95% confidence interval, 15.18–27.92) ($t = 6.70$, $P = 0.000$). **Conclusions:** The negative implications of URE on the quality of education and other socioeconomic aspects of life underscore the need to increase efforts on its screening and increase other relevant interventional measures.

Keywords: Academic performance, marginalized schoolchildren, quality education, Sustainable Development Goal, uncorrected refractive error

INTRODUCTION

The right to quality education is universal to all children and does not allow any form of debarment or exclusion. Marginalized children or individuals such as the visually impaired are often excluded from the national educational policy, thus preventing them from their educational rights. Refractive error results when the eye fails to correctly bring the rays of light from an external object onto the fovea in the retinal plane, leading to blurring of the image perceived by the individual unless refractive correction is made. It stands as one of the most common causes of poor vision around the world, accounting for more than 2/5th of all the causes of visual impairment, and is the second leading cause of treatable blindness.¹⁻⁴ Visual problems are a major cause of limitations to school pupils with regard to the learning process.⁵

Visual problems may negatively affect physical, psychological, educational, vocational, and social development of children. It is estimated that more than 75% of all learning comes from the use of the eye, and that one in every five children has a correctable visual problem which, if left uncorrected or undetected for a long period of time, may bring about maladjustment and educational failure of the child.⁶ Obtaining

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Submitted: 26-Jun-2019 **Revised:** 25-Oct-2019
Accepted: 14-Nov-2019 **Published:** 24-Feb-2020

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How to cite this article: Olatunji LK, Abdulsalam LB, Lukman A, Abduljaleel A, Yusuf I. Academic implications of uncorrected refractive error: A study of Sokoto metropolitan schoolchildren. Niger Med J 2019;60:295-9.

Access this article online

Quick Response Code:



Website:
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DOI:
10.4103/nmj.NMJ_89_19

a quality primary education is fundamental to improving children's lives and sustainable development.

Gomes-Neto *et al.*⁷ showed that primary schoolchildren with reduced vision had a higher probability of repeating a class and scoring very low on achievement tests. Similar relationships between poor vision and academic performance were seen in findings of many researchers like Goldstand *et al.*⁸ in the United States of America, Toledo *et al.*⁹ and Junior *et al.*¹⁰ in Brazil, Chen *et al.*¹¹ in the Klang Valley region of Malaysia, and Kotingo *et al.*⁵ in the southern part of Nigeria. Reduction of the magnitude of visual impairment due to refractive error remains an important international public health goal due to its high prevalence and substantial costs of its correction.¹² Early detection of a visual problem has some educational, behavioral, and improved quality-of-life benefits. This research aimed to assess the quality of education of the children with uncorrected refractive error (URE) in Sokoto metropolis, Sokoto State, Nigeria, by assessing their academic performance.

METHODS

Sokoto Metropolis is the capital of Sokoto State. It comprises of Sokoto North, Sokoto South, part of Wamakko, and part of Dange-Shuni local government areas and has a projected population of 687,767 people out of the projected population of 4,968,458 million people in the State.¹³ The inhabitants of the State are mainly Hausa and Fulani. Other ethnic groups include Zabarmawa, Yoruba, Nupe, Igala, and Igbo. Hausa is the commonly spoken language. Civil servants form the greater percentage of the population, whereas the rest are farmers, traders, and artisans, among others. There are 118,830 primary school pupils within the metropolis as of March 2016.¹⁴

A descriptive cross-sectional study design was employed, in which only primary school pupils aged 5–15 years in the four randomly selected primary schools were included in the study. Those that are completely blind or mentally retarded were excluded from the study. The sample size was determined using the following formula:

$$n = z^2 pq/d^2,$$

where

n = Desired sample size (where the population is > 10,000)

z = Standard normal deviate, usually set at 1.96, which corresponds to the 95% confidence level

p = The proportion (prevalence) of the primary schoolchildren population estimated to have a refractive error from previous studies which was 7.3% (or 0.073).¹⁵

q = The proportion of the primary schoolchildren without refractive error, i.e.,

$$q = 1 - P = 0.927$$

d = The degree of accuracy (was set at 0.05)

$$n = 1.96^2 \times 0.073 \times 0.927/0.05^2$$

$$n = 104$$

Ten percent non response was anticipated, which was adjusted as $n_s = n/R = 104/0.9 = 116$ pupils.

