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

Visual impairments amongst preschool and school attendees: A scoping review of vision school screening in Nigeria and Kenya

Authors:
Irene Langeggen[1]
Kenechukwu Ofochebe[1]

Affiliations:
[1]Department of Optometry, Radiography and Light Design, Faculty of Health and Social Sciences, University of South-Eastern Norway, Kongsberg, Norway

Corresponding author:
Irene Langeggen,
irene.langeggen@usn.no

Dates:
Received: 06 Oct. 2021
Accepted: 12 May 2022
Published: 23 Aug. 2022

How to cite this article:
Langeggen I, Ofochebe K. Visual impairments amongst preschool and school attendees: A scoping review of vision school screening in Nigeria and Kenya. Afr Vision Eye Health. 2022;81(1), a711. https://doi.org/10.4102/aveh.v81i1.711

Copyright:
© 2022. The Author(s). Licensee: AOSIS. This work is licensed under the Creative Commons Attribution License.

Read online:
Scan this QR code with your smart phone or mobile device to read online.

Background: The United Nations Convention on the Rights of the Child emphasises the importance of quality education and good health. Vision problems affect the academic performance of schoolchildren in developing and under-resourced countries. The most prevalent vision problem amongst children is uncorrected refractive errors (URE).

Aim: To gain knowledge about vision problems and visual impairments (VI) through school vision screening amongst children in Kenya and Nigeria.

Method: A scoping review of online databases (Web of Science and PubMed) and one African registry (African Journals Online) for articles from January 2011 until April 2021 was conducted. The authors included 26 articles of the 439 screened.

Results: The literature revealed inconsistencies in how VI was defined. The main cause of vision problems is URE. Furthermore, there is a lack of systematic school vision screening tools and programmes.

Conclusion: Efficient eye care services to schoolchildren aged 3–18 years in Kenya and Nigeria must involve multiple disciplinary interventions and governmental responsibility. Collaboration models between public and private health sectors, nongovernmental organisations and families are necessary to prevent VI amongst children. Better vision enhances school performance.

Keywords: children's rights; visual school screening; visual impairments; refractive errors; multidisciplinary healthcare.

Introduction

Child eye health and prevalence of visual impairments (VI) in children remain important public health issues, especially in low- and middle-income countries. The consequences of not curbing VI can affect eye healthcare, quality of education, social participation and economic productivity.[1] The United Nations Convention on the Rights of the Child is an important official human rights convention that provides a mandate for communities, governments and civil societies to improve child eye health.[2] The United Nations Sustainable Development Goals (SDGs) also emphasise no poverty, good health and well-being, quality education, zero hunger, clean water and sanitation, gender equality, good jobs and economic growth, reduced inequality and partnerships for equality.[3] Promotion and improvement of visual health for children will contribute to the objectives of the SDGs.[4] Primary education plays a significant role in the economic growth and development of any country. An educated population holds the potential to create a better society, including democracy, equity and greater well-being.[1] In Nigeria, the population of 207 million has a mean age of 18 years.[2] The mean age amongst 57 million inhabitants of Kenya is 20 years.[5] Therefore, these two countries have a necessity to improve vision eye care, which influences education and quality of life.

The challenge is to establish eye healthcare programmes that will meet the basic needs of schoolchildren.[6,7] The World Health Organization (WHO) defines VI as presenting visual acuity (VA) less than 6/12 in the better eye.[8] Refractive errors (RE)[9] prevent clear imaging on the retina.[10] The effect of RE is determined by measuring VA. Uncorrected refractive errors (URE) are regarded as the most common cause of VI and blindness globally.[11] The results of VI have adverse effects on health, socio-economic development and quality of life, and 90% of people with URE live in developing countries.[12] Visual impairment is ranked in sixth position in the global load of disease relating to disability-adjusted life years and increased mortality, and the numbers of people with

VI are growing because of an increase of population.[13] About 18.93 million children in the age group of 0–14 years were estimated to have VI in a population of 1.848 billion.[14] Thus, a great deal of interest and attention should be focused on the younger generation towards enhancing good quality of life.[15]

Costs to build the necessary infrastructure and train personnel to deliver the services needed to correct VI over five years are estimated at around $20 billion.[16] Only one university in Kenya graduates optometrists, Masinde Muliro University of Science and Technology,[17] whilst six education alternatives are available in Nigeria.[18] The ratio for optometry educational programmes to population is similar in the two countries, that is, one educational programme per 50 million people (optometrists are educated healthcare personnel who are trained in outpatient care).[19]

This paper presents a scoping review[20] to gain knowledge about school vision screening amongst preschoolers and schoolchildren in Kenya and Nigeria and their vision problems.[21,22] The authors searched for a model to learn from in relation to care for visual health amongst young people.

