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Abstract

Background: Childhood visual impairment is a global public health problem, especially in low and middle-income countries. Its most common causes are avoidable by early diagnosis and treatment.

Aims: To assess prevalence of refractive error and visual impairment among school-aged children in Hargeisa, Somaliland, Somalia.

Methods: This was a cross-sectional study of 1204 students (aged 6–15 years) in 8 randomly selected primary schools in Hargeisa from November 2017 to January 2018. We used the modified Refractive Error Study in Children to determine prevalence of refractive error and visual impairment, including the following investigations: distance visual acuity, assessed by Snellen Tumbling E-chart; refraction, assessed by retinoscope binocular vision assessment; and examination of anterior and posterior segments.

Results: Prevalence of uncorrected, presenting and best-corrected visual impairment of 6/12 or worse was 13.6%, 7.6% and 0.75%, respectively. Only 16 of 91 (17.6%) children were using spectacles and the rest were unaware of the problem. Refractive error was the cause of visual impairment in 76.8% of participants, amblyopia in 22.0%, trachoma in 2.4%, and corneal opacity and cataract in 0.6%. Anterior segment abnormalities were found in 8.3%, mainly vernal keratoconjunctivitis, while posterior abnormalities were observed in 0.7%. Prevalence of myopia was 9.1%, hypermetropia 2.7% and astigmatism 3.9%. Prevalence of visual impairment

because of Refractive Error was associated with increasing age, but there was no significant association with school grade or sex.

Conclusion: Prevalence of visual impairment among school-aged children in Hargeisa was high, and the leading cause was uncorrected Refractive Error. There are barriers to care and it is critical that they are overcome.

Keywords: refractive error, childhood visual impairment, myopia, hypermetropia, vernal keratoconjunctivitis

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Introduction

Globally, it is estimated that there are 36 million people who are blind, 216.6 million have moderate to severe visual impairment (VI) and 188.5 million have mild VI. The leading cause of VI is uncorrected refractive error (RE) (1,2). Furthermore, 90% of people with VI live in developing countries. Almost 19 million children aged

Somaliland, Somalia has a population of 4.5 million, with estimated urban poverty of 29%, which is similar to 26% in Ethiopia. Only about half of children aged 6–13 years go to primary school in Somaliland, in stark contrast to 87% in neighbouring Ethiopia (13,14). No studies have assessed VI and RE among school-aged children in Hargeisa, Somaliland. The aims of this study were to assess the common causes of VI, types of RE, and differences in prevalence according to sex, age and school grade.

Methods

Study design

This was a cross-sectional, school-based study of VI and RE among children from Hargeisa, Somaliland. According to the Ministry of Education, the overall number of students enrolled in public and private primary schools in Hargeisa during 2017–2018 was 243 485, comprising 127 829 boys and 115 656 girls. The modified RESC protocol was used to assess the prevalence of VI and RE in these children. Noncycloplegic refraction was used to assess the prevalence of RE, which is defined as follows: (1) myopia ≥ –0.5 D in one or both eyes; (2) hypermetropia ≥ 2.0 D ; and (3) astigmatism ≥ 0.75 D cylindrical refraction (11).

Inclusion and exclusion criteria

Children aged 6–15 years who attended school on the days of examination and their parents agreed to participate in the study. Children unable to provide parental consent were excluded.

Study sample

The study sample was selected through stratified multistage sampling. We assumed a prevalence of RE of 5% according to the estimated prevalence of childhood RE in Africa (5%), Sudan (6.8%) (5) and Kenya (5.1%) (15, 16). Considering a prevalance of RE of 5%, 95% confidence interval and maximum acceptable random sampling error of 1.5%, a sample size of 811, based on the formula below, was estimated. Considering the design effect = 1.5, a final sample of 1216 was estimated.

$$n = (z2\ pq)/d2 = (1.962 \times 0.05 \times 0.95)/0.0152 = 811 \Rightarrow 811 \times 1.5 = 1216$$

Considering a nonresponse rate = 10%, the final sample size was 1351 schoolchildren. The study sample comprised 8 schools (4 for boys and 4 for girls) that were randomly selected from 22 districts of Hargesia. One class from each grade (1–8) with a minimum of 21 children was randomly chosen.

Ethical considerations

Ethical permission for the study was obtained from Al-Neelain University, Khartoum, Sudan because of unavailability of an ethics committee in Somaliland. The study was conducted according to the Declaration of Helsinki guidelines. Informed consent was obtained from all participants. All forms and data sheets were shredded as soon as the details were entered into

the database system for analysis.

Clinical investigation

The clinical examinations were performed using the modified RESC protocol. Demographic information was collected from participants, and VA at distance was measured using the Snellen Tumbling E-chart with E's of standard size at a 6-m distance. Participants with VA ≤ 6/12 were assessed by pinhole test, and if their vision improved, they underwent retinoscopy without cycloplegia and subjective refraction. All children were examined by a penlight and low-power hand magnifier to assess any anterior-segment abnormalities in the eyelids, conjunctiva, cornea, pupils and pupillary reflex reaction. A cover test was conducted for heterophoria or heterotropia and the angle of deviation was measured using the corneal light reflex (Hirschberg test) and the Prism Cover Test at distance and near fixation, respectively. The ocular motility test was performed to assess eye muscle function. Subjective refraction was determined using a standard refraction trial set to achieve best correct vision for children whose vision improved with the pinhole test. Children with VA ≤ 6/12 whose vision did not improve by pinhole test had outer eye and fundus examination by direct ophthalmoscopy, and any abnormal findings were recorded as causes of VI.

Data analysis

Data for each participant were analysed descriptively using standard deviations and percentages with SPSS version 22. The relationship between measures was determined using correlation, cross-tabulations and $\chi 2$ analysis. For all statistical determinations, significance levels were established at $P = 0.05$.

Results

Study population

A total of 1351 children were selected to participate in the study and 1204 (89%) were actually entered into the study.

Demographic characteristics of participants

The 1204 participants were aged 6–15 years, with a mean of 11.18 [standard deviation (SD); 2.45] years (Table 1). There were 658 (54.7%) boys and 546 girls (45.3%). The mean (SD) age of the boys and girls was 11.15 (2.47) and 11.21 (2.44) years, respectively. Most participants were aged 11 (14.2%) and 12 (13.7%) years, respectively. The ages with the fewest participants were 6 (3.2%) and 7 (5.1%) years, respectively. There was no significant difference in mean age between the boys and girls (ANOVA: $F = 0.167$, $P = 0.683$), although there was a significant difference in mean ages of the children according to school grades (ANOVA: $F = 341.733$, $P = 0.01$).

Distribution of ocular signs and symptoms

A total of 943 (78.8%) participants did not complain of any ocular symptoms; 153 (12.7%) complained of blurred vision; 87 (7.2%) had itching and redness; and 15 (1.2%) had pain and photophobia.

VA

A total of 1044 children presented with normal vision (6/6) in the right eye; 1034 had normal vision in the left eye; and 1071 had normal vision in the better eye

(Table 2). Thirty-six, 38 and 42 children had uncorrected vision (6/9) in the right, left and better eye, respectively. An uncorrected VI was found in 164 children (13.6%, 95% CI, 11.7–15.5%), while 91 (7.6%, 95% CI, 6.1–9.1%) children had VI. With best-corrected VA, this decreased to 9 (0.75%, 95% CI, 0.3–1.2%) children.

Prevalence of VI

The prevalence of presenting VI was 91 (7.6%, 95% CI, 6.1–9.1%) and only 16 (17.6%) of these children were wearing spectacles. There were no significant association between prevalence of VI and age (P = 0.209), sex (P = 0.060) and school grade (P = 0.393). Girls had a higher prevalence of VI (4.6%, 95% CI, 3.4–5.8) than boys had (2.6%, 95% CI, 1.7–3.5%). Younger children age 6–7 years had lower prevalence of VI (2%, 95% CI, 1.2–2.8%) than those aged 10–11 years (3.4%, 95% CI, 2.4–4.4%), and the highest prevalence was in children aged 14–15 years (4.4%, 95% CI, 3.2–5.7%).

Binocular anomalies

Tropia was found in 9 (0.7%) children: 4 with esotropia and 5 with exotropia.

Anterior-segment examination

A total of 1104 children (91.7%, 95% CI, 90.1–93.3%) had no abnormalities detected in the right eye and 1103 (91.6%, 95% CI, 90.0–93.2) had no abnormalities in the left eye. Ninety-seven children (8.1%, 95% CI, 6.6–9.6%) had vernal keratoconjunctivitis in both eyes. Three children (0.25%, 95% CI, 0.03–0.5%) had trachoma in the left eye and 2 (0.2%, 95% CI, 0.1–0.5%) had trachoma in the right eye. One child had cataract in the right eye (0.1%, 95% CI, –0.1 to 0.3%) and one (0.1%, 95% CI, 0–0.3%) had corneal opacity in the left eye.

Prevalence of RE

A total of 189 children (15.7%, 95% CI, 13.7–17.8%) had REs, and 1015 (84.3%, 95% CI, 82.3–86.4%) were emmetropic (Table 3). Myopia had the highest prevalence

(n = 110, 9.1%), followed by astigmatism (n = 47, 3.9%) and hypermetropia (n = 32, 2.7%). The prevalence of RE was significantly associated with age (P = 0.011) but not sex

(P = 0.073) or school grade (P = 0.168). Prevalence of REs was higher among girls (n = 100, 18.3%) than boys (n = 89, 13.5). Prevalence of REs significantly increased with age. Children aged 15 years had the highest prevalence (n = 21; 17.5%), compared to those aged 8 years (n = 14, 14.3%),

7 years (n = 10, 16.1%) and 6 years (n = 5, 13.2%). Children in school grade 4 had the highest prevalence of REs (n = 33, 21.9%), and those in grade 2 had the lowest prevalence

(n = 16, 10.7%). The prevalence of myopia was increase with age; it was more common in children aged 15 years (10.8%) than in those aged 6 (5.3%), 7 (8.1%) and 8 (7.1%) years. In contrast, prevalence of hypermetropia was highest in children aged 6 years (5.3%), and lowest in those aged 15 years (0.8%). According to the gender the prevalence of myopia, hypermetropia and astigmatism was higher in girls at 10.3, 2.7 and 5.3%, respectively, than in boys at 8.2, 2.6 and 2.7%, respectively.

Posterior-segment examination

Posterior-segment examination revealed that 1196 children (99.3%, 95% CI, 98.8–99.8%) had no abnormalities. Ocular media and fundus abnormalities were seen in 8 (0.7%) children. Retinal disorders were found in 6 (0.5%) children and media opacity in 2 (0.2%).

Principal causes of VI

The causes of UVA of 6/12 or worse at least in 1 eye are presented in Table 4 . RE was the main cause of VI in 126 (76.8%) affected children, followed by amblyopia (n = 36, 22.0%) and corneal opacity and cataract (n = 1, 0.6%).

Schoolchildren who received eye drops or were referred

One hundred and forty-two children (11.8%, 95% CI, 10.0–13.6%) had uncorrected REs and were referred to Manhal Specialist Hospital, Hargeisa. Two children were referred for further examination and treatment of media opacity. Eighty-seven children (7.2%, 95% CI, 5.7–8.7%) were prescribed eye drops, and 15 (1.2%, 95% CI, 0.6–1.8%) received only advice for their complaints.

Discussion

Childhood blindness and VI are priority conditions targeted in Vision 2020: the Right to Sight Initiative of WHO (17). Knowledge of the prevalence of RE and VI among school age children can help the relevant authorities to plan and provide eye care services in the particular geographical area. The present study attempted to provide this information, as well as being the first study in Somaliland to assess the prevalence of the VI and RE among school-aged children.

Noncycloplegic refraction was used to assess REs in this study, similar to studies of school-aged children in Nigeria (18) and South Africa (19). Noncycloplegic refraction was chosen so as not to interfere with the academic activity of the children.

The prevalence of VI in the present study was 7.6%, which is lower than 10.1% in Malaysia (20) and 10.3% in China (21), but higher compared with 1.2% in South Africa (5) 1.2%, 2.67% in South America (22) and 3.5% in the Islamic Republic of Iran (23). These results indicate that VI among school-aged children requires urgent intervention by the community and nongovernmental organizations. The results also reflect lack of childhood eye care services in this region as well as lack of community awareness about the consequences of childhood VI.

In the present study, the prevalence of VI was higher among girls than boys (4.6% vs 2.6%), which agrees with a study in Ethiopia (3.2% for girls and 2.6% for boys) (24). This might have been due to socioeconomic factors that contributed to better access to health services for boys. However, the difference was not significant.

The prevalence of RE in either eye was 15.7%, which is lower than that in Ghana (25.6%) (25), India (25.1%) (26), Egypt (22.1%) (27) and Qatar (19.7%) (28), but higher than in Uganda (11.6%) (29), Ghana (13.3%) (30) and Saudi Arabia (13.7%) (31). The prevalence of RE in our

study was similar to that in Viet Nam (16.3%) (32) and Saudi Arabia (16.3%) (33). This variation may be related to the type of sampling method used, size of population screened, and variation in geographic location. We found no significant association between prevalence of RE and school grade or sex. However, we did show that the prevalence of VI caused by uncorrected RE increased significantly with age. Nevertheless, we found that prevalence of RE was higher among girls than boys (81.3% vs 13.5%), which, as mentioned above, might have been due to better access to health care for boys in this culture. This is consistent with a similar study in Saudi Arabia (34).

The prevalence of myopia was 9.1%, which is higher than 6.0% in Ethiopia (24) but lower than 14.1% in Ghana (30). In our study, older school children had a higher prevalence of myopia, which was similar to a study in Viet Nam (32). Alrasheed et al. (7) attributed this age-associated increase in myopia with decreased outdoor activity of many children and this has been reported as an issue in other studies (5,25,32).

The prevalence of hypermetropia in this study was 2.7%, which is significantly lower than that reported in studies in Ethiopia 26.4% (24) and Saudi Arabia 6.9% (35). However, it is higher than in South Africa (1.8%) (10) and China (1.6%) (36) but similar to Tunisia (2.61%) (37). The lower prevalence of hypermetropia in our study might have been due to use of noncycloplegic refraction, which could have missed a significant number of cases of hypermetropia. The prevalence of hypermetropia decreased with age and was higher in children aged 6 and 7 years compared with 14 and 15 years. This result agreed with Chebil et al. (37), who reported that this variation could be related to a decrease in the dioptric power of the lens (it goes form 23 D at age 3 years to 20 D at 14 years), or with an increase in the optical density of the crystalline cortex.

The prevalence of astigmatism in the current study was 3.9%. This is lower than that found in the Islamic Republic of Iran (6.6%) (38) and South Africa (14.6%) (5) but similar to that in Poland (4%) (39).

The prevalence of manifest strabismus was 0.7%, which is similar to that among children in the United Republic of Tanzania (0.5%) (40) but lower than in Iranian school children (1.2%) (41).

In this study, uncorrected RE was the most common cause of VI among children, and was responsible for 76.8% of cases. This is similar to other studies that used RESC protocol, such as in Ethiopia (77.3%) (24) and India (77%) (26) but lower than in Malaysia (87.0%) (20) and in

the Islamic Republic of Iran (87.3%) (23). Alrasheed et al. (7) suggested that this could have been because of genetic differences as well as different lifestyles in terms of outdoor activities. The second most frequent cause of VI among children was amblyopia at 22.0%, which is higher than in Sudan (5.6%) (6) and South Africa (9.6%) (4). This may be due to the high rate of poverty and illiteracy in Somaliland and the poor health system in the country.

In the present study, out of 91 children with VI, only 16 (17.6%) were already using spectacles, while the rest were not aware of the problem. This may have been due to lack of child and parental awareness of the vision problem, attitudes regarding the need for spectacles, cost of spectacles, cosmetic appearance, peer pressure and concerns that wearing glasses may cause progression of RE (42,43).

This study had several limitations. First, a large number of schools were not registered with the Ministry of Education in Hargeisa, so the study sample did not include all schools. Second, almost half of school-age children were not attending school due to poverty, thus the study only included children who attended school. Third, places of study and examination differed among schools in terms of lighting, ventilation and comfort. Fourth, distribution of children's ages at school levels was not uniform, so older children were not only in the eighth and seventh grades, and children aged 6 and 7 years were less prevalent in this study, because many children in Somaliland start school later than the recommended 6 years. Fifth, Log Mar charts were not available, so we used Snellen Tumbling E-charts, and slit lamps and fundus biomicroscopy were not easy to transport between locations, so they were replaced by torch and magnifier, and ophthalmoscopy. Finally, RE was assessed by noncycloplegic refraction, which could have missed a significant number of cases of hypermetropia.

Conclusions

The prevalence of VI among school-aged children in Hargeisa, Somaliland was high and the commonest causes were uncorrected REs. There are barriers to care and it is critical that they are overcome.

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Competing interests: None declared.

Prévalence du vice de réfraction et de la déficience visuelle chez les enfants d'âge scolaire de Hargesia, au Somaliland (Somalie)

Résumé

Contexte : Les troubles visuels chez l'enfant constituent un problème de santé publique mondial, en particulier dans les pays en développement. Ses causes les plus courantes sont évitables par un diagnostic précoce et la mise en place rapide d'un traitement.

Objectifs : La présente étude avait pour objectif d'évaluer la prévalence du vice de réfraction et de la déficience visuelle chez les enfants d'âge scolaire à Hargeisa, au Somaliland (Somalie).

Méthodes : Il s'agissait d'une étude transversale menée auprès de 1204 élèves (âgés de 6 à 15 ans) de huit écoles primaires sélectionnées de manière aléatoire à Hargeisa, entre novembre 2017 et janvier 2018. Nous avons utilisé l'étude modifiée sur le vice de réfraction chez les enfants afin de déterminer la prévalence de cette affection et de la déficience visuelle, comprenant les examens suivants : acuité visuelle à distance, évaluée par l'échelle de Snellen avec des E ou C directionnels ; la réfraction, évaluée par examen de la vision binoculaire par rétinoscopie ; et examen des segments antérieurs et postérieurs.

Résultats : La prévalence de la déficience visuelle non corrigée, détectée et la mieux corrigée de 6/12 ou un score inférieur était respectivement de 13,6 %, de 7,6 % et de 0,75 %. Seuls 16 enfants sur 91 (17,6 %) portaient des lunettes tandis que les autres n'avaient pas conscience du problème. Le vice de réfraction était la cause de la déficience visuelle chez 76,8 % des participants, l'amblyopie dans 22,0 % des cas, le trachome chez 2,4 % des enfants, et l'opacité cornéenne et la cataracte chez 0,6 % d'entre eux. Des anomalies du segment antérieur ont été observées chez 8,3 % des participants à l'étude, principalement des kératoconjonctivites vernales, tandis que des anomalies du segment postérieur ont été observées dans 0,7 % des cas. La prévalence de la myopie était de 9,1 %, celle de l'hypermétropie de 2,7 % et celle de l'astigmatisme de 3,9 %. La prévalence de la déficience visuelle due à un vice de réfraction était associée à un âge supérieur, sans toutefois que l'on puisse noter de corrélation significative

avec le niveau scolaire ou le sexe.

Conclusion : La prévalence de la déficience visuelle chez les enfants d'âge scolaire de Hargesia était élevée, principalement en raison d'un vice de réfraction non corrigé. Il existe des obstacles aux soins et il est essentiel de les surmonter.

WHO EMRO | Prevalence of refractive error and visual impairment among school-age children of Hargesi

1%.9 ، ومد البصر 2.7% ، واللابؤرية 3.9%. وارتبط معدل انتشار ضعف البصر الناجم عن الخطأ
الانكساري بزيادة العمر، ولكن لم يكن هناك ارتباط مهم بالصف المدرسي أو نوع الجنس .

: كان معدل انتشار ضعف البصر بين الأطفال في سن الدراسة في هرجيسا مرتفعاً،الاستنتاجات
وكان السبب الرئيسي وراءه الخطأ الانكساري غير المُصحَّح . وثَمَّة عوائق تحول دون
تقديم الرعاية، ومن الأهمية بمكان أن يتم التغلب عليها .

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