One hundred and sixteen pupils were recruited for the study using a multistage sampling technique as follows:

- Stage I: Four primary schools were selected using simple random sampling technique (balloting)
- Stage II: From each selected school, stratified sampling technique was used for class 1 to class 6, then from each class arm, a subclass (e.g., A, B, C, or D) was selected using a simple random sampling technique (balloting)
- Stage III: From each of the selected subclass, systematic sampling technique was used to select pupils. Sampling interval was calculated using the formula N/n where N is the total number of pupil within the subclass and n is the proportionate allocation of the subclass. The starting number for each subclass was selected using simple random sampling technique (balloting).

The method of data collection included interviewer-administered semi-structured questionnaires containing information on sociodemographic data, average academic performance, and eye examination and the questionnaire was administered to selected pupils, parents, and class teachers by the research assistants. An Illiterate E chart was hung on a wall at a distance of 6 m away from where the pupil stood for the visual acuity measurement in the examination room and at a height of 2 m. Visual acuity was measured one eye at a time, with each pupil standing erect and facing directly to the chart, and then reading out the direction of the E letter on the charts starting from the biggest one to the smallest readable. The eye not being tested was covered with an occluder. For those with reduced visual acuity, i.e., 6/12 or worse, the pinhole visual acuity was then measured by peeping through a pinhole at the chart, and the pinhole visual acuity was then recorded. Refractive error was diagnosed based on a visual acuity of 6/12 or worse which improves with pinhole visual acuity testing.⁴ Collected data were cleaned, entered, and analyzed using the Statistical Package for Social Sciences (IBM SPSS) version 20 (SPSS Inc. Chicago, IL, USA) and MS Excel 2016. Pretesting was conducted with the field research team consisting of an ophthalmologist, two ophthalmic nurses, and two trained staff. Survey fieldwork was preceded by 2 days of staff training so as to familiarize them with the standard examination procedures involved. A day field pretesting exercise was conducted in a primary school which was not included in the final sampling to validate the data collection tools and to minimize interobserver variations. The average academic score was calculated by adding the aggregate score of the first-, second-, and third-term continuous assessment and examination scores and calculating the average.

Frequency distribution tables were constructed; cross-tabulations were done to examine the relationship between categorical variables, Chi-square test was used to compare differences between proportions, and Student's

“*t*”-test was used to compare means. All statistical analyses were set at 5% level of significance ($P < 0.05$).

Approval for the study was sought and obtained from the Health Research Ethics Committee of Usmanu Danfodiyo University Teaching Hospital Sokoto. Approval to conduct the study was also obtained from Sokoto Universal Basic Education Board and head teachers of selected schools. Written informed consent was sought and obtained from the parents of the participating pupils and assent was obtained for each participating pupil.

RESULTS

A total of 116 questionnaires were administered, out of which 113 questionnaires were completed fully, thus giving a response rate of 97.4%. Three pupils were excluded from the study because they were not fully cooperative with visual acuity measurement. The mean age of the pupils was 10.89 ± 2.27 years, with a male-to-female ratio of approximately 1:1. Majority of the respondents (46%) were between the ages of 10 and 12 years, and more than half (54.5%) of all cases of URE lie within this age group. The prevalence of URE equals pupils with URE/total population of respondents, i.e., $11/113 = 9.7\%$ [Table 1].

