African Vision and Eye Health
ISSN: (Online) 2410-1516, (Print) 2413-3183

Refractive error prevalence among the traditional Quranic boarding schools in Al-Gezira, Sudan

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Dates:
Received: 07 Aug. 2022
Accepted: 29 Aug. 2023
Published: 24 Oct. 2023

How to cite this article:
Mohamed ZD, Vankudre GS. Refractive error prevalence among the traditional Quranic boarding schools in Al-Gezira, Sudan. Afr Vision Eye Health. 2023;82(1), a804. https://doi.org/10.4102/aveh.v82i1.804

Background: Uncorrected refractive error is an avoidable aetiology of visual impairment, negatively affecting children's quality of life. There is limited evidence related to the prevalence of refractive errors among the children or adolescent population within Sudan.

Aim: To determine the prevalence and types of refractive error among children enrolled in traditional Quranic boarding schools in the Al-Gezira state, Sudan.

Setting: This cross-sectional, quantitative study conducted within the student population of traditional Quranic boarding schools in Al-Gezira, Sudan.

Methods: A total of 551 male children from eight schools underwent subjective and objective refraction, including direct ophthalmoscopy as well as binocular vision assessment.

Results: Out of the total 551 school children, the refractive error prevalence was 6.2% (n = 34). The prevalence of myopia among the participants was 5.1% (n = 28), followed by hypermetropia 1.1% (n = 6). Astigmatism was diagnosed in 3.3% (n = 18) of the study population classified as myopic astigmatism of 2.4% (n = 13) and hyperopic astigmatism 0.9% (n = 5).

Conclusion: This study found the prevalence of refractive errors among the children as 6.2%. It provides baseline data about refractive error among the children in this sample, which is useful as a reference point, however further studies need to be conducted in all the Quranic schools of Sudan.

Contribution: This study offers a principal information about the ametropia among the children in this community and highlights the need for further refractive errors related epidemiological studies within the region.

Keywords: prevalence; refractive error; hyperopia; myopia; astigmatism; children; Sudan.

Introduction

Uncorrected refractive error (URE) is the second leading cause of avoidable blindness worldwide, posing a challenge to the global eye healthcare system.[1,2,3] The URE affects around 1 billion people globally.[4] Of the 19 million children worldwide with visual impairment (VI), approximately 65% relate to refractive errors only.[1,5] Importantly, around 1% of the global population within the ages of 5 years to 15 years old have VI because of uncorrected or inadequately corrected refractive errors.[3] Among the different types of refractive errors (such as myopia, hypermetropia or astigmatism) myopia is the most common refractive error among school-going children as well as adolescents and myopia has the potential to create ocular morbidity.[4] Similarly, studies in South Africa and Nigeria found that URE was the main cause of reduced vision in African children.[6,7] As a result of the potential increased threat to the public health system, observing VI and refractive error prevalence within the school-going adolescent population of Al-Gezira state, Sudan would be beneficial to future intervention strategies.

Development of refractive error is multifactorial and refractive conditions such as myopia are sometimes associated with genetics. Also, environmental factors such as light intensity or exposure to near work, play a key role in the development of refractive error.[8] Variability in refractive error prevalence is also observed in different geographic regions as well as with social economic profiles within populations.[9] Developing countries have a double risk of VI because of the non-correction of refractive error and the cataract-related blindness.[9] In addition, rapid urbanisation in recent years has followed behavioural transitions among the African population. Most of the African continent's population is young and exposed to more indoor and near activities as compared with previous generations. Increased educational awareness and exposure to recent technologies such as mobile or other electronic[10,11] devices are also

placing this population at a higher risk of developing refractive conditions such as myopia.[4]

The potential danger of URE among school-going children poses a major risk to their learning abilities as well as their academic progress,[12] which might lead to future socioeconomic effects[4,13] and possible loss of educational opportunities and decreased job prospects as well. Uncorrected refractive error poses a public health challenge among children and adolescents and almost half of this population remain uncorrected.[14] Proactive vision screening strategies and timely management of refractive errors among vulnerable populations ensures overall improvement in their quality of life.[1] Unfortunately, current governmental and/or organisational practices have not been able to provide the required attention for visual screenings among the young Sudanese population.[15] As the health of young, African children and adolescents is important to the African continent for its development, the issue of URE needs to be urgently addressed.[4] There is limited evidence related to the prevalence of refractive error among children or adolescents within Sudan but URE is considered as one of the most prevalent ocular disorders among Sudanese school children.[3] This study provides baseline data for refractive error prevalence among young children within the traditional Quranic boarding schools of Sudan. It also focuses on determining the types and magnitude of refractive errors among children enrolled in traditional Quranic boarding schools in the Al-Gezira state, Sudan.

Methods

Study design

This was a cross-sectional, quantitative study conducted among the student population of traditional Quranic boarding schools (*Maseed*) based in Al-Gezira state, Sudan where children learn and write the Quran. The students' age for this study were between 6 years and 15 years. Inclusion criteria were being all children who attended the Quranic Boarding Schools in Al-Gezira state. Exclusion criteria were any ocular diseases or operations.

Sample size and statistical analysis

As there are no formal registration processes in these traditional schools because of a non-governmental authority for these traditional schools,[16] the sample size was calculated using the formula for estimating a single population proportion (i.e., an unknown statistical population), which is:

$$N = (Z/M)^2 \times (P) \times (1 \times P), \quad \text{[Eqn 1]}$$

where N is sample size, M is the margin of error, P is an estimated value of the proportion, and Z is the confidence interval.[17] The sample of study was selected according to 95% confidence interval (CI). The minimum sample size should be round up to 384 to achieve a 95% CI with a margin of error of 5%. A total of 551 Quranic boarding school children distributed among eight schools in Al-Gezira state were included.

A multistage sampling technique using two levels of the sampling process was used while selecting the schools within the region and eight schools were selected. The authors (who were optometrists) conducted this study within two phases among the selected sample. The first phase of the screening collected demographic data including name, gender, age, duration of study in Maseed, and origin of students. In addition, the researchers also collected data related to symptoms, family or personal history, which included systemic and ocular history. Three participants with ocular diseases were excluded from the study.

In the second phase, uncorrected as well as current habitual visual acuities were measured for all participants monocularly and binocularly using Snellen's visual acuity chart. Visual acuity was analysed using decimal notation. Anterior ocular health was assessed using a torch and Heine magnifying binocular loupes, while the posterior segment of eyes were evaluated using a Heine Beta 200 LED Ophthalmoscope. A Heine Beta 200 retinoscope and Nidek-AR-800 autorefractometer was used before subjective refraction. The American Academy of Optometry Clinical Practice and Classification Guidelines were used where necessary regarding the methodology for the refractions.[18]

Refractive errors were categorised considering the spherical equivalent (SE) of the spectacle prescription. Myopia was defined if SE ≤ -0.5 dioptre (D), hyperopia if SE ≥ 1.5 D, and astigmatism if cylindrical component of the spectacle prescription was > 0.5 D. The criteria for exclusion with regard to VA was defined as uncorrected or habitual VA of $<$ 6/9 (decimal acuity of < 0.67) in any eye. The subjective and objective refractions were conducted for children with VA $<$ 6/9 in one or both eyes.

Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 22 software for Windows 10 (Armonk, NY: IBM Corp) and Microsoft Excel 2016. The data were analysed using descriptive statistics. The relationship between age and myopia, duration period in the school and myopia were determined using Pearson's correlation test with $p < 0.05$ indicating significance.

Ethical considerations

The study followed the tenets of the Declaration of Helsinki. School authorities have authority to provide student consent and this was obtained from the schools included in the study. Ethical clearance to conduct this study was obtained from the Al Neelain University of Sudan (No. CN/KDP). Quranic school authorities received study information sheet and the consent form in the Arabic language from Al-Neelain University. All the schools agreed to participate in the study. The optometrist visited various schools as per agreement with the necessary authorities.

Results

Demographic profile of the participants

A total of 551 male participants with the mean age of 12.46 years (standard deviation [s.d.]: ± 1.97 years) were included in the study. Schools in the study were from all regions of Sudan and had only male students. Their duration in school ranged from 1 year to 8 years (s.d.: ± 1.55). Two (0.4%) participants had an ocular history of trauma, six (1.1%) had family history of diabetes and 10 (1.8%) were already wearing spectacles. The two participants with a history of ocular trauma had no serious ocular abnormalities and hence were included in the study.

Correlation between age and myopic refractive error

The mean age of the participants with myopia (n = 44) was 12.73 years (s.d.: ± 1.59). The spherical refractive error equivalent among myopic population was −1.08 D (s.d.: ± 0.60). A Pearson correlation coefficient was used to assess the linear relationship between spherical refractive error equivalent and age of the study participants. As shown in Table 1, there was a statistically insignificant correlation between the two variables, r (44) = 0.629, p = −0.075.

Refractive error profile among the study participants

Out of 551 children, refractive errors in either eye appeared in 34 (6.2%) children. The prevalence of myopia among the participants was 5.08% (n = 28), followed by hypermetropia 1.09% (n = 6). Astigmatism was found in 3.27% (n = 18) of the study population classified as myopic astigmatism 2.36% (n = 13) and hyperopic astigmatism 0.90% (n = 5) as in Figure 1 and Figure 2.

Types and degree of refractive errors among the study participants

Of 55 eyes with refractive error, 29 (52.7%) had astigmatism (Figure 2). Compound myopic astigmatism was most common (n = 7 [21.8%]) with most participants with low myopic refractive errors, that is, 44 (80%).

Participants' spherical equivalent and visual acuity profile

Table 1 is based on decimal VA measured using Snellen's visual acuity chart. The mean uncorrected decimal visual acuity was 0.97 (s.d.: ± 0.15), which improved with correction to mean decimal visual acuity of 0.99 (s.d.: ± 0.08).

TABLE 1: Participants' spherical equivalent and visual acuity.

Parameters	Minimum	Maximum	Mean	Standard deviation
VA	0.08	1	0.97	0.15
Binocular VA	0.25	1	0.98	0.11
SE	-2.88	5	-0.02	0.42
Corrected VA	0.08	1	0.99	0.08

SE, spherical equivalent; VA, visual acuity.

Discussion

Refractive errors are the leading cause of VI worldwide and their prevalence varies among regions and societies with these differences being partially related to genetic and/or environmental factors.[18] This study evaluates the prevalence of refractive errors among traditional Quranic Boarding Schools in Al-Gezira, Sudan. The prevalence of refractive errors among the children was 34 (6.2%). This is comparable to a study performed by Pradhan et al.[19] among children of similar age in East Sikkim, which found the prevalence of refractive error at 6.7%.[1] Another study[3] in Sudan by Ghalib et al. in Khartoum (an urban area of Sudan) had a prevalence of 27%, which is higher compared with our study. This indicates a significant variation between the refractive error prevalence within a similar region having higher prevalence among urban populations.

The prevalence of myopia (5.1%, n = 28) was the most common refractive error among the participants followed by hypermetropia at 1.1% (n = 6). This myopia prevalence is comparable to children in East Sikkim[1] and is similar to that for children of Hyderabad, India.[20] Myopia prevalence in the Sudan is higher than school children in North India,[21] and primary students in Chongqing.[21] About 3.3% (n = 18) of our study population had astigmatism with myopic astigmatism of 2.4% (n = 13) and hyperopic astigmatism of 0.9% (n = 5),

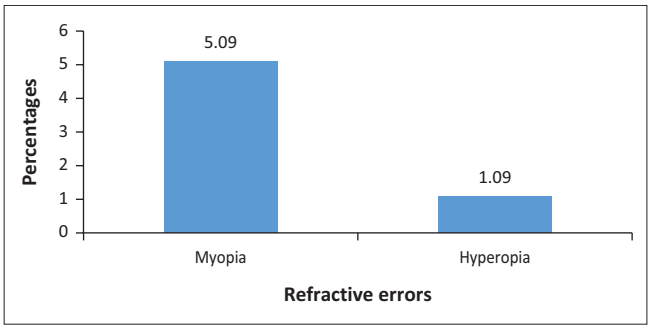

FIGURE 1: Classification of refractive errors prevalence among participants (spherical equivalent was used).

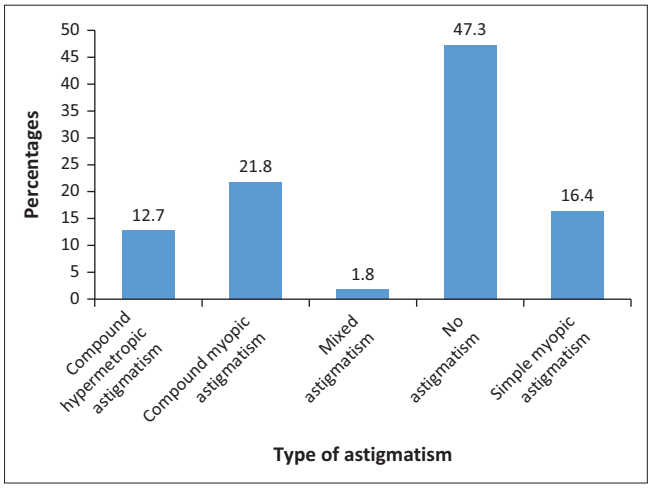

FIGURE 2: Prevalence for types of astigmatism among the 55 eyes having refractive error.

that is lower than a multicountry refractive error study findings in 2014.[22]

Most participants with myopia were aged between 11 years and 15 years, which is similar to studies by Olusanya et al. in Ibadan,[23] and in Osogbo, Nigeria.[24] While the current study could not find a correlation between age and prevalence of myopia, two studies in an urban region in India[25,26] found a positive association between myopia and age.

This study's finding provides introductory information on refractive error prevalence among the specified student population in Sudan. Uncorrected refractive error remains the most common cause of childhood VI in many countries,[25] and therefore screening for refractive errors is essential and should be conducted as part of the annual physical examination in all children.[26,27,28] Regular assessment in primary, secondary, and tertiary eye care is important for the management of preventable causes of URE and VI in traditional Quranic boarding schools in Al-Gezira state of Sudan.[29]

Conclusion

Refractive error prevalence among the children was 6.2%, with myopia being the most prevalent (5.1%), followed by hypermetropia (1.1%). Approximately, 3.3% of the study population had astigmatism with myopic astigmatism of 2.4% and hyperopic astigmatism of 0.9%. This study provides useful baseline data for refractive error among children within Quranic schools in Sudan. However, a wider or larger study needs to be conducted in all the Quranic schools of Sudan. Exposure for these children to intensive near work supports the need for evaluating refractive error prevalence (especially regarding progressive myopia) and changes perhaps in trends while conducting future epidemiologic studies.

Acknowledgements

Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

Z.D.M. and G.S.V. contributed equally to the article.

Funding information

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Data availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any affiliated agency of the authors.

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