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Original Research

Refractive error and visual impairment in primary s

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Abstract

Background: Vision problems have been shown to adversely affe

Aim: To determine the prevalence of refractive error and visual im

Setting: The study was conducted in a primary school in Onitsha,

Methods: A stratified random cluster sampling method was used primary schools in Onitsha North and South. A total of 1020 childr included visual acuity measurements, ocular motilities, retinoscop and fundae.

Results: The prevalence of uncorrected, presenting and best corr respectively. Refractive error accounted for 86.6% of all causes of astigmatism (36.1%) and hyperopia (17.5%). Refractive error and 0.04). Refractive error was highest among children aged between and 7 years.

Conclusion: The prevalence of refractive error and visual impairm for services and strategies to address these conditions in that area

Introduction

Refractive error (RE) is an optical defect of the eye that prevents p cause of visual impairment (VI) and blindness worldwide.[1 (#CIT00] 2006, 153 million people had uncorrected refractive error (URE) o [(#CIT0004_455)] The resulting VI can lead to health, socio-economic in developing countries such as Nigeria.[5 (#CIT0005_455)] Refractive refractive surgery, with spectacles being the most common and co

Studies on the prevalence of RE and VI have been conducted in va Southeastern[8 (#CIT0008_455)] and South–South,[9 (#CIT0009_455)] ar prevalence and causes of VI, with most being conducted on older and VI peculiar to children in each community, as this varies from

geographical and socio-economical differences, which may have a
VI in Onitsha, Anambra State, Nigeria. Data on RE and VI will be u
in this group. In addition, the information can be used as baseline

Methods

Onitsha is an urban area located on the eastern bank of the Niger
children from all the private and public schools in Onitsha North ar
projected to be 15 324 by the year 2017.[10 (#CIT0010_455)] A multi
the baseline sample size was determined using the equation[11 (#C

$$N = (Z)^2\ (1.0 - P)\ (P) / ([B][P])^2$$

where *P* is the anticipated prevalence of RE, *B* is the desired error
previous studies conducted in Nigeria ranged between 7.3% and 2
estimates from previous studies, was used. The minimum sample
adjust for anticipated absenteeism and non-participation rate, whi

Children aged between 5 and 15 years whose parents or legal gua
were children who gave verbal assent and/or signed assent, childr
Children younger than 5 years and older than 15 years, those whc
provide informed consent were excluded from the study. Ethical ap
Biomedical Research and Ethics Committee (BE620/16) and Onitsl
Declaration of Helsinki for research involving human subjects. The
with the children in their schools. Each school provided a room in
the children would be called out of class to have their eyes tested

Clinical examination

Clinical examinations were conducted by five optometrists in the 1
Anambra State, Nigeria. Examination procedures followed the orig
distance visual acuity (VA) was measured with a retro-illuminated
Ocular deviations were evaluated with a cover test at both distanc
degree of tropia measured using corneal light reflex and neutralisi

Examination of the anterior segment was performed with a pen to
used: two drops of 1% cyclopentolate eye drops administered 15
administered. The light reflex and pupil dilation were checked afte
or greater and a light reflex was absent. Cycloplegic refraction wa
a semi-dark room at a distance of 67 cm and a +1.50 D lens in th
according to the manufacturer's instructions. The auto-refractor w
rankings were obtained for each eye. Using the objective refractio
refraction was determined using the trial frame. Refractive error w
refractive correction with or without pinhole.

Examination of the crystalline lens, vitreous and fundus was perfo
who had an unaided VA of 20/40 or worse in either eye to ascerta

Pilot study

Prior to the main study, a pilot study was conducted among 50 pri
procedures, methods and logistics. All queries that arose from the
main study was performed.

Definition of terms

Uncorrected VA of 20/40 or less was regarded as mainly because
20/40 or less, less than 20/63 and 20/200 or less were used in de
or more and astigmatism as −0.50 D or more using subjective ref

Data management and analysis

Class enumeration and clinical examination data forms were revie
Assistance of a statistician was sought for the data analysis, which

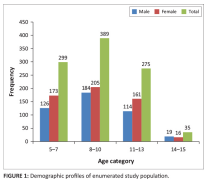
Social Sciences (SPSS) version 24. Ranges, means, standard devi
correlation tests were used to investigate relationships between a

Ethical consideration

The study was approved by the Biomedical Research and Ethics C
the heads of the identified schools, Onitsha, Nigeria, and the stud

Results

Of the 1020 primary school children aged between 5 and 15 years
(97.8%) participated in the study. The participants included 443 (
was 9.01 ± 2.5 years and 389 (39%) were aged between 8 and 1



(https://avehjournal.org/index.php/aveh/article/viewFile/455/

Visual acuity

Of the 998 children examined, uncorrected VA of 20/32 or better i
20/40 or worse in the better eye and 20 (2%) wore spectacles. Ei
13 (13.4%) had best corrected VA of 20/40 or worse in the better
prevalence of uncorrected VA of 20/40 or worse in the better eye
).

TABLE 1: (https://avehjournal.org/index.php/aveh/article/viev
acuity.

Refractive error

Ninety-seven (9.7%) children who had VA of 20/40 or worse in eit
(87.6%) right eyes and 79 (81.4%) left eyes. However, pupil dilat
eyes, while the absence of light reflex without full pupil dilation wa
children satisfied one or both criteria for *cycloplegia dilation* in bot

Hyperopia ranged from +1 D to 5 D with retinoscopy and from +1
hyperopia decreased with increasing age and was highest among
−11.50 D with auto-refraction. Myopia increased with increasing a
and 15 years. Astigmatism of −0.50 D to −1.75 D was found in 2
and 38 (39.2%) left eyes with auto-refraction. Astigmatism of ≥ 2
(4.1%) right eyes and 6 (6.2%) left eyes with auto-refraction. The
children. The prevalence of hyperopia ranged between 17.5% and
retinoscopy, the prevalence of myopia ranged from 6.2% in 5- to
refraction, the prevalence of myopia was 49.5%, while auto-refrac
co-operation, fixation and claustrophobia.

TABLE 2: (https://avehjournal.org/index.php/aveh/article/viev

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Of the 97 children who had RE, 45 (46.4%) had myopia, 35 (36.1
two (43.3%) children who had RE were males, while RE was highe
aged between 14 and 15 years (**Figure 3 (#F0003_455)**). Refrac
0.00) and gender (Pearson's $\chi^2 = 4.17$, $p = 0.04$). Myopia was sig
hyperopia were not significantly associated with age and gender (

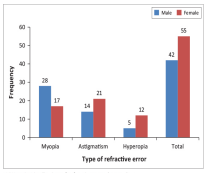

FIGURE 2: Distribution of refractive error by gender.

(https://avehjournal.org/index.php/aveh/article/viewFile/455/

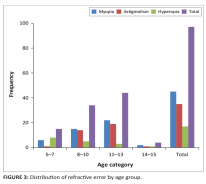

FIGURE 3: Distribution of refractive error by age group.

(https://avehjournal.org/index.php/aveh/article/viewFile/455/

Out of 70 eyes of 35 children with astigmatism, 41 (58.6%) eyes

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TABLE 3: (https://avehjournal.org/index.php/aveh/article/viev

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Ocular anomalies

Exotropia accounted for the highest proportion of deviations and t
10 (1%) with distant fixation. Twenty-one (72.4%) of the tropias
at near. The exterior and anterior segment abnormalities were obs
eyes of 10 (1%) children. Conjunctival abnormalities were present
in two eyes of two (0.2%) children, and an abnormal lens was obs
retinal degenerations, were present in 8 eyes of 12 (1.2%) childre

Causes of visual impairment

Of the 97 children with uncorrected VA of 20/40 or worse in the b
refraction, while 13 (13.4%) could not be improved to ≥ 20/32 in
eye) was therefore 13 (1.3%) (**Table 4 (#T0004_455)**).

TABLE 4: (https://avehjournal.org/index.php/aveh/article/viev

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Nine (69.2%) children who had VI were females and 4 (30.8%) ar
aged between 8 and 10 years and no VI was found in children old
(Pearson's χ^2 = 19.36, p = 0.00) but not with gender (Pearson's χ

Discussion

Except for a relatively large number of 8- to 10-year-olds and a sr
reasonably uniform. The high response rate in this study could be
Onitsha, so the children felt it was an opportunity to get their eye
teachers and Parent-Teacher Association (PTA) also contributed to

The prevalence of RE among primary school children aged betwee
Health Organization (WHO) prevalence range of 2% – 10% report
Table 5 (#T0005_455) **6 (#CIT0006_455)** ,**7 (#CIT0007_455)** ,**8 (#CIT0**
(#CIT0016_455) ,**17 (#CIT0017_455)** ,**18 (#CIT0018_455)** ,**19 (#CIT0019_4**
(#CIT0024_455) ,**25 (#CIT0025_455)** ,**26 (#CIT0026_455)** ,**27 (#CIT0027_4**
various ages in a range of African countries.

TABLE 5: (https://avehjournal.org/index.php/aveh/article/viev

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The prevalence of 9.7% for URE is higher than the 2.2% reported
Nigeria, specifically the 7.3% and 8.7% in Lagos,**28 (#CIT0028_455)**
However, the prevalence is lower than 22.5% and 58.0% reported
prevalence recorded in Bayelsa study could be because of the fact

and normal VA could have been missed. In addition, the current st
among 4- to 15-year-olds, which could have accounted for this dif
rates of conditions than in the general population.[9 (#CIT0009_455)]
for the differences between them. For example, the current study
of RE, while a sample size of 4225 and VA of 20/32 or worse were

Comparison of the current study with studies in Africa shows that
5 (#T0005_455)). The differences observed in the prevalence cou
authors and differences in demographic variables. Moreover, lifest
variations in the prevalence of RE.[31 (#CIT0031_455)] Recently, incre
dwellers, have been suggested to be factors influencing the preva
increased near work and indoor activities common among urban d
[(#CIT0032_455)] However, other studies have shown the prevalence
developed areas.[33 (#CIT0033_455)] Although racial and ethnic differ
have also shown that genetically determined factors (such as eye
light exposure) to impact RE development in black people.[2 (#CIT0

Various studies have shown that gender differences at the age of
parameters of males and females being reported, which suggests
found to be significantly higher in females (56.7%) than males (4
[(#CIT0006_455)] South-South Nigeria,[9 (#CIT0009_455)] Kebbi State N

Studies have shown that the human eye grows by 5 mm from birt
[(#CIT0006_455)] The prevalence of RE has been reported to increase
population,[7 (#CIT0007_455)] indicating the possibility of a relationsh
highest (48.9%) among children 11 to 13 years old. Similar findin
[(#CIT0009_455)] in South-South Nigeria. However, a study in Enugu
between RE and age. The large age range of 12–21 years used in

Myopia was the most prevalent (46.4%) URE found in this study.
urban environment engage more in indoor and near work activitie
,[32 (#CIT0032_455)] Studies in Abia State[8 (#CIT0008_455)] and Bayels
condition among primary school children aged between 7 and 17
environments, variations in the prevalence rates could be attribute
the current study used a sample size of 998 and an age range of
4225 and an age range of 7–17 years. In addition, the present stu

Studies in Tanzania and South Africa by Wedner et al.[14 (#CIT0014
prevalent refractive condition among children aged between 5 and
China,[36 (#CIT0036_455)] Vietnam,[37 (#CIT0037_455)] Egypt[38 (#CIT00
studies was attributed to the high prevalence of myopia in Asians
early detection and management being highly indicated for educat

In this study, myopia was found to increase with age, starting fror
6 which is the grade for preparing and writing entrance examinati
onset of myopia. A possible reason could be the onset of juvenile
because of axial elongation that is usually caused by intensive nea
progression starting from 12 to 17 years in Abia State, Nigeria, wi
[(#CIT0039_455)] and South Africa,[15 (#CIT0015_455)] with the upward

Myopia was found to be significantly associated with males (p = 0
activities, such as computer video games, chatting on phones, rea
chores. Msiska et al.[17 (#CIT0017_455)] also found myopia to be sig
Mayeku[18 (#CIT0018_455)] reported contrary results in Tanzanian ar
[(#CIT0020_455)] did not find any significant association between ger
of the diverse age groups in the study samples. The prevalence of
be among the reasons for the differences observed in the prevaler
astigmatism are important, as most asthenopic symptoms that co
of astigmatism of −0.50 D or worse found in this study was high.

with increased near work. The prevalence is lower than 38.8% rep
comparable to 6.1% and 7.8% recorded in South-South Nigeria a
discrepancies could be the inclusion of diverse age and ethnic grou

With-the-rule astigmatism was the most common type found in th
Similar findings were reported by Atif et al.[16 (#CIT0016_455)] amon
Naidoo et al.[15 (#CIT0015_455)] found astigmatism to increase with
study did not find astigmatism to increase with age, the variability
gender difference in the prevalence of astigmatism in this study, t

The prevalence of hyperopia was low (**Table 5 (#T0005_455)**), w
involved in near work and less outdoor activities, thus reducing th
study is higher than those reported in other Nigerian studies but l
(#T0005_455)). This wide variation could in part be because of t
the various studies. For example, Ahuama and Atowa[8 (#CIT0008_4
and higher (**Table 5 (#T0005_455)**). The study by Ahuama and
could have increased the prevalence of hyperopia, as it is well rep
(#CIT0017_455) ,**19 (#CIT0019_455)** Hyperopia was found to decrease
because of the fact that this younger age group is prone to be mo
and near work compared with the older age groups. Similar findin
(#CIT0008_455) as well as in China,[36 (#CIT0036_455)] Chile[39 (#CIT0
the present study, a result similar to that reported by Opubiri et a
but contrary to findings obtained by Kawuma and Mayeku[18 (#CIT
refraction in some of these studies could also have influenced the
hyperopia.

The prevalence of VI was 1.3%, indicating that VI is relatively unc
that reported in other Nigerian studies by Megbeleyin and Asana[2
(**Table 5 (#T0005_455)**). It is, however, not possible to make ge
backgrounds and methodologies used. Most (84%) uncorrected V
other studies.[9 (#CIT0009_455)] ,**15 (#CIT0015_455)** ,**19 (#CIT0019_455)**
(#CIT0043_455) ,**44 (#CIT0044_455)** ,**45 (#CIT0045_455)** ,**46 (#CIT0046_4**
amblyopia, retinal disorders, corneal opacity and albinism, which a
Ghana by Kumah et al.[20 (#CIT0020_455)] This study also recorded
of VI.

Several limitations of our study must be acknowledged. First, som
and 6-year-olds was difficult because of poor attention span, lack
other population-based RESC surveys and the fact that the sample
state or country. Future studies should include all children in Onits

In conclusion, this is the first RESC study undertaken in Onitsha,
primary school children were 9.7% and 1.3%, respectively. These
need to conduct local studies to establish regional baseline data to
screening for teachers and school healthcare may ensure early de

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Competing interests

The authors declare that they have no financial or personal relatio

Authors' contributions

N.E.E. and K.P.M. made equal contributions to the writing of this a

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