Only 11 (9.7%) respondents have had previous eye examination, whereas a majority of them (90.3%) have never had a prior eye examination. The previous history of eye examination was seen to be more common in children with URE ($\chi^2 = 17.695$, $P = 0.000$). About two-thirds of the parents of the respondents were using eyeglasses, and about 67% of the paternal parents have completed tertiary education, whereas more than two-fifths of the maternal parents had no Western education. Majority of the respondents’ parents (over $2/3^{rd}$) were civil servants, and about one-third of them were businessperson. Farmers form $<2\%$ of commercial activities of the respondents’ parents [Table 2].

More than half (6 [54.6%]) of the respondents with URE scored an average academic score of $<50\%$, whereas all normal sighted respondents scored $>50\%$. Only one in 11 of those with URE had an average score of $>70\%$ and above, a contrast to one in two for respondents without refractive error ($\chi^2 = 64.968$, $P = 0.000$) [Figure 1].

DISCUSSIONS AND CONCLUSIONS

Goal four of the Sustainable Development Goal ensures that all children have an inclusive and equitable quality education; however, an undiagnosed URE tends to prevent schoolchildren from such right. In this study, the prevalence of URE was found to be 9.7%; similar findings were reported within Nigeria¹⁵⁻¹⁸ and across Africa.¹⁹⁻²² These findings were about two or more folds lower than those reports from Asian countries.²³⁻²⁸ These differences may be due to the genetic composition of different racial group and some environmental factors. The prevalence of URE was found to be more common in females than males (54.5% vs. 45.5%) although the difference was not statistically significant ($P = 0.775$). Mahjoob *et al.*,²⁷ Mehari and Yimer,²² Yared *et al.*,²¹ Nebiyat *et al.*,⁴ Hashim *et al.*,²⁹ and Ajaiyeoba *et al.*³⁰ reported a high prevalence of URE in females than their male counterparts. Only about 10% of the respondents, most of whom have an URE ($\chi^2 = 17.695$, $P = 0.000$), had a prior ocular evaluation. Similar findings were seen in reports from the southern part of the country^{17,31} and neighboring country.²⁰ These suggest that West African regional countries have not mandated the routine visual screening as part of school health services at school entry. The prevalence of URE increases with age ($P = 0.018$),

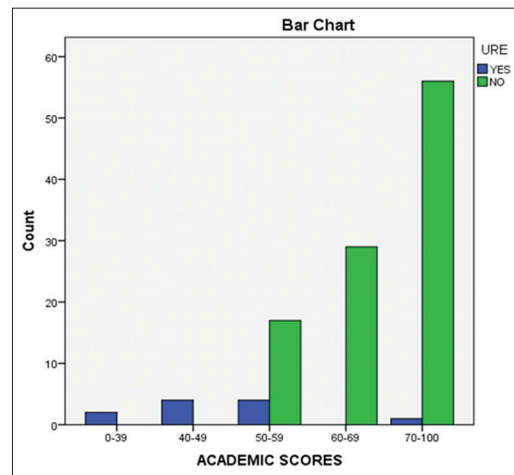


Figure 1: Relationship between uncorrected refractive error and academic performance of the respondents. URE: Uncorrected refractive error, YES: URE present, NO: URE absent, Count: Number of students, Academic score: Average academic scores

Table 1: Distribution of uncorrected refractive error among primary schoolchildren, according to sex and age group

Variables	Normal vision (n=102), n (%)	URE (n=11), n (%)	Total, n (%)	P
Sex				
Male	51 (45.1)	5 (4.4)	56 (49.6)	0.775
Female	51 (45.1)	6 (5.3)	57 (50.4)	
Age (years)				
<7	0 (0.0)	1 (0.9)	1 (0.9)	0.018
7-9	29 (25.7)	2 (1.8)	31 (24.7)	
10-12	46 (40.7)	6 (5.3)	52 (46.0)	
13-15	27 (23.9)	2 (1.8)	29 (25.7)	

URE – Uncorrected refractive error

Table 2: Sociodemographic characteristics of the pupils and their parents

Variables	Normal vision (n=102), n (%)	URE (n=11), n (%)	Total, n (%)	P
Previous eye examination of pupil				
Yes	6 (5.3)	5 (4.4)	11 (9.7)	0.000
No	96 (85.0)	6 (5.3)	102 (90.3)	
Eyeglasses usage by the parent				
Yes	34 (30.1)	3 (2.7)	37 (32.7)	0.684
No	68 (60.2)	8 (7.1)	76 (67.3)	
Level of father's education				
Primary	2 (1.8)	0 (0)	2 (1.8)	0.356
Secondary	21 (18.6)	1 (0.9)	22 (19.5)	
Tertiary	69 (61.1)	7 (6.2)	76 (67.3)	
None	10 (8.8)	3 (2.7)	13 (11.5)	
Level of mother's education				
Primary	7 (6.2)	0 (0)	7 (6.2)	0.802
Secondary	28 (24.8)	3 (2.7)	31 (27.4)	
Tertiary	30 (26.5)	3 (2.7)	33 (29.2)	
None	37 (32.7)	5 (4.4)	42 (37.2)	
Father's occupation				
Businessperson	29 (25.7)	5 (4.4)	34 (30.1)	0.472
Civil servants	71 (62.8)	6 (5.3)	77 (68.1)	
Farmers	2 (1.8)	0 (0)	2 (1.8)	

URE – Uncorrected refractive error

peaking at the age group of 10–12 years. Goh *et al.*³² show the relationship between refractive errors, with age being present in 9.8% of children at the 7th year of age, increasing to 34.4% at the 15th year of age. Other researchers like Maul *et al.*,³³ Pi *et al.*,²⁵ Rudnicka *et al.*,³⁴ and Okoro and Odeyemi (2013)³¹ gave similar assertion. About two-thirds of the parents of the respondents were using eyeglasses; however, no statistical difference was observed between the parents of normally sighted children and those with UREs ($P = 0.684$). These findings were similar to what was obtained by Hashim *et al.*²⁹ while conducting a research on the prevalence of refractive error in Malay primary schoolchildren in suburban area of Kota Bharu, Kelantan, Malaysia. Similarly, Aniza *et al.*³⁵ found no relationship between visual impairment and use of eyeglasses by the parents. This study shows no relationship between URE and parental education or occupation. Although Rajesh *et al.*³⁶ reported similar findings, several researchers established the association between these variables and refractive error.^{2,15,34,37} These differences may be due to the fact that the respondents' parents were from a similar socioeconomic background.

The average mean academic performance of the pupils with URE (49.54% ±10.49%) was found to be significantly lower than those without refractive error (71.08 ± 10.09), mean difference = 21.55 (95% confidence interval, 15.18–27.92) ($t = 6.70, P = 0.000$). Similar findings with regard to low vision and poor academic performance were found by Chen *et al.*¹¹ in Malaysia, Kotingo *et al.*⁵ in southern part of Nigeria, Toledo *et al.*⁹ and Gomes-Neto *et al.*⁷ in Brazil, Williams *et al.*³⁸ in the United Kingdom, and Taylor *et al.*³⁹ in the United States of America. This may be due to the fact that more than 80%

of what the child learns in school comes through the use of the eyes.

CONCLUSION

This study concludes that about one in every ten schoolchildren has an undiagnosed URE, and it is more common in females and older schoolchildren. About 90% of the respondents have never had a previous eye examination. The average mean academic performance of the pupils with an URE was found to be significantly lower than those without refractive error.

The negative implications of URE on the quality of education and other socioeconomic aspects of life underscore the need to increase efforts on its screening and increase other relevant interventional measures.

Recommendations

An undetected URE can be a stumbling block to a child's educational pursuit. Thus, establishment and integration of an effective school eye health into school health program where a compulsory visual acuity assessment is performed before registering a pupil into primary school and subsequently screening annually while the child is in school. Secondly, pupil found to have reduced visual acuity should be referred to an eye care specialist for appropriate treatment before school entry. Lastly, Teachers should be equipped with the basic knowledge and instruments for the training of the visually impaired children.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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