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Patterns of refractive errors and visual function in school-going children in South Africa

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Background: Uncorrected refractive error is the most significant contributor of VI in children and is usually detected through vision screenings or scheduled eye and vision examinations conducted among school children.

Aim: To describe patterns of refractive errors (RE), visual function and amblyopia in school-going children.

Setting: Mankweng, Polokwane, South Africa.

Methods: Retrospective chart reviews were conducted on 837 clinical record cards of children attending selected schools and who were screened between 2019 and 2021 at the University of Limpopo Optometry clinic. Purposive sampling was used to sample the clinical record cards.

Results: About 134 children (16%) reported blurred vision, 197 (23.5%) failed distance visual acuity screening, while 173 (20.7%) had RE. Myopia among 168 (9.6%) children was the most common RE, followed by astigmatism and hyperopia at 60 (4.70%) and 28 (4.4%), respectively. Furthermore, 14 (1.7%) children had anisometropia. Amblyopia, colour vision deficiency and contrast sensitivity were also detected at prevalence rates of 4.4%, 9.8% and 8.2%, respectively.

Conclusion: Vision screenings and regular comprehensive eye examinations are commonly conducted to detect and manage REs to prevent or delay the onset of amblyopia and strabismus. Children had a high prevalence of RE and amblyopia, which is similar to global estimates.

Contribution: To describe the pattern of REs, amblyopia and visual function, which is critical to understand the prevalence of amblyopia and associated conditions. Knowing the patterns of these conditions may provide an impetus for the implementation of strategies such as vision screenings and vision examinations in schools.

Keywords: refractive error; amblyopia; visual impairment; vision anomalies in children; Polokwane; South Africa.

Introduction

Globally, moderate to severe visual impairment (VI) and blindness in 2020 were estimated to be 295.0 million and 43.3 million, respectively.[1] A further 258.0 million had mild VI.[1] Comparing these findings to the earlier estimate of VI in 100.0 million children, there is evidence of increasing prevalence.[2] About 55% of those affected were female.[1] Global Burden of Diseases (GBD) 2019 Blindness and Vision Impairment Collaborators further predicted that blindness will reach 61.0 million, moderate to severe VI will reach 474.0 million and mild VI will reach 360.0 million by the year 2050. Studies suggested that children were more affected[2,3] and may reach ≥ 100.0 million.[3] About 158.0 million people aged 5 years and above have VI while 80 million of those are blind.[1] At least 19.0 million of those between ages 5–15 have some form of VI.[2] Uncorrected refractive errors (UREs) contribute to VI in 12.8 million children with the likelihood of the number reaching over 100.0 million, given the rise in myopia, especially in China and other East Asian countries.[3]

The impact of VI in children is dire and has long-term consequences. If not attended to, affected children may drop out of school, which has a potential of limiting their meaningful participation in economic activities such as formal jobs later in their life.[4,5] In low- to medium-income countries (LMIC), children access health and eyecare through the schooling programme although the focus is on the detection of refractive errors (RE) and referral to eyecare facilities.[6] Although not

mandatory in South Africa, especially in the public schooling system, vision screening and examination are the most common programme that provides children with access to eyecare. When healthcare and eyecare are provided through the public schooling system, families and individual children lack awareness and recognition on eye and vision problems.[1]

Visual health has a significant impact in the educational achievement of children in schools, their quality of life in general and their ability to contribute to the economic activities as they grow older.[7,8] If children are myopic, they may struggle to read on the board at school.[9] If they are hyperopic, they may struggle to do near work, hence affecting their functional ability and enjoyment towards their learning.[9] If not identified and treated early, visual and eye disorders may lead to VI, which can be permanent for some.[9]

Children entering school at primary level or leaving school at secondary level or those presenting with apparent signs and symptoms such as white pupil, squint, red eyes, ocular torticollis, persistent headaches and inability to copy from the board should be screened for visual and eye health.[8] Vision screening for children is a primary programme in school eye health in many countries and has proven to be highly successful and effective in improving children's visual health and educational performance in schools.[10]

In countries such as the United Kingdom (UK), neonates are examined after birth with red reflex to check for eye defects with follow-up done by a general practitioner at about 6–8 weeks to check whether the eyes of babies are free from abnormalities.[11] Typically, the next vision screening of these children is at ages 4–5 years, and reports of serious challenges were noted in children with low socio-economic backgrounds.[11] Benefits of vision screening in early life include detection and treatment of conditions that may cause permanent vision loss such as amblyopia.[12,13] The amblyopia causing conditions include UREs, anisometropia, cataract and strabismus.[12,13] Vision screening processes and procedures commonly include visual acuity (VA) testing with Snellen or Lea symbols VA charts, contrast sensitivity screening although Cardiff VA, strabismus screening using cover-uncover test, red reflex test to screen the ocular media abnormalities, corneal light reflex test to screen the eye alignment, colour vision testing using Ishihara or Farnsworth Panel D-15 and stereopsis acuity testing using Titmus, stereo fly, Random Dot and contour Circle test.[12] Autorefractor and photo-screeners are also included as part of the screening.[12]

There is a battery of tests considered for vision screening in South Africa as outlined by the Health Professions Council of South Africa (HPCSA) guidelines.[14] It does not specify the referral criteria that determine a pass or fail for a specific test except a stipulation on the VA for which the cut-off is Snellen 6/9. Arresting VI conditions earlier in life is the most common, effective and cost-efficient way to reduce the risk of amblyopia and associated visual problems especially if done before the age of 5 years.[15] Thus far, no national study has been conducted on the prevalence of REs and visual ailments in South Africa although a number of studies have been conducted in various parts of the Western Cape,[16] KwaZulu-Natal[17,18,19] and Limpopo province.[20,21] As compared to the two studies conducted in separate districts in Limpopo province,[20,21] this study was conducted in Polokwane and also investigated visual function and amblyopia. The current study aimed to present the patterns of REs, visual function and amblyopia in school-going children attending University of Limpopo Optometry clinic, South Africa. Knowledge of these patterns may be an impetus for development of intervention strategies to curb the onset of visual and ocular ailments especially amblyopia and strabismus in children.

Methods

Study design

Quantitative retrospective chart reviews were conducted to analyse optometry clinical record cards medical records of 837 primary school children aged from 5 to 15 years who attended the University of Limpopo Optometry clinic in Polokwane, Limpopo province, South Africa, between 2019 and 2021.

Sampling

A purposive total population sample of optometry clinical record cards of school children from selected schools in Polokwane who consulted at the University of Limpopo Optometry clinic were selected for the study. Patient examination in this clinic was only conducted on children whose parents granted consent for their children's participation. Optometry clinic record cards without data on diagnosis on REs were excluded.

Data collection

A Microsoft Excel spreadsheet was created for extracted data from the patients' optometry clinical record cards. Demographic data, including age, gender, race and clinical data, including VA, reason for seeking a consultation, presenting signs and symptoms, RE, contrast sensitivity, colour vision and the 2 D test were collected.

Data analysis

Data were exported into the Statistical Package for Social Sciences (SPSS) software version 28 (Armonk, New York, United States) for analysis. The pass and/or fail criteria for the vision screening are outlined in Table 1. Visual acuity for both distances was converted to decimal notation, for ease of analysis. The main reported reason for seeking a consultation was considered for analysis. The adapted Refractive Error Study in Children (RESC) protocol[19,20] in

TABLE 1: Criteria used for classification of findings.

Variables	Minima
Visual acuity	6/9 or worse (Equivalence)
2 D test	2 lines difference or more
Refractive errors	
Myopia	≤ -0.50 D
Hyperopia	≥ 2 D
Astigmatism	≤ -0.75 D
Colour vision	Ishihara test: Fail = one or more plates missed
Stereopsis	40″

Sources: Naidoo KS, Raghunandan A, Mashige KP, et al. Refractive error and visual impairment in African children in South Africa. Invest Ophthalmol Vis Sci. 2003;44(9): 3764–3770. https://doi.org/10.1167/iovs.03-0283; and Magakwe TSS, Xulu-Kasaba ZNQ, Hansraj R. Visual impairment and refractive error amongst school-going children aged 6–18 years in Sekhukhune District (Limpopo, South Africa). Afr Vis Eye Health. 2020;79(1):1–8. https://doi.org/10.4102/aveh.v79i1.551

Table 1 was used to define whether children had refractive errors or not.

The Kolmogorov-Smirnov and Shapiro-Wilk tests were performed to check normality of the distribution of continuous data. Both tests showed significant difference ($p < 0.001$) for all the variables tested; hence the null hypothesis was rejected, and it was concluded that the data were not normally distribution. Mann-Whitney-Wilcoxon test was then carried out to test symmetry between the two eyes and also between the distance visual acuity (DVA) and near visual acuity (NVA). Gender variation of variables on the left eye (OD) were tested using the Kruskal-Wallis test. Chi square tests were used to test the gender preference on amblyopia, colour vision anomalies and contrast sensitivity. Spearman rank correlation tested the association between tested variables and age. Significance level (p) was set to be 0.05.

Ethical considerations

The research process of study observed the Declaration of Helsinki. Ethical approval was obtained from the University of Limpopo Research and Ethics Committee (TREC) reference no. TREC/171/2021: UG.

Results

Table 2 presents relevant demographic results for the sample of 837 children as derived from their clinical records.

Figure 1 shows the main reason reported for seeking a consultation where 441 (52.7%) consulted for a general check-up, 128 (15.3%) reported having blurred distance vision, 86 (10.37%) had itchy eyes and 62 (7.4%) had photophobia. Thirty-seven (4.4%) participants were diagnosed with vernal keratoconjunctivitis (VKC) and were receiving treatment.

As shown in Table 3, the mean DVA in decimal notation for both eyes was 1.19 ± 0.42, and the mean NVA test was 0.95 ± 0.15. There was no significant difference in DVA ($p = 0.070$) and NVA ($p = 0.749$) between the right and left eyes ($p = 0.070$). There was a significant difference ($p = 0.051$)

TABLE 2: Demographic information ($n = 837$).

Variables	*n*	%	Mean and s.d.	*p*
Gender				
Males	401	47.9	-	-
Females	436	52.1	-	-
Ages				
Mean and s.d.	-	-	8.23 ± 2.15	-
Male	-	-	8.16 ± 2.06	-
Female	-	-	8.29 ± 2.23	0.403
Age categories (in years)				
5–7	323	38.6	-	-
8–10	410	49.0	-	-
11–13	89	10.6	-	-
14–15	15	1.8	-	-

s.d., standard deviation.

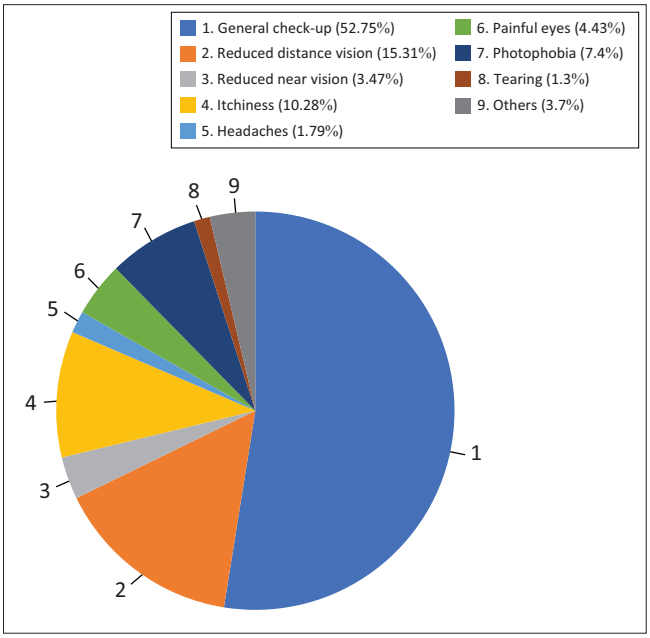


FIGURE 1: Reasons for seeking vision screening ($n = 837$ children, aged 5–15 years).

in DVA between females and males, but no significant difference ($p = 0.232$) was observed for NVA by gender. There was no correlation for DVA ($r = 0.028$; $p = 0.412$) and NVA ($r = 0.019$; $p = 0.665$) against age.