Scoping review

Two online databases (Web of Science and PubMed) and one African registry (African Journal Online [AJOL]) were searched for articles published from January 2011 until April 2021. The search revealed 439 articles, and 26 of those that were included are listed in Table 1. The search process is illustrated in Figure 1. The reason for choosing the last 10 years of publications was to include newer studies that were accomplished closer to the current date. AJOL's filters were used on date from newer to older articles and relevance of articles. Included articles in this search are in relation to relevance. Search words and terms were 'school visual screening, visual problems, refractive errors'. Limitations for the search were age, namely 3–18 years of age, and search words like 'children', 'adolescence' and 'pupils' were used in addition to age limits. The scoping review was limited to Kenya and Nigeria. No profession was specified in the search since visual evaluation at community health level is performed by different professions. The two authors screened titles and abstracts for the words of interest. Articles of interest included screening methods and learned lessons or recommendations (see Table 1). This review presents vision problems and VI in young school-aged populations within the borders of Kenya and Nigeria. The scoping review followed PRISMA scoping guidelines.[20]

Ethical considerations

This article followed all ethical standards for research without direct contact with human or animal subjects.

Results

The search revealed 439 articles, where 26 articles met the inclusion criteria. The PRISMA diagram (Figure 1) presents details of the evaluation process.[23] African Journals Online (AJOL) search filters were used for relevance or date,[24] and the number of articles from AJOL exceeded those from the other databases. In Table 1, the articles are presented with author, year of publication, country, population size and gender, age of examined children, visual acuity defining VI in study, visual findings of interest, refractive error causing VI, specific clinical procedures and the main outcome or recommendation of studies. The outcome is presented with letters such as 'A', that is, recommending visual screening amongst children; 'B', recommending parents and teachers be involved in avoiding unnecessary VI amongst children; and 'C', recommending obligatory visual evaluation of children's vision and eye health. The included 26 articles comprise three studies from Kenya with a study population of 24 879 (including two cohorts),[25] and 23 studies from Nigeria with a study population of 24 344.

Visual impairment

Visual impairments were defined to be equal to or below VA of 6/9.[5] in 10 studies,[30,34,35,37,39,40,42,43,48] seven studies[9,22,34,35,36,37,38] presented VA equal to or below 6/12 and two presented VA below 6/18.[25,35] Visual acuity was not recorded in seven studies (see Table 1). Pinhole VA, which is possibly a better VA estimate, was seldom tested.[34,39] Refractive errors causing VI varied from 0.7%[39] to 81%.[35] Visual acuity amongst preschoolers requires a visual acuity test valid for preschoolers such as LEA symbols and Tumbling E.[36,40] Table 1 presents the different methods or procedures used to measure VA.

Ocular findings

Refraction results were given by retinoscopy[27,29] or cycloplegic procedure,[12,27] or no method was mentioned (see Table 1). A few studies included amblyopia[33,38] or binocular vision evaluations.[26,31,41] Ocular health[27,30,31,34,41,42] and colour vision[26,30] were also evaluated. Ocular axial dimensions (see Table 1)[43] were estimated in relation to prevalence of myopia. Prevalence of ocular injuries was 7.93% and education of children remains necessary to prevent ocular hazards.[44]

Sustainable eye healthcare

Three different protocols for school screening were mentioned: refractive error in school-aged children (RESC),[29] convergence insufficiency symptom survey (CISS)[31] and the Peek Acuity screening app.[25] School vision screening programmes were recommended by 20 of 26 studies (see section C in Table 1). Teachers can perform and be active in school vision screening.[32,39,41] Optometrists were only mentioned as active participants in school vision screenings in one study.[26] None of the studies were performed in schools or communities with an established visual healthcare programme for children.

TABLE 1: Summary of articles included in scoping review.

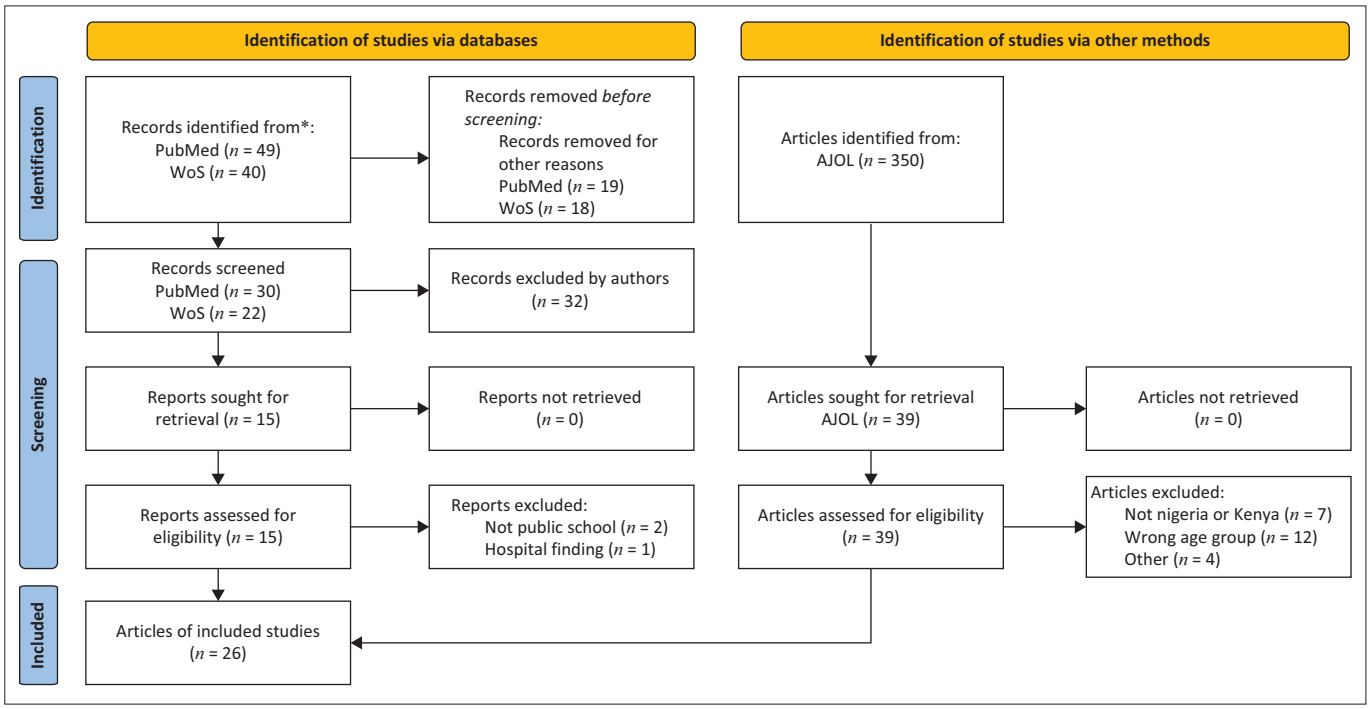
Authors and year of publication	Country	Population	Age range	Mean (age) ± s.d.	VA def. VI	Visual findings	Refractive status	Specific clinical procedures	Summary and recommendations	A	B	C
Adejumo et al.[40]												
2021	N	560 M:F ratio 1:1.1	3–5	-	≤ 6/18	6.3% ocular disorders	3.9% RE	-	Preschool visual screening reduces URE	X	-	-
Ezegwui et al.[29]												
2021	N	1167 (F = 653)	5–15	10.6 ± 3.0	≤ 6/12	7.5% with reduced VA	2.1%	Refractive error in school-age children (RESC) protocol + cycloplegic refraction	VS important to identify ocular morbidities	X	-	-
Ezinne et al.[51]				-								
2020	N	998	5–15		≤ 6/12	-	9.7% RE	-	Low utilisation of spectacles among children with RE	X	X	-
Muma and Obonyo[28]												
2020	K	3240 (F = 1800)	5–16	12 ± 2	≤ 6/18	2.4% with reduced VA	62% URE cause VI	Snellen chart 6m	VI in Kenya is associated with age	X	-	X
Obajolowo et al.[36]												
2020	N	464	3–5	-	≤ 6/9.5	24.1% with reduced VA	3.5% RE	LEA symbols	Improve public awareness on the existence of VI in children	X	X	X
Atowa et al.[52]												
2019	N	537 (F = 282)	10–16	13 ± 2.0	-	16.8% accommodative anomalies	-	VA, non-cycloplegic refraction, CT, vergence and accommodative test, ocular health evaluation	Measured near vision functions	X	-	X
Atowa et al.[31]												
2019	N	537 (F = 282)	10–16	13 ± 2.0	-	4.1% CI		CI, Symptom Survey (CISS)	Demand screening and management strategies that target visual conditions to prevent educational and social progress being affected	-	-	x
Ebri et al.[45]												
2019	N	4241	10–18	-	≤ 6/12	-	7.2%	-	URE major cause of VI	-	-	x
Alabi et al.[53]												
2018	N	1308 (F = 734)	5–16	12.3 ± 2.5	< 6/9.5	6.7% VI	39.7%	-	Sustainable school eye health services are of advantage	-	-	x
Ezinne and Mashige[12]												
2018	N	998	5–15	-	< 6/12	n = 97	n = 45	-	Improved VS program; reduction of intense near work activities, increase outdoor activities to avoid development of myopia	-	x	x
Rono et al.[25]												
2018	K	Peek group 10 579/ standard group 10 284	1–8 graders	-	< 6/12	VI: 5% Peek group/ 4% standard group	-	Teachers evaluated vision, referral when needed t o hospital	High follow-up rate by using SMS and smartphone technology	-	-	x
Okeigbemen and Momoh[37]												
2018	N	225 (F = 111)	5–10	-	-	n = 91 ocular disorders	n = 41	-	Advice to have eye care service for school-going children	-	-	x
Olatunji and Bodunde[43]												
2018	N	468 (F = 233)	-	8.8 ± 3.8	-	-	-	Lens thickness (LT), anterior chamber depth (ACD) and vitreous chamber depth (VCD) were measured using a B-ultrasound machine	Ocular axial dimensions increased with age	x	-	-
Alarepe et al.[33]												
2017	N	1153 (F = 586)	4–16	-	≤ 6/9.5	n = 6 with amblyopia	-	Snellen's tumbling E charts, pinhole VA	Mandatory VS to avoid burden of VI	-	-	X
Atowa et al.[34]												
2017	N	1197	8–15	11.5	< 6/9	n = 96 children with RE	URE 78.1%	-	VS is important to identify, prevent VI and blindness	-	-	X
Ekpenyong et al.[27]												
2017	N	2110 examined children (F = 1117)	6–17	11.69 ± 3	-	32.1% eye disease	11.5% RE	LogMAR visual charts, non-cycloplegic auto-refraction, retinoscopy, external and internal eye examination	Eye health examination prior school entry strongly recommended; integration of eye care into school health program	-	-	X
Ikuomenisan et al.[38]												
2016	N	1702 (F = 803)	4–16	7.5 ± 1.6	< 6/9	1.4% with amblyopia	-	HOTV charts, ocular alignment using Hirschberg light reflex + cycloplegic refraction	Enlightenment of parents on RE and need for early screening and correction.	-	X	-
Nathaniel and Pedro-Egbe[32]												
2015	N	271 (F = 150)	5–15	-	-	10.3% ocular disorders	n = 10 RE	-	Eye health Education in school and routine VS upon school entry	-	-	X

Table 1 continues on the next page→

TABLE 1 (continues...): Summary of articles included in scoping review.

Authors and year of publication	Country	Population	Age range	Mean (age) ± s.d.	VA def. VI	Visual findings	Refractive status	Specific clinical procedures	Summary and recommendations	A	B	C
Okpala et al.[44]												
2015	N	1236 (F = 652)	-	15	-	7.93% with eye injury	4.85% RE	Snellen chart, pen torch, head loupe, direct ophthalmoscope	Major causes of eye injury are preventable through education of children	-	-	X
Akpe et al.[41]												
2014	N	2139 (F = 1115)	5–19	-	< 6/9	0.89% strabismus.	6.64% RE	VA using Snellen chart, cover test, near point of convergence, ophthalmoscope, anterior eye examination	Any pupil with strabismus was evaluated using cycloplegic refraction; training of non-ophthalmologic personnel to detect and refer strabismus cases	-	X	X
Barasa et al.[35]												
2013	K	776 (F = 384)	6–15	-	< 6/18	4.8% with VI	81% of VI have RE	PH, ocular assessment	VS prior school admission, annual VS and provision of spectacles to VI pupils	-	-	X
Okoye et al.[39]												
2013	N	2092 (F = 1011)	6–16	-	<6/9	6.1% ocular disorders	0.7% RE	VA tested with Snellen eye chart, PH repeated test if VA <6/9	Health education and access to a quality eye care facility will reduce burden of eye disease	-	X	X
Okoro and Odeyemi[26]												
2013	N	183 (F = 96)	5–11	-	< 6/12	2.7% and 3.3% had visual acuity in right and left eyes respectively	21% RE, Undetected poor vision can hinder a child's academic pursuit	VA tested by Snellen chart, colour vision, squint by evaluation of corneal reflexes	Regular visual testing before school enrolment and annually in school. provision of spectacles to school children to avoid negative effects of VI	X	-	X
Ogbonnaya et al.[47]												
2013	N	213 (F = 106)	5–15	9.6 ± 2.7	<6/9	0.9%	*n* = 2 RE	Used retinoscope in RE evaluation	Prioritizing regular VS as part of primary eye care to facilitate optimal learning ability	X	-	X
Opubiri and Pedro-Egbe[42]												
2013	N	1242 (F = 658)	5–15	-	< 6/9	97.7% VA of 6/6	2.2% RE	VA<6/9, retested with PH and fundoscopy	VS should provide spectacles	-	-	X
Abah et al.[30]												
2011	N	327 (F = 178)	5–17	9.6 ± 3.1	6/9.5	22.6% ocular disorders	8% RE	VA test, anterior and posterior segment evaluation, colour vision testing, IOP measurement and refraction	VS is important to address URE and ocular diseases	X	-	-

N, Nigeria; K, Kenya; VA, Visual acuity (normal value 6/6); VI, visual impaired (VA<6/12); VS, visual school screening; CI, convergence insufficiency; SER, Spherical equivalent refraction; PH, pinhole visual acuity; A, Recommend visual screening amongst children; B, Recommend parents and teachers involvement to avoid unnecessary VI amongst children; C, Recommend obligatory visual evaluation of children's vision and eye health.



Source: Page MJ, Moher D, Bossuyt PM, et al. PRISMA 2020 explanation and elaboration: Updated guidance and exemplars for reporting systematic reviews. BMJ. 2021;372:n160. https://doi.org/10.1136/bmj.n160 [23]

Note: For more information, visit: http://www.prisma-statement.org/. WoS, Web of Science; AJOL, African Journals Online.

*, Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all database/register).

FIGURE 1: PRISMA flow-chart.

The main outcome of the studies were to introduce regular eye health examinations[12,27,29,31,37,45] through eye healthcare programmes (see Table 1, section C). Uncorrected RE influences education and it is thus important to provide refractions and good vision with spectacles, for example, to all age groups.[27,30,34,37,42]

Discussion

The scoping review revealed that clinical procedures for evaluation of vision amongst children aged 3–18 years were inconsistent or even missing. Refractive errors amongst schoolchildren can vary significantly based on gender, age group, school type and socio-economic status (SES) of the parents or guardians.[27] The scoping review revealed the differences in defined VI in relation to VA. Refractive errors are the main cause of VI. The results from the scoping review form the basis for a potential recommendation to official stakeholders to enhance children's visual eye care.

Visual impairment

Visual acuity procedures presented in the articles indicate that VA at distance is measured by different clinical procedures (see Table 1). There is no defined recommendation of which acuity chart to use whilst in school screening settings.[46] The WHO definition of VI as VA equal or below 6/12 was used by six studies.[9,22,34,35,36,37,38] The argument of VI being better than the WHO definition is probably to detect lower refractive errors. None of the articles discussed why the definition of VI was different from WHO recommendation.[8]

Refractive errors

The Ophthalmic Division in Kenya has improved the healthcare awareness on ocular disorders like URE.[28] This improves early detection and management and provides patients with spectacles to regain their sight at an early age. To optimise learning, there is a need to prioritise regular vision school screening as part of primary eye care in Nigeria.[47] Kenya and Nigeria require more advanced awareness and education to the public through health professionals such as optometrists to fight unnecessary blindness and VI. In addition, comprehensive eye assessment to determine RE and type of spectacles is also required.

Many children in the study populations had URE as the main cause of VI. Visual improvement was achieved by wearing spectacles. One study suggested that RE is more likely to affect children who have parents of high SES or middle-class status than children with low-SES parents. The findings are linked to the fact that those in private schools were two times more likely to have RE than those in public schools. Children from high- and medium-income families are mainly enrolled in private schools rather than public schools.[27] The study in the West District of Kenya[35] indicates that VI usually manifests amongst 11–15 year-old adolescents, and differences in the economic characteristics of the children's parents can contribute to VI cases. It is expected that good economic status facilitates access and affordability of eye care services that reduce the problem of VI and blindness. Parents from public schools had lower economic status and could not afford the costs of acquiring spectacles for their children. Meanwhile, parents from private schools had better economic status and hence were more likely to acquire spectacles. The pupils with RE who could afford spectacles had corrected VA > 6/18 and thus were not subjected to further examination.[35] Thus, there is a need for enforcement of school health policies on vision screening before enrolment as well as annual school eye examination to enhance early VI detention and management.[35]

In South-East Nigeria, Onitsha Nigeria children in this urban environment mostly engage in indoor rather than outdoor activities,[12] including higher usage of computers, smartphones and video games, which contributed to an increased prevalence of RE. However, in rural areas, increased outdoor activities and exposure to high light intensity are quite common amongst the dwellers, which have been suggested to be the main factors reducing prevalence of RE in rural areas.[48] Myopia was found to increase with age. It could possibly be because the age group is mostly in Grades 5 and 6, which are the grades for preparing and writing entrance examinations to high school in Nigeria, leading to increased academic demand and near work activities.[12]

Sustainable eye healthcare

Ocular findings, including binocular anomalies, amblyopia and hazards, imply other causes of VI than URE. Knowledge of normal ocular axial dimensions is important to establish school screening programmes with clear procedures and pass or fail determinants. The WHO has established a definition of VI,[8] but this literature review presents several definitions of VA in relation to VI. Worldwide there are several clinical guidelines to evaluate visual status amongst children. The interdisciplinary team must be involved to achieve a cost-effective school vision screening programme.[46]

A range of strategies are required to control visual loss in children and improve school eye health in Nigeria and Kenya. The main purpose of health promotion is to promote safe and healthy behaviours through policies and other modules of health education strategy.[1] The aim of primary health prevention is to reduce the occurrence of cases of potentially blinding conditions. Secondary prevention deals with interventions which can prevent blindness and VI consequences, such as early detection and treatment of corneal ulcers in children and lid surgery for an affected person with trachoma. Tertiary prevention involves treatment which resorts to functions such as spectacle correction of URE and interventions to improve function where sight cannot be restored, such as low vision services and rehabilitation.[1]

Yasmin et al. argue that children should be offered general vision screening when they enter and leave primary school and when they graduate high school. The main idea is to conduct eye health screening for children and teachers in

school and to refer those who need further management for eye examination, refraction and dispensing of spectacles. Successful school eye health programmes should include the support and engagement of the local education authorities and increasing awareness about a healthy school environment amongst children, teachers and communities. Also, it is necessary to make schools inclusive for children with VI so they can learn together with normal children.[49,50]

A study in Nepal[7] identified established models for school screening programmes that can be adopted in Nigeria and Kenya. One model is the teacher-oriented approach, whereby the teacher through continuous education is empowered to conduct initial visual tests. The second approach is the 'eye care team', where optometrists conduct VS, and VI children with URE are referred to nearby hospitals for follow-up. The third approach is a combination of the first and second models that also includes health promotion education of children and next of kin and optimal utilisation of spectacles. The third model also includes an official strategy and structure to enhance visual care amongst children.[7] The integration of eye health into comprehensive school health programmes will help to identify children with VI. This will enable eye health education to reach many children and their families through a child-to-child approach.

Vision affects the way a human being relates to and integrates in society, and vision influences education, employment, mental health, child development and operative capacity of older people. The effects of VI in developing countries challenge these countries to achieve the United Nations SDGs, which include no poverty, quality education, decent work and economic growth and reduced inequalities.[13,21]

The Ministries of Health and Education are key developers of policy and crucial partners to school eye health initiatives with the purpose of scaling up activities at the national level. The development of school screening guidelines is crucial to integrate strategies for early detection and intervention in children using the 'promoting healthy schools' framework.[1] Eyecare includes correction of RE by use of quality spectacles that are acceptable, durable, comfortable and affordable. Children with VI need further optometric and ophthalmological care and a patient path including identification, referral and treatment of potentially visual impairing conditions.[1]

Conclusion

This scoping review revealed some inconsistency in defining VI and visual healthcare or eye service amongst preschool and schoolchildren in Kenya and Nigeria. Refractive errors account for VI, which is possible to avoid through refraction and spectacles amongst children of 3–18 years of age. Interventions are required due to the rapid growth of the population. In the future, an eye healthcare model or programme with optometric competencies and following a systematic approach must aim at avoiding unnecessary refractive errors and providing good vision. It is legitimate to conclude that good visual health is likely to reduce productivity loss amongst future generations.

Acknowledgements

The authors are grateful for the initiative and support to write this article by Kesi Naidoo, African Eye Institute, Durban, South-Africa.

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

I.L. and K.O. have written in collaboration and with equal input to the article.

Funding information

The Norwegian Agency for Exchange Cooperation (NOREC) supports the EYE-FX project, from which both authors gained interest in optometry and eye health education.

Data availability

Data supporting the findings of this study are available from the corresponding author, I.L., on request.

Disclaimer

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

References

1. Gilbert C, Minto H, Morjaria P, Kahn I. Standard school eye health guidelines for low and middle-income countries. IAPB School Eye Health Work Group. England, UK: International Agency for the Prevention of Blindness (IAPB); 2018.
2. Worldbank. Population, total – Nigeria [homepage on the Internet]. 2021 [cited 2021 May 20]. Available from: https://data.worldbank.org/indicator/SP.POP.TOTL?locations=NG
3. UN D of E and SA. Sustainable development [homepage on the Internet]. The 17 goals. 2015 [cited 2021 Jun 16]. Available from: https://sdgs.un.org/goals
4. Gray Z. Tackling inequality and inequity in eye health: Can the SDGs help us? Community Eye Health. 2016;29(93):4.
5. Worldbank. Population, total – Kenya [homepage on the Internet]. 2021 [cited 2021 May 20]. Available from: https://data.worldbank.org/indicator/SP.POP.TOTL?locations=KE
6. Kruk ME, Gage AD, Arsenault C, et al. High-quality health systems in the sustainable development goals era: Time for a revolution. Lancet Glob Health. 2018;6(11):e1196–e1252. https://doi.org/10.1016/S2214-109X(18)30386-3
7. Murray CJL, Abbafati C, Abbas KM, et al. Five insights from the global burden of disease study 2019. Lancet. 2020;396(10258):1135–1159. https://doi.org/10.1016/S0140-6736(20)31404-5
8. Vision impairment and blindness [homepage on the Internet]. n.d. [cited 2021 Apr 27]. Available from: https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment
9. Galvis V, Tello A, Camacho PA, Gómez LM, Rey JJ, Serrano AA. Definition of refractive errors for research studies: Spherical equivalent could not be enough. J Optom. 2021;14(2):224–225. https://doi.org/10.1016/j.optom.2020.10.003
10. Dandona L, Dandona R, Srinivas M, et al. Blindness in the Indian state of Andhra Pradesh. Invest Ophthalmol Vis Sci. 2001;42(5):908–916.
11. Blindness and vision impairment: Refractive errors [homepage on the Internet]. n.d. [cited 2022 May 02]. Available from: https://www.who.int/news-room/questions-and-answers/item/blindness-and-vision-impairment-refractive-errors
12. Ezinne NE, Mashige KP. Refractive error and visual impairment in primary school children in Onitsha, Anambra state, Nigeria. Afr Vision Eye Health. 2018;77(1):1–8. https://doi.org/10.4102/aveh.v77i1.455

13. Fricke TR, Jong M, Naidoo KS, et al. Global prevalence of visual impairment associated with myopic macular degeneration and temporal trends from 2000 through 2050: Systematic review, meta-analysis and modelling. Br J Ophthalmol. 2018;102(7):855–862. https://doi.org/10.1136/bjophthalmol-2017-311266
14. Pascolini D, Mariotti SP. Global estimates of visual impairment: 2010. Br J Ophthalmol. 2012;96(5):614–618. https://doi.org/10.1136/bjophthalmol-2011-300539
15. Muma KIM, Chipalo-Mutati G, Munthali J, et al. Vision screening of learners by teachers in Kafue district in Zambia as a strategy to address the challenges of childhood blindness. Med J Zambia. 2020;48(1):4–14.
16. Naidoo KS, Fricke TR, Frick KD, et al. Potential lost productivity resulting from the global burden of myopia: Systematic review, meta-analysis, and modeling. Ophthalmology. 2019;126(3):338–346. https://doi.org/10.1016/j.ophtha.2018.10.029
17. MMUST [homepage on the Internet]. n.d. [cited 2021 Jun 17]. Available from: http://www.mmust.ac.ke/mmust/index.php/news-media/news-and-events/388-mmust-optometry-department-reaps-big-from-the-staff-exchange-program-with-norway-government
18. Shaibu J. Top ten things to know about optometry in Nigeria [homepage on the Internet]. Eyes On Eyecare; 2019 [cited 2021 Jun 17]. Available from: https://eyesoneyecare.com/resources/top-ten-things-to-know-about-optometry-in-nigeria/
19. Toomey M, Gyawali R, Stapleton F, Ho KC, Keay L, Jalbert I. Facilitators and barriers to the delivery of eye care by optometrists: A systematic review using the theoretical domains framework. Ophthalmic Physiol Opt. 2021;41(4):782–797. https://doi.org/10.1111/opo.12801
20. Tricco AC, Lillie E, Zarin W, et al. PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. Ann Intern Med. 2018;169(7):467–473. https://doi.org/10.7326/M18-0850
21. Burnett AM, Yashadhana A, Lee L, Serova N, Brain D, Naidoo K. Interventions to improve school-based eye-care services in low- and middle-income countries: A systematic review. Bull World Health Organ. 2018;96(10):682–694, 694A–694D. https://doi.org/10.2471/BLT.18.212332
22. Michaeline I, Sheriff A, Bimbo A. Paediatric refractive errors in an eye clinic in Osogbo, Nigeria. Ethiopian J Health Sci. 2016;26(2):145–152. https://doi.org/10.4314/ejhs.v26i2.8
23. Page MJ, Moher D, Bossuyt PM, et al. PRISMA 2020 explanation and elaboration: Updated guidance and exemplars for reporting systematic reviews. BMJ. 2021;372:n160. https://doi.org/10.1136/bmj.n160
24. African Journals Online [homepage on the Internet]. 1998 [cited 2021 Apr 28]. Available from: https://www.ajol.info/index.php/ajol/Gsearch/google?q=
25. Rono HK, Bastawrous A, Macleod D, et al. Smartphone-based screening for visual impairment in Kenyan school children: A cluster randomised controlled trial. Lancet Glob Health. 2018;6(8):e924–e932. https://doi.org/10.1016/S2214-109X(18)30244-4
26. Okoro VA, Odeyemi KA. Visual acuity in primary school pupils in Lagos, Nigeria. J Community Med Prim Health Care. 2013;25(1):51–57.
27. Ekpenyong BN, Naidoo K, Ahaiwe K, et al. Visual status and prevalence of eye disorders among school-age children in Southern Nigeria. Afr Vision Eye Health. 2017;76(1):a377. https://doi.org/10.4102/aveh.v76i1.377
28. Muma S, Obonyo S. The prevalence and causes of visual impairment among children in Kenya – The Kenya eye study. BMC Ophthalmol. 2020;20(1):399. https://doi.org/10.1186/s12886-020-01665-w
29. Ezegwui IR, Oguego NC, Okoye OI, et al. Prevalence of refractive errors and visual impairment in school children in Enugu South-East Nigeria. Niger J Clin Pract. 2021;24(3):380–386. https://doi.org/10.4103/njcp.njcp_521_19
30. Abah ER, Oladigbolu KK, Samaila E, Gani-Ikilama A. Ocular disorders in children in Zaria children's school. Niger J Clin Pract. 2011;14(4):473–476. https://doi.org/10.4103/1119-3077.91759
31. Atowa UC, Wajuihian SO, Hansraj R. Vergence profile and prevalance of non-strabismic vergence anomalies among school children in Abia state, Nigeria. Ophthalmic Epidemiol. 2019;26(2):121–131. https://doi.org/10.1080/09286586.2018.1532523
32. Nathaniel G, Pedro-Egbe CN. Vision screening in primary school children in Kegbara-Dere, A rural community in rivers state, Nigeria. PMJ. 2015;9(1):21–27.
33. Alarepe A, Balogun M, Obiekwe O, Ulaikere M, Oderinlo O. Amblyopia in rural Nigerian school children. Niger J Ophthalmol. 2017;25(1):36–41. https://doi.org/10.4103/0189-9171.207379
34. Atowa Uchenna C, Wajuihian Samuel O, Munsamy Alvin J. Prevalence and risk factors for myopia among school children in Aba, Nigeria. Afr Vision Eye Health. 2017;76(1):1–5. https://doi.org/10.4102/aveh.v76i1.369
35. Barasa E, Otieno S, Karimurio J. The prevalence and pattern of visual impairment and blindness among primary school pupils in Kitale municipality, Kenya. J Ophthalmol East Central S Afr. 2013; 17(2): 66–70.
36. Obajolowo TS, Olatunji FO, Ademola-Popoola DS, Popoola GO. Performance of the Lea symbols chart for screening Nigerian children aged 3 to 5 years. Niger J Clin Pract. 2020;23(10):1381–1386. https://doi.org/10.4103/njcp.njcp_204_19
37. Okeigbemen VW, Momoh RO. Outcome of eye screening among primary school children in Benin City. Niger J Clin Pract. 2018;74(1–2):8–11.
38. Ikuomenisan SJ, Musa KO, Aribaba OT, Onakoya AO. Prevalence and pattern of amblyopia among primary school pupils in Kosofe town, Lagos state, Nigeria. Niger Postgrad Med J. 2016;23(4):196–201. https://doi.org/10.4103/1117-1936.196261
39. Okoye O, Umeh RE, Ezepue FU. Prevalence of eye diseases among school children in a rural south-eastern Nigerian community. Rural Remote Health. 2013;13(3):2357. https://doi.org/10.22605/RRH2357
40. Adejumo OO, Olusanya BA, Ajayi BG. Ocular disorders among preschool children in Southwest Nigeria. Middle East Afr J Ophthalmol. 2021;28(1):23–28. https://doi.org/10.4103/meajo.MEAJO_191_19
41. Akpe BA, Dawodu OA, Abadom EG. Prevalence and pattern of strabismus in primary school pupils in Benin city, Nigeria. Niger J Ophthalmol. 2014;22(1):38–43. https://doi.org/10.4103/0189-9171.142755
42. Opubiri I, Pedro-Egbe C. Screening for refractive error among primary school children in Bayelsa state, Nigeria. Pan Afr Med J. 2013;14:74. https://doi.org/10.11604/pamj.2013.14.74.1345
43. Olatunji AA, Bodunde OT. Effect of age and sex on ocular dimensions in emmetropic children in South West Nigeria. Niger Postgrad Med J. 2018;25(2):112–116. https://doi.org/10.4103/npmj.npmj_3_18
44. Okpala NE, Umeh RE, Onwasigwe EN. Eye injuries among primary school children in Enugu, Nigeria: Rural vs. urban. Ophthalmol Eye Dis. 2015;7:13–19. https://doi.org/10.4137/OED.S18659
45. Ebri AE, Govender P, Naidoo KS. Prevalence of vision impairment and refractive error in school learners in Calabar, Nigeria. Afr Vision Eye Health. 2019;78(1):1–8. https://doi.org/10.4102/aveh.v78i1.487
46. Metsing IT, Hansraj R, Jacobs W, Nel EW. Review of school vision screening guidelines. Afr Vision Eye Health. 2018;77(1):e1–e10. https://doi.org/10.4102/aveh.v77i1.444
47. Ogbonnaya C, Ogbonnaya L, Okoye O, Ezeanosike E. Prevalence of refractive errors in primary school children in a rural community in Ebonyi state of Nigeria. Int J Med Health 2013;18(2):24–33.
48. Hashemi H, Abbastabar H, Yekta A, Heydarian S, Khabazkhoob M. The prevalence of uncorrected refractive errors in underserved rural areas. J Curr Ophthalmol. 2017;29(4):305–309. https://doi.org/10.1016/j.joco.2017.02.007
49. Singh SK, Thakur S, Anwar A. School eye health in Nepal: A holistic model. Community Eye Health. 2017;30(98):S18–S20.
50. Yasmin S, Minto H, Chan VF. School eye health – Going beyond refractive errors. Community Eye Health. 2015;28(89):14–15.
51. Ezinne NE, Mashige KP, Akano OF, Ilechie AA, Ekemiri KK. Spectacle utilisation rate and reasons for non-compliance with wearing of spectacles amongst primary school children in Onitsha, Anambra state, Nigeria. Afr Vision Eye Health. 2020;79(1):e1–e6. https://doi.org/10.4102/aveh.v79i1.544
52. Atowa UC, Hansraj R, Wajuihian SO. Accommodative anomalies among schoolchildren in Abia State, Nigeria. Afr Vision Eye Health. 2019;78(1):7. https://doi.org/10.4102/aveh.v78i1.465
53. Alabi AS, Aribaba OT, Alabi AO, Ilo O, Onakoya AO, