Prevalence of Refractive Errors among Children in Different Geo-political Zones of Nigeria

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ABSTRACT

Background: Most children in developing nations only notice a problem with their vision when they had started schooling and are hence unable to cope with studies, causing poor school performance. Information on prevalence of childhood refractive errors in Nigeria is necessary to design and implement strategies to contain the associated challenge, but this is lacking.

Method: This was a descriptive review of literatures reporting prevalence of refractive errors. A total of 11 out of 26 articles recovered through internet searches qualified for inclusion and full text review. Results were summarized with SPSS.

Result: Myopia was the commonest form of the refractive eye disorders in Nigeria of 9.73±10.31, with a range of 0.65% to 31.05% (95% CI = 2.81 – 16.66). The mean prevalence of hypermetropia in the studies reviewed is 4.92 ± 5.33%, with minimum and maximum values of 0.20% and 19.03% respectively (95% CI = 1.34 – 8.50). The average prevalence for astigmatism was 10.36 ±21.83% with range of 0.81% to 75.50% (95% CI = -4.30 – 25.03), while median prevalence of the three refractive errors were 4.5% for myopia, 3.8% for hypermetropia whereas astigmatism was 2.38%.

Conclusion: This study has pinpointed the burden of childhood refractive errors in different geopolitical zones of Nigeria and have provided evidence that the subject matter is understudied in our locality This calls for the need for more research in the area and also for the government to scale up quality eyecare for children in different parts of Nigeria

INTRODUCTION

Ocular problems such as myopia, hyperopia and astigmatism have been blamed as the main etiology of curable but undetected eye defects in school age children (Uhuanmwen, 2014). Screening these children for these refractive errors is a veritable tool in diagnosing and averting these visual impairments in children. Moreover, uncorrected refractive errors remain a public health problem among different population groups studied in Nigeria and elsewhere (Balarabe, Adamu & Abubakar, 2015). This challenge that can impact negatively on a child's school performance also has potential to cause permanent visual impairment in adulthood if it is not diagnosed early and managed promptly. Although these refractive errors are common among populations in many developing countries, neither enough attention has been paid to the problem nor the significant benefit health measure to reverse the trend appreciated. Undoubtedly, greater attention is frequently paid to certain uncommon health challenges in the same countries. This behaviour may not be unconnected to assumption that refractive errors are a benign, non-life-threatening minor trouble which of course do not qualify for such measures that may seemingly be disproportionate to their low priority (Semanyenzi, Karimurio, & Nzayirambaho, 2015).

Uhuanmwen (2014) also observed that children are born with intact eye structures essential for sight but their usage of these structures are progressively learnt to fully develop and mature with their physical growth progresses. This vision continues to evolve throughout their pre-school years and time of completion of primary school often corresponding with time this visual system is typically completely developed. Late recognition of visual abnormality in any of the stages of eye development in children could cause a permanent visual impairment. Additionally, refractive errors have been shown to increase with age, hence the need for vision screenings to continue throughout the school age years.

In addition, Uhuanmwen (2014) noted that vision screening is a practical approach to detection of children who may need professional eye services and care. It has been proven to be an efficient, economical, cheap and effective means of isolating sufferers and halting potential vision problems or eye disorders which could lead to relative visual impairment and possible total loss of vision in school age populations. Although not a diagnostic tool on its own, this has been proven useful when it is complemented by appropriate and prompt referral, treatment and management of identified problems. Hence, it is a practical approach to identifying children needing professional eye services and prevent possible complications of visual problems including physical, intellectual, social, academic and emotional formation of these individuals which can go into adulthood.

The visual system starts developing at 3 months of age and ends at age of six years. Any problem that interferes with the arrival of images to the visual cortex during these formative years becomes more difficult to reverse later. Refractive defects are one of the problems that causes children not to develop the visual system properly. Therefore, it is important to detect refractive errors in children early. When the child is one year old, he is normally hyperopic of +1.50ds (+/-0.25D) with astigmatism of not

more than 1D that decreases gradually until 3 years old. The preschool stage of children is a stage where refractive error has lower incidence, because the interaction of different dioptres has been compensating this condition and because the conditions that produce refractive errors in adults have not been activated yet. Therefore, early examinations are necessary for children because problems at this stage are easier to solve due to a greater plasticity of the visual and cerebral system.

Current studies estimate 285 million people all over the world to be visually impaired from different visual anomalies. Out of this number, 153 million are from uncorrected refractive errors, of which 8 million are blind (Resnikoff, Pascolini, Mariotti & Pokharel, 2008). Different research studies have indicated refractive error as the leading cause of visual impairment, (Scott & Ajaiyeoba, 2003; Ashaye & Asuzu, 2005; Okoye & Umeh, 2002). In 85.9% of children tested in Ghana, refractive error was found to be the cause of visual anomaly (Ovenseri, Ogbomo & Assien, 2010). In school-aged children, uncorrected refractive errors affect academic achievements of these children, especially in regions hit by poverty (Onua & Pedro-Egbe, 2012; Dineen, Gilbert, Rabiu, Kyari, Mahdi, Abubakar et al., 2008).

Because of the population size of Nigeria, nearly 25% of Africa's childhood visual impairment originates from Nigeria. In the recent global estimate of visual impairment due to refractive errors, children aged between 5 and 15 years old were visually impaired from uncorrected refractive error, having a prevalence rate of 0.96% globally (Kawuma & Mayeku, 2002). Refractive errors include myopia, hyperopia and astigmatism. They cause defocusing of images formed on the retina of a relaxed eye resulting in poor vision and asthenopia. Uncorrected refractive errors in children can result in amblyopia, limited or slow academic progress, poor social functioning and impaired quality of life. These errors can be easily diagnosed, measured and corrected. However, refractive errors often remain uncorrected due to various reasons, such as lack of awareness or failure to recognize symptoms in children by parents and teachers.

Although numerous studies report prevalence of refractive errors every year, many new articles are published on epidemiology of these errors annually due to their importance and prevalence. Although recent studies suggest an increase in prevalence of myopia due to lifestyle changes, differences in ethnic groups, measurement methods, definitions of refractive errors and age groups of participants hinder a definite conclusion regarding the pattern of distribution of refractive errors worldwide. When a child with visual impairment is not corrected on time, it leads to poor grades in school for the child, thereby affecting the child psychologically.

Studies on prevalence of refractive errors in Nigeria are mostly from urban regions and data got from clinics and hospitals in different parts of Nigeria (Nwosu, 1997; Nworah & Ezepue, 1973; Olurin, 1973). These studies established refractive errors to be common among Nigerian children with prevalence rates of 7.3% (Faderin & Ajaiyeoba, 2001) to 8.9% (Yoloye, 1990). In another study in Kaduna, Northern Nigeria, among secondary school students, Abiose, Bhar & Allanson (1980) found out that

refractive errors were the second most common ocular anomalies.

Evidence shows that roughly 90% of children who developed visual problems are not receiving optimal education, giving as a result factors like discrimination, stigmatisation and lack of access to appropriate schools (WHO, 2007; Holden, 2007). Literatures also hints that most of visual defects in both developed and developing countries is either preventable or manageable (Gilbert & Foster, 2001; Keeffe, 2004). There is also an ample evidence documenting that timely detection and effective therapy for underlying causes of visual impairment at this delicate time of visual formation is thus fundamental approach for mitigating this untoward impact (Kvarnström, Jakobsson & Lennerstrand, 2001; Ehrlich, Braddick, Atkinson, Anker, Weeks, Hartley et al., 1997; Lithander & Sjöstrand, 1991).

One important factor to be considered in designing policies to contain the menace of visual impairment, especially the ones occurring as a result of refractive errors is availability of data. Reliable statistics on the prevalence of refractive errors in children are instrumental for formulating a systematic vision screening program with valid and reliable test protocols (Atowa, Hansraj & Wajuihian, 2019). This information is necessary in directing the application of available resources and efforts for early identification of at-risk group, thus ameliorating both the immediate and long-term impact of these refractive errors on our health system and society. Therefore, the overall aim of this literature review was to document the prevalence of uncomplicated refractive errors in school-age children from the six geopolitical zones of Nigeria.

METHODS

This was a review undertaken through a detailed evaluation of studies on school children in different regions of Nigeria. Nigeria has six geopolitical zones: South-East, South-West, South-South, North-West, North-East and North-Central. Keywords for search included ‘prevalence of refractive error’, ‘school children’, ‘myopia’, ‘hyperopia’ and ‘astigmatism’ in children in Nigeria. Only epidemiological studies with participants of 20 years old and below were included. Search was conducted on online databases such as Google scholar, Researchgate, Pubmed, Hinari and Science direct to collect data on this review.

Specifically, features that guided the selection of the different articles reviewed included characteristics such as study setting (Nigeria), bearing in mind the criteria for inclusion and exclusion. In all the studies, the samples of population were selected either from schools, in hospitals or ophthalmologic centers. For the determination of population samples, the different studies were on children aged 20 years old and below in primary and post-primary schools. Variables of interest for review included: sample size, sampling method, gender, age, prevalence rates of corresponding studies, information on diagnostic criteria and measurement techniques. A summary of each study was first presented and evaluated in relation to findings from other studies. Mean representation of the various refractive errors reported were computed along with the standard deviation. Findings from studies that met outlined criteria were thoroughly reviewed and summarized with the aid of SPSS (SPSS Inc. v23, Chicago) and presented using tables according to the geographical zones where the studies were

done, and flow diagram for ease of understanding.

Inclusion and Exclusion Criteria

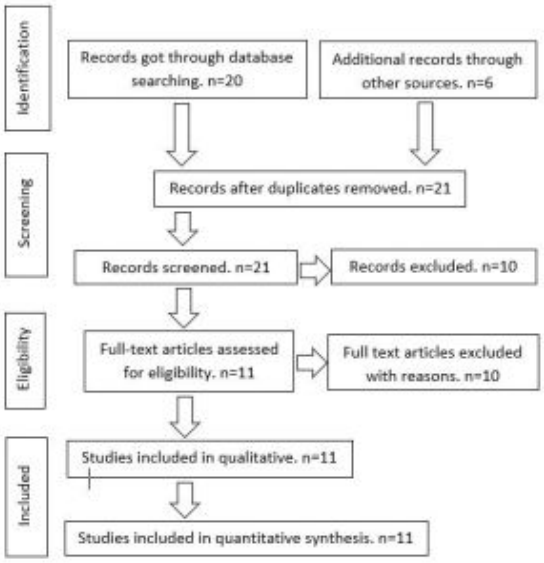
Studies that reported prevalence of refractive errors in children in Nigeria were considered for full text review. Studies that reported prevalence of only one refractive error or prevalence of refractive error with other ocular anomalies were excluded from study. Furthermore, studies reporting prevalence of combined refractive errors were excluded from review.

Characteristics of Excluded Study

A total of ten studies were excluded from the review as they either reported prevalence of only one refractive error or prevalence of refractive error with other ocular anomalies. Moreover, studies that reported prevalence of combined refractive errors were excluded from review.

Figure 1.

Article screening and selection



LITERATURE REVIEW OF PREVIOUS STUDIES ON SCHOOL AGE CHILDREN IN DIFFERENT GEOPOLITICAL ZONES OF NIGERIA

There were wide variations in the prevalence of refractive errors reported in Nigeria with very few eligible studies found in the Northern hemisphere. Some of the studies were also very old.

One study was reported in Abia state (South-East) Nigeria by Ahuama and Atowa (2004). The authors carried out a study through visual screening in which 2,525 school children aged 7 to 17 years from one primary and one secondary school in Abia state were examined. The participants were randomly selected, they were all refracted both objectively and subjectively using retinoscope and trial case respectively. The results showed a prevalence rate of 31.05% for myopia, 19.13% for hyperopia and 7.80% for astigmatism. Frequency of distribution of myopia was found to show a linear progression with age while that of hyperopia was found to be on the decrease within the same age range.

In Birnin-kebbi (North-West) Nigeria, Balarabe, Adamu and Abubakar (2015) carried out a prospective cross-sectional study that was conducted over a period of 2 months, from May to June 2014, in three secondary schools. A total of 614 students who were aged from 11- 20 years were randomly selected for the study, amongst whom 312 (50.8%) of them were males whereas 302 representing the remainder of 48.2% were females. Visual acuity was measured with a Snellen chart and students who had subnormal visual acuity (VA $\leq$ 6/9) were further examined using pinhole and subsequently referred for detailed eye

examination. Refractive error in either eye was present in 30 (4.8%) of the children. Of these, myopia was diagnosed in 18 (2.93%) children, hyperopia in 7 (1.14%), and astigmatism in 5 (0.81%).

In another study in Onitsha (South-East) Nigeria, Ezinne and Mashige (2018) used stratified random cluster sampling method to select 1,020 children aged between 5 and 15 years from seventeen primary schools in Onitsha North and Onitsha South, with 998 (97.8%) examined to determine visual acuity and ocular motilities. Examination was via retinoscopy and autorefraction under cycloplegia. Results showed astigmatism in 3.51% of the patients, hyperopia in 1.7% and myopia in 4.5%.

In Kano (North-West) Nigeria, Lawan and Eme (2008) carried out a retrospective study on the pattern of refractive errors in children of 15 years of age and below in Aminu Kano teaching hospital from January to December 2007. The clinic refraction register was used to determine the proportion of out-patients presenting with refractive errors, and prevalence of refractive errors in children. The authors retrieved the case folders of all patients refracted during the review period. The patients studied had unaided and pin hole visual acuity done with Snellen's or "E" charts (for verbal and school age children). All of the subjects had basic eye examination including fundoscopy to rule out other causes of subnormal vision, and as well streak retinoscopy at two third meter working distance. Patients for cycloplegic refraction were placed on atropine 1% ointment twice a day for two days before the procedure was done. The final refraction given to patients was used to categorize the types of refractive errors. A total of 4687 out patients were seen during the study period, 857 were children aged 15 years or less. Of this total, 1376 patients had refractive errors and 248 were children. The results showed astigmatism in 2.81% of the children, hypermetropia in 1.01%, myopia in 1.01% and aphakia in 0.26%.

In Onitsha, South-East Nigeria, Nwosu and Alozie (2006) conducted a study among consecutive school children at the Guinness Eye center Onitsha between September 2001 and August 2002, with patients that had visual acuity of 6/9 or worse in at least one eye, complaints of visual blurring, eye strain, brow ache or discomfort while reading. Cycloplegic refraction on each child was performed, using 0.5% tropicamide eyedrops. Post-cycloplegia was performed within 72 hours. Of the 306 patients, 301 (98.4%) of them had ametropia. Astigmatism occurred in 231 (75.5%), myopia in 47 (15.4%) and hyperopia in 23 (7.5%). Anisometropia was present in 80 (26.1%) children, 16 of whom did not improve with refraction.

Agagu, Duru, Chigozirim and Isibor (2017) also conducted a study in Port-Harcourt, South-South Nigeria, in which 1,680 children aged between 5 to 15 years were selected by multistage cluster sampling method from fifteen different schools. After obtaining a written consent, participants had unaided and aided visual acuity tests, with those that had subnormal vision examined using pinhole, cover test, auto refractor and subjective refraction. A total of 1,535 (91.4%) completed their examinations. Of these, myopia was diagnosed in 59 patients (3.8%), hyperopia in 113 (7.4%) and astigmatism in 177 (11.5%), while 1,186 (77.3%) were emmetropic. The prevalence of refractive error discovered in females in this study was 22.7%.

In one study done in Lagos, South-West Nigeria, Faderin and Ajaiyeoba (2001) aimed to determine refractive errors among primary school children in Nigeria Army children's schools. A total of 919 pupils from two primary schools were selected using stratified random sampling methods. In school A, mean age of pupils was 8.5 years while at school B, the mean age of pupils was 10.5 years. They were refracted with retinoscope and subjective refraction was carried out. Hypermetropia dominated with 3.8% of all errors and was common between 6-15 years of age, myopia was found in only 0.65% and was common in children of less than 8 years of age, while astigmatism was seen in 2.83% of the children.

In Bayelsa state, South-South Nigeria, Opubiri, Adio and Emmanuel (2013) carried out a retrospective review of data from children aged between 4 – 15 years who were refracted at the Optometric unit of the Ophtamology department of Niger Delta University Teaching Hospital between January 2009 and December 2012. Out of the total of 506 children who were seen in the hospital, 114 children had refractive errors out of which 72 were females while 42 were males. The prevalence of myopia, astigmatism and hyperopia was 13.8%, 6.1% and 2.6% respectively. Refractive errors were further shown to be more common in females than the male counterpart.

In the most recent study in Ado-Odo Ota local government area of Ogun state, South-West Nigeria, Ogbonna (2020) conducted a study on prevalence of refractive errors among children aged 4 to 9 years in the area using multi-stage sampling to recruit 205 participants attending primary schools in this area. Following ocular pathology screening for the children, subjects who were found fit were refracted objectively and subjectively using auto refractor and trial lenses respectively. Results showed myopia to have a highest prevalence of 24.88%, while hyperopia was 2.44%, and astigmatism 3.42%. The study further revealed that older children had higher frequencies of refractive error than the younger ones with males having more refractive error than the female counterpart (19.51% and 11.22%) respectively.

Another recent study was conducted by Obajolowo, Ademola-Popoola & Olatunji (2019) in North-Central Nigeria. It was a descriptive, cross-sectional, school-based study of 464 children enrolled by multistage sampling. Visual acuity (VA) of selected children was assessed using the Lea symbols chart. Children meeting the referral criteria of VA worse than 20/30 (6/9.5), two lines difference in VA between the eyes, visible anterior and posterior segment anomalies, and untestable children with the Lea symbols thereafter had a comprehensive eye examination. Seventy (15.1%) of the children screened were 3 years' old, 176 (37.9%) were 4 years, whereas 218 (47%) were 5 years' old. Nine hundred and twenty-eight eyes of 464 children were screened; 707 (76.2%) eyes in 332 (71.6%) children had VA 6/9.5 or better, whereas 184 (19.8%) eyes in 112 children (24.1%) had VA worse than 6/9.5 and 37 (4%) eyes in 20 children (4.3%) were untestable. An identifiable cause of VI was found in 36 eyes of 23 children, giving a prevalence of 5%. The causes of VI were myopia (2.5%), astigmatism (1.8%) and hypermetropia (0.2%).

Finally, Uhuanmwen (2014) also did a relatively recent case study in Lagos Nigeria (South-West) in which the author screened

primary school children for refractive errors in an urban school. This was cross-sectional study conducted between November and December, 2012. The study population were school age children from primary 1-6 and the pupils age was 5–11 years. Near acuity was done at 40cm and distance visual acuity for each eye was assessed by an intern Optometrist at 6 meters distance. Those with visual acuity of 6/12 or less were presented with a pinhole and the test repeated. Improvement of visual acuity with pinhole was considered refractive error. Penlight examination was carried out to check for external examination and opthalmoscopy was done under dim illumination to check the internal status of the eye. The Ishihara chart was used to assess the color vision. A total of 580 (340 females and 240 males) pupils were examined. Of these, 506 pupils (87.24%) had no refractive error but 74 pupils (12.76%) had refractive errors including amblyopia and color vision defects. Myopia was found to be highest refractive 51.35%, followed by hyperopia 29.73%, astigmatism 10.81%, amblyopia 2.70% and color vision 5.41%. This translates to overall prevalence of 6.56%, 3.8% and 1.4% for myopia, hypermetropia and stigmatism respectively.

RESULTS

A total of twenty-five articles were gotten through database searches in PubMed central, Google scholar, Science direct, Hinari, etc, whereas six works were sourced through other platforms. However, ten works were duplicated and thus were removed. In addition, another ten works were screened out for failing the eligibility requirement. Therefore, eleven articles qualified for full text review.

(See Table 1.)

Out of the eleven studies reviewed, seven recorded myopia as the most prevalent, though with wide margin. For instance, study by Ahuoma and Atowa (2004) in Abia State, South-East recorded the highest prevalence of myopia to be 31.05%; Balarabe et al. (2015) documented prevalence of 2.93% in Birnin-kebbi (North-West), Ezinne and Mashige (2018) found a rate of 4.5% in Onitsha, South-East, while a South-West study by Ogbonna (2020) recorded a prevalence rate of 24.88% in Ogun. The average prevalence of myopia in this study was 9.73±10.31. This ranged from 0.65% to 31.05%. (95% Confidence Interval = 2.81 – 16.66).

However, for some other three results of the various studies reviewed, astigmatism was reported to be the highest prevalence among school children in Nigeria. Highest prevalence rate of astigmatism was recorded by Nwosu and Alozie (2006) who established a prevalence of 75.5% in Onitsha, South-East Nigeria. Also, Lawan and Eme (2008) reported higher prevalence than either of myopia and hypermetropia of 2.81% prevalence rate in Kano (North-West), as well as Agagu et al. (2015) who found 11.5% prevalence rate in Port Harcourt (South-South) while Nwosu and Alozie (2006) recorded prevalence rate of 75.5% in (South-East). The mean prevalence of hypermetropia as found in the studies is 4.92 ± 5.33% (95% Confidence Interval = 1.34 – 8.50), with minimum and maximum values of 0.20% and 19.03% respectively. One Lagos study (South-South) by Faderin and Ajaiyoba (2001) was the only study that recorded higher prevalence of hyperopia compare to the other refractive errors. The average prevalence of this specific refractive

error as documented by the studies is 10.36 ±21.83% with range of 0.81% to 75.50% (95% Confidence Interval = -4.30 – 25.03). The median prevalence of the three refractive errors as shown by the studies were 4.5% for myopia, 3.8% for hypermetropia while astigmatism was 2.38%.

DISCUSSION 1

The detection and successful management of visually significant refractive errors, especially in children is a matter of continued investigation and debate (Lawan & Eme, 2008) all over the world, but particularly in undeveloped countries. Children affected by visual impairment resulting from refractive errors, making them to face a significant problem during the school age which has a considerable impact on public health.

Findings from the results of this review show that myopia was the most prevalent refractive error documented in most of the studies among school aged children in the six geopolitical zones of Nigeria. South-Eastern part of the country had the highest prevalence at 31.05%, followed by South-West at 24.88%, while the least prevalence of myopia was recorded in the Northern hemisphere. The average prevalence for this specific refractive error was 9.73%. Interestingly, the prevalence of myopia noted in this study is not in concord with the observations of African children elsewhere, although the average in the prevalence of refractive errors reported are comparable. While this study recorded myopia as the most common of the three refractive errors, other African studies most frequently documented astigmatism as the leading cause of refractive error in these children. For instance, when compared with the reports of recent surveys in our region, a study by Khan, Jangir, Kochar and Bhargawa (2016) in North-west Rajasthan reported a highest prevalence rate of 12.4% for astigmatism followed by 6.3% for myopia while hyperopia was 5.8%. Another Ugandan study, though relatively older, conducted by Kawuma and Mayeku (2002) found a high prevalence rates of 6.1% for astigmatism, 4.33% for hyperopia, while myopia was seen in only 1.28% of the population sampled. Additionally, evidence from two Iranian studies done by Alrahili, Jadidy, Alahmadi, Abdula'al, Jadidy et al. (2017) on one hand, and Hashemi, Yekta, Jafarzadehpur, Ostadimoghaddam, Etemad, Asharlous et al. (2016) on the other hand showed that the prevalence of astigmatism (25.3%) was higher compared to that of hypermetropia (1.5%), and myopia (0.7%) in Alrahili et al. (2017) study; and the prevalence rates of myopia, hyperopia and astigmatism were 3.04% (95% CI: 2.30-3.78), 6.20% (95% CI: 5.27-7.14), and 17.43% (95% CI: 15.39-19.46), respectively in the later.

However, this finding, though relatively lower than the prevalence rate reported by Hashemi, Rezvan, Beiranvand, Papi, Yazdi, Ostadimoghaddam et al. (2014) in Iran supports their result in the sense that myopia was the commonest error found. In the study, the prevalence of myopia, hyperopia and astigmatism was 29.3% [95% confidence interval (CI), 25-33.6%], 21.7% (95%CI, 17.8-25.5%), and 20.7% (95%CI, 16.9-24.6%), respectively.

Elsewhere in the Western world, Wen, Tarczy-Hornoch, McKean-Cowdin, Cotter, Borchert, Lin, Kim, Varma et al. (2013) reported prevalence of myopia, hyperopia

and astigmatism in non-Hispanic, White and Asian children of 1.20% (95% Confidence Interval (CI) = 0.76-1.89%), 25.65% (95% CI= 23.5-27.9%), and 6.33% (95% CI = 5.21-7.68%), respectively. In this study, hyperopia was the most frequent and was very high. These results are quite different from the findings of this present review in Nigeria. These observed differences could be explained by the differences in the study design and measurements. The use of different measurement methods affect the outcome of results. For instance, in most of the reviewed studies in Nigeria, only few used cycloplegia which affected outcome of type of refractive error since some patients could be pseudomyopes, some could have latent hyperopia which may not be revealed with just subjective refraction. Ngozika and Khathutshelo (2008); and Nwosu et al., (2006) were the only studies that used cycloplegia.

Geographic or environmental factor is another possible explanation for the disparities. Different environment could affect our development and optimal function in different ways.

Limitations of the Studies

While all studies reviewed included a relatively large sample sizes in their measuring technique, some flaws inherent in the study designs may have affected the generalizability of this findings. Some of the studies did not detail their eligibility criteria for subject enrolment. Moreover, convenience sampling method of participant selection in the participating schools studied may limit the generalization of findings of study. In addition, all the different geopolitical zones of Nigeria were not adequately represented in the study (North-East) due to lack of documented evidence or published literature on the subject of the research; there were very limited studies on prevalence of refractive errors among children especially in Northern Nigeria.

Also, most of the studies did not take into account that when measuring visual acuity in children, it should be considered whether the child is in preverbal, verbal stage or have reached intellectual maturity and usage of appropriate visual acuity chart for each particular age. There were marked disparities in the ages of the children studied (Rand = 3-20 years). In the study conducted by Balarabe et al. (2015), sample were children between ages of 11 to 20 years, cycloplegia was not carried out and trial lens was used for refraction, acceptance of either plus, minus or cylindrical lens by child was dispensed, which would have affected true refractive status as true refractive state cannot be revealed by trial lens method alone. Cycloplegic refraction determines absolute refractive value through paralysis of accommodation, especially in children. Worst still, Opubiri et al. (2013) in their study sampled children between ages of 4-15 years. Method of measurement used to diagnose refractive error was not indicated as data was extracted from records department of eye clinic for the study. Also, method of measurement of visual acuity was also not indicated in the study especially for children of age 4 years who requires Snellen E chart or Lea chart for visual acuity measurement.

In the study by Ogbonna (2020), Logmar chart was used for visual acuity of children tested which were between the ages of 4 to 9 years. In this, although myopia was well defined as spherical equivalent of -0.50ds and above after retinoscope and subjective refraction, hyperopia was defined as

spherical equivalent of least +1.00ds and astigmatism as cylindrical power greater than -0.75ds, visual acuity measurement for children especially at age four is best done with Lea chart or Snellen E chart. Moreover, since study sample in Lawan and Eme (2008) study was children 15 years and below, use of appropriate visual acuity chart for that age group would have been indicated which was not, this would have affected visual acuity measurement especially for the very young children.

In the studies conducted by Nwosu and Alozie (2006); Agagu et al. (2017); and Ezinne and Mashige (2018), there was use of cycloplegia. Agagu et al. (2017) study clearly defined myopia as ≥ -0.50ds, hyperopia as ≥ +1.00ds and astigmatism as ≥-0.50ds cylinder. Although visual acuity of 6/9 or less can detect myopia in children of school-age, there is no reliable visual acuity threshold for clinically significant hyperopia and astigmatism, high amounts of hyperopia and astigmatism have been reported in children who were able to read 6/6 on VA chart. To determine the actual prevalence of refractive error in study samples, cycloplegic refraction should be performed on all children irrespective of visual acuity.

What's more, most of the studies did not have a definitive criteria for the minimum amount of error considered as refractive error. In Faderin Ajaiyeoba's study, incidence of hyperopia was 3.8% in a sample size of 919 participants, hyperopia was more prevalent in age group of 6-15 years with only objective and subjective refractions done without cycloplegia. Astigmatism greater than 1D occurs in 50% of children under 3 and a half years old and it decreases until 4 years old in about 12%. From 5 to 13 years there are no changes in refractive error of more than 0.5D and prevalence of myopia increases between 9 and 19 years old (Garcia de Oteyza, 2003). Moreover, most of the studies used only objective and subjective refraction in determining refractive errors, to make comparison of findings among studies, a better approach is to develop a standardized method of measuring visual acuity among children in Nigeria.

Nevertheless, this review has highlighted the previous studies documenting prevalence of refractive errors in school age children in various geopolitical zones of Nigeria using different methods across studies in identifying children with these abnormalities. It has also shown that there is dearth of literature in Nigeria addressing refractive problems among the school aged children. This information is highly desired to map out strategies for a heightened screening for early detection and treatment of these errors especially in children in whom it truncates their chances for successful adaptation in schools.

DISCUSSION 2

This study was a retrospective literature review of the prevalence of refractive errors among children in different geopolitical zones of Nigeria. A total of twenty-six articles were screened with 11 meeting the inclusion criteria, three from South-East, two each from South-West and South-South. In the North, two studies were from North-West while only one study was reported in North Central. There was no eligible published literature for review in the North-East. Myopia was identified as the most common form of the refractive eye disorders in Nigeria of 9.73±10.31, with a range of 0.65% to 31.05%. (95% Confidence Interval = 2.81

– 16.66). The mean prevalence of hypermetropia in the studies reviewed is 4.92 ± 5.33%, with minimum and maximum values of 0.20% and 19.03% respectively (95% Confidence Interval = 1.34 – 8.50). Regarding astigmatism, the average prevalence was 10.36 ±21.83% with range of 0.81% to 75.50% (95% Confidence Interval = -4.30 – 25.03). The median prevalence of the three refractive errors as shown by the studies were 4.5% for myopia, 3.8% for hypermetropia while astigmatism was 2.38%. This literature review has pinpointed the burden of refractive errors among children in different geopolitical zones of Nigeria and have also provided evidence the subject matter is understudied in our locality, especially the Northern part probably due to poverty and lack of basic amenities to access those parts of the country, especially in the wake of persistent armed conflict in the region.

Good visual acuity and good vision is very important for school children to be able to achieve good academic performance in school. In view of this findings, and particularly the scarcity of literatures in Nigeria documenting this assessment, notably in the Northern part probably due to poverty and lack of basic amenities to access those parts of the country, especially in the wake of persistent armed conflict in the region, there is need for improvement visual screening of children of school age in all geopolitical zones of Nigeria especially in the Northern hemisphere in order to support and increase their performance in school and make learning interesting.

It is also important that the government incorporates eye health to be able to help out the children with visual problems since most children normally do not complain about their poor vision but try to cope with by moving close to television, going very close to the board and avoiding reading, hence the need for early visual screening and detection.

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APPENDIX

Table 1.

Distribution of refractive errors in the different Geopolitical zones of Nigeria.

Study	State	Sample size	Type of study	Measurement technique	Age	Geopolitical zone	Prevalence of myopia	Prevalence of hyperopia	Prevalence of astigmatism
Ahuama &Atowa (2004)	Abia	2525	Visual screening	Retinoscope Subjective refraction	7-17 years	South-East	31.05	19.03	7.8
Balarabe, Adamu &Abubakar (2015)	Birnin kebbi	614	Prospective study	Trial lens	11-20 years	North-West	2.93	1.14	0.81
Ezinne & Mashige (2018)	Onitsha	1020	Stratified random cluster sampling	Cycloplegic refraction, retinoscopy, Autorefraction	5-15 years	South-East	4.5	1.7	3.51
Nwosu & Alozie (2006)	Onitsha	306	Random study	Cycloplegic refraction	15 years and below	South-East	15.4	7.5	75.5
Lawan & Eme (2008)	Kano	857	Retrospective study	Auto refraction, subjective refraction	15 years and below	North-West	1.01	1.01	2.81
Agagu, Duru, Isibor & Choko (2017)	Port-Harcourt	1535	Multistage cluster sampling	Auto refraction, subjective refraction	5-15 years	South-South	3.8	7.4	11.5
Faderin & Ajaiyeoba (2001)	Lagos	919	Stratified random sampling	Retinoscope, subjective refraction	6-15 years	South-West	0.65	3.8	2.83
Opubiri, Adio & Emmanuel (2013)	Bayelsa	506	Retrospective review	Not indicated	4-15 years	South-South	13.8	6.1	2.6
Ogbonna (2020)	Ado-Odo Ota	205	Cross-sectional research method	Auto-refractor and subjective lens	4-9 years	South-West	24.88	2.44	3.42
Obajolowo, Ademola-Popoola & Olatunji (2019)	Illorin	464	Descriptive study	Cycloplegic auto refraction and retinoscope	3 – 5 years	North-Central	2.5	0.2	1.8
Uhuanmwen (2014)	Lagos	580	Descriptive study	Not indicated	5-11 years	South-West	6.56	3.8	1.4
Mean ± SD (Range)	N/A		N/A	N/A	N/A	N/A	9.73±10.31 (0.65-31.05)	4.92 ±5.33 (0.20-19.03)	10.36 ±21.83 (0.81-75.50)