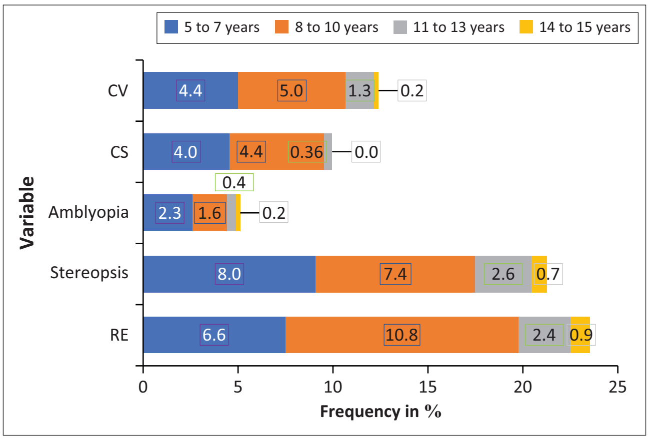
In terms of diagnosis (as shown in Table 3), 173 (20.7) children had RE in either eye, with 80 (9.6%) classified to have myopia, 57 (6.1%) had hyperopia and 36 (4.3%) had astigmatism. Refractive errors were asymmetrical between the two eyes ($p < 0.001$). Refractive errors were more common in females than in males ($p < 0.001$). Anisometropia was noted in 14 (1.7%) persons. For functional tests, 92 (11.0%) had colour vision deficiency, 78 (9.3%) had reduced stereopsis, 73 (8.7%) had reduced contrast sensitivity and 37 (4.0%) had amblyopia. Colour vision deficiencies (CVD), reduced stereopsis, reduced contrast sensitivity and amblyopia were more common in females than in males ($p < 0.001$).

Figure 2 shows the association between RE and visual functions with age categories, and there was an association between age and REs ($p < 0.001$), colour vision ($p < 0.001$) and amblyopia ($p < 0.001$).

TABLE 3: Distribution of distance and near visual acuity, refractive error and anisometropia for 837 children.

Variables	All eyes			Symmetry							Gender variation (OD)							Age variation (Spearman's correlation, ρ)	
				OD			OS				Male (401)			Female (436)					
	Mean	*n*	%	Mean	*n*	%	Mean	*n*	%	*p*	Mean	*n*	%	Mean	*n*	%	*p*	*ρ*	*p*
Mean DVA	1.19 ± 0.42	-	-	1.19 ± 0.43	-	-	1.18 ± 0.42	-	-	< 0.070	1.16 ± 0.44	-	-	1.22 ± 0.44	-	-	0.051	0.028	0.412
DVA test	-	197	11.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean NVA	0.95 ± 0.15	-	-	0.95 ± 0.15	-	-	0.95 ± 0.15	-	-	< 0.749	0.94 ± 0.16	-	-	0.96 ± 0.12	-	-	0.232	0.019	0.665
Refractive error	-	318	19.00	-	146	17.5	-	173	20.7	< 0.001	-	59	14.80	-	94	21.60	< 0.001	-	-
Myopia	-	167	10.10	-	88	10.5	-	80	9.6	-	-	37	9.30	-	51	11.70	-	-	-
Hyperopia	-	70	4.20	-	14	1.7	-	57	6.1	< 0.001	-	4	1.00	-	10	2.30	< 0.001	-	-
Astigmatism	-	79	4.70	-	43	5.2	-	36	4.3	-	-	18	4.50	-	25	6.30	-	-	-
Anisometropia	-	14	1.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amblyopia	-	37	4.40	-	-	-	-	-	-	-	-	11	2.70	-	26	5.96	< 0.001	-	-
CV deficiency	-	92	11.00	-	-	-	-	-	-	-	-	59	13.53	-	33	8.23	< 0.001	-	-
Reduced stereopsis	-	78	9.30	-	-	-	-	-	-	-	-	38	9.50	-	40	9.10	0.149	-	-
Reduced CS	-	73	8.73	-	-	-	-	-	-	-	-	35	7.80	-	39	9.40	< 0.001	-	-

DVA, distance visual acuity; NVA, near visual acuity; CS, contrast sensitivity, CV, colour vision; *n*, sample size; OD, right eye; OS, left eye; *ρ*, correlation coefficient; *p*, significance level.



CV, colour vision; CS, contrast sensitivity; RE, refractive error.

FIGURE 2: Visual functional tests including colour vision and contrast sensitivity and refractive error in the various age groups.

Discussion

Children (of mean age 8.13 ± 2.30 years) with ages between 3–18 years attended the clinic to receive an eye examination. The majority (49%) of the children were between ages 8–10 years and another significant proportion (24.5%) being between ages 3–6 years. An advantage of screening children early is that amblyopia and strabismus are usually established between ages 6–7 years, and response to treatment in children between ages 8–9 years or younger is greater.[22] Hence, 87.5% of children were still within the appropriate ages between 3–10 years. Vision screening programmes or vision examinations are commonly conducted in children of ages 5–18 years.[1,19,23,24,25,26,27] On the contrary, timelines for these programmes are structured and mandatory pre-school entrance criteria in countries such as the United States (US), Canada and Australia. In South Africa, vision screenings are only mandatory for some private schools but not in mainstream public schools.[14] Approaches towards mandatory vision screening should be explored to ensure every child has an equal opportunity to quality of vision.

Slightly more females (52.1%) attended the clinic for vision examination. This reflects the demographics of the area targeted.[28] It further demonstrates that there is a change in the patriarchal inclination and stereotypes, which initially limited females to accessing services.[29] Most of the participants, 441 (52.8%), consulted for a general check-up, 128 (15.3%) reported having blurred distance vision, 86 (10.3%) had itchy eyes and 62 (7.4%) had photophobia. Clinicians ask patients questions before they conduct any examination on that patient to seek the reasons patients are consulting. This assists the clinicians to develop the plan or approach they will follow in the examination of the patient. The reported symptoms and observed signs serve as indicators for seeking eyecare. The presence of reported symptoms may be related to a reduced quality of life.[30] To create awareness among children on their vision and eye health, they should be educated about symptoms and signs that are associated with presence of vision and eyecare

anomalies.[31] In this study, 15.3% and 3.5% of the children reported blurred vision and distance and near respectively, although 19.0% had RE. This suggest that almost all the children with REs were aware of their eye condition. This suggests that children had previous exposures to some awareness campaigns for eyecare in the past. These campaigns are therefore commended as they promote awareness and patient self-referral such as to access a consultation. This is necessary for early detection of diseases.[29] The frequency of consultations should also enable detection of changes in eye health timeously. A significant number of children (10.2%) reported itchiness to be the primary reason for consultation. Itchiness is common in persons located in warmer environments and is one of the common reported symptoms in patients with VKC.[31] This itchiness and VKC may be associated with the warmer conditions in Polokwane.

Almost a half (47.1%) of the children in this study reported not seeing clearly at distance, at near or to have some ocular discomfort. Reduced vision or ocular discomforts can affect the quality of life to those inflicted.[32] Visual discomforts may discourage children to participate in daily activities that expose them to such discomforts. Access to eyecare to curb such challenges is necessary at an early age to improve the prognosis of certain conditions. Children may initially be asymptomatic but ultimately develop symptoms of visual and ocular ailments with most likely to develop VI with a consequent negative effect on their quality of life.[30]

Mankweng area has a warm and dry environment,[33] and such weather conditions pose risk of children developing VKC and later keratoconus (KC).[34] Vernal conjunctivitis was reported in 4.3% of the patients who were also undergoing treatment. In Africa, VKC is regarded as the most common cause for hospital attendance in children ranging between 2.8% and 60.0% prevalence in children and adolescents.[35] The presentation of VKC in this study is therefore similar to those in other studies throughout Africa. Besides this, 10.2% had itchy eyes, 7.2% had photophobia, 4.2% had painful eyes and 1.3% had tearing, which may be associated with VKC. A study on VKC in the same area found hospital-based prevalence of 22.6% of VKC.[36] Frequent screening of children should be used as a preventative measure to detect early onset of VKC and to curb its progression and that of its associated conditions.

About 11.4% of the children failed DVA test. Distance visual acuity measurement is commonly used in many screening programmes, with the 6/9 or poorer DVA necessitating referral for a comprehensive vision examination. This criterion is referred to as the 'golden standard' and an acceptable indicator to determine the visual well-being of children.[14] Distance visual acuity measurement is a common indicator of the presence of REs[37] and may also be utilised to determine likely presence of amblyopia or other ocular anomalies.[37] The measured VA was asymmetrical between the two eyes. Regular examinations are necessary for determination and corrections in view of correcting REs that may result in amblyopia and strabismus.[38] While the DVA measurement is lauded for its accuracy to detect presence of myopia in vision screening programmes, it has limitations in detecting myopia in children.[14] This study findings presents some similarities to support the foregoing assumption. In this study, 11.4% of the children had VA less than the desired but about 19.0% had RE, which support the assumption on limitations of DVA in detecting presence of myopia. The 6/9 (0.67) cut-off point may well indicate presence of myopia although there is limited or no clearly defined VA measure that supports presence of hyperopia in children. In terms of screening children for hyperopia, there is a need for extensive research to establish most appropriate protocol to detect hyperopia in children.

In all, 10.3% of the children failed the near NVA test. Near VA is an essential test and may be an indicator to check the ability of the children to see well at near when executing tasks in the classroom environment.[14] This test may help to detect children that are not able to see comfortably when performing the tasks at near, as they are likely to take less interest in performing such tasks, hence this affecting their academic performance especially in the classroom environment. It is, however, not usually considered when VA is used as a screening procedure.[19,20,21,39,40,41]

Prevalence of REs in this study was 20.7%. This finding is lower than that for another study also conducted in Limpopo province at the Mopani district (35.8%)[21] but similar to another study in the Sekhukhune district (20.6%).[20] A further study in South Africa, in the KwaZulu-Natal province, found a lower prevalence of 8.0%. Other studies elsewhere found much higher prevalence of RE especially that of Chinese children in Malaysia with a prevalence of 80.5%.[42] Variations of the RE spread may be attributed to definitions of the RE and the previous exposures and access to eyecare, variation in sampling techniques and procedures, and the definition criteria used to classify REs are the likely contributors to these variations. Early detection and management of REs assist in avoidance of conditions such as amblyopia and strabismus, which have a likelihood to cause VIs.

In terms of spread of the REs, myopia was the most prevalent RE at 9.6% of the sampled population. This finding is similar to the 10.4% found in the Sekhukhune area of Limpopo province,[20] but less than that found by Baloyi et al.[21] in Mopani district of the same province at 16.2%. Naidoo et al.,[19] on the other hand, found a slightly lower prevalence, at 8.0%, for their study in KwaZulu-Natal. Mashige et al.[17] found a 11.4% in the same province as that in the study by Naidoo et al.[19]

This current study found astigmatism (4.7%) to be more common as compared to that of hyperopia (4.2%). This varied with findings of other studies elsewhere. Astigmatism was estimated to be higher than hyperopia in a South African population[19] with prevalence at 14.6% – 2.6% that of hyperopia, 5.4% of astigmatism to 4.0% of hyperopia in

an Indian population,[39] 16.5% of astigmatism to 5.2% of hyperopia in a Chinese population,[43] and 29.7% of astigmatism to 28.3% of hyperopia in a Saudi Arabian population.[44] On the contrary, some studies found a higher hyperopia prevalence with 52.1% of hyperopia to 1.0% of astigmatism in Ethiopian population, and 10.1% of hyperopia to 9.5% of astigmatism in the South African population.[21]

Amblyopia was present in 4.4% of the children screened. This is in line with a study conducted by Mustafaie et al.[22] who estimated a global prevalence of amblyopia to be 4.3% even though the same study estimated the prevalence of amblyopia of only 0.71% in Africa. The prevalence of amblyopia in this study surpassed those estimated by Mustafaie et al.[45] and another estimated by Hu et al.[46] A lower prevalence of amblyopia in Africa are attributed to the low research output and low access to amblyopia screening in children.[22] Vision screening is mandatory towards entrance to school education in some developed countries such as Australia, and this has a potential to detect amblyopia-causative conditions early in view of reducing exposure to the causative risk factors. The current study found that more females with amblyopic as compared males. This finding is similar to that in Palestine.[47] This is contrary to findings for studies that found amblyopia to be more common in females.[46] The current study found a significant association ($p < 0.001$) between age and presence of amblyopia. Amblyopia is more responsive to treatment at ages below 7 years[48] and therefore requires early detection and intervention such as to improve its prognosis.[46]

The study revealed a 9.2% presence of CVD. The prevalence of CVD varies between 2% and 14%.[49] Mashige and van Staden[18] found 2.2% in a South African-based study, Ugalahi et al.[50] found 2.3% in a Nigerian-based study, Woldeamanuel and Geta[51] found 4.1% in an Ethiopian-based study while Osman et al.[52] reported a 6.9% in an Egyptian-based study. Males were mostly reported to have a higher prevalence of colour vision deficiency than females.[50,51,52,53] According to Krishnamurthy et al., clinical risk factors include REs, opacities of the media, abnormalities of the macular and retina and the disorders of the optic nerve. Consequently, some non-clinical risk factors were associated with colour vision deficiency including socioeconomic status, geographical areas, low literacy level and consanguinity among Muslim communities.[49] In this study, more males had colour deficiencies as compared to females although colour vision was varied with age categories.

Amblyopia was prevalent in 4.4% of the children, which is in line with the global estimate although it was very high as compared to estimated prevalence in Africa. In addition, there multi-approaches of intervention are required to immediately address these challenges. Firstly, awareness campaigns should be organised at a larger scale in schools that are targeted at children to provide awareness about visual and ocular health. Secondly, government through the Department of Basic Education should implement mandatory screening for children entering various phases of education such as early childhood development phase (crèche; for 3–4-year-olds), foundation phase (grade R to 3; for 5–9 years old) and intermediate phase (grade 4–6; for 10–12 years old), senior phase (grade 7–9; for 13–15 years old). Thirdly, educational programs for teachers can be implemented such as to enable them to identify children that have challenges with their vision.[54]

This study did not explore the potential causative or risk factors that contribute to onset of REs and visual function deficiencies. The presence of REs is limited to this clinic population and may not be generalised to the entire population. A structured protocol was developed with a defined tool for transcription of data to ensure validity of the study.

Conclusion

This study outlines the profile of REs, amblyopia and visual functions. Most children had good vision although a significant number had REs, and some had amblyopia. Visual function tests found presence of CVD, poor contrast sensitivity and stereopsis, which were more common in females than males and varied according to age. The findings provide a good baseline to raise awareness on the need of mandatory vision screening and/or examination in schools or early life of children. Teachers and children may be educated such as to increase the rate of self-referral to eyecare facilities and to enable teachers to identify children that have visual and ocular challenges.

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Competing interests

The authors declare that this article was written in the interest of knowledge contribution and not influenced by any financial or personal relationships.

Authors' contributions

R.M.L. was the study leader. R.M.L., N.S., M.T.M, T.K., K.E.M., R.G.M. and L.M. developed the study protocol and performed data collection. The study was performed under the supervision of P.M.W.N. and C.M.L.S, who provided feedback on the research protocol development. P.M.W.N., C.M.L.S. and M.G.R. wrote the manuscript.

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Data availability

Data used to support the findings of the study are available from the corresponding author, P.M.W.N., upon reasonable request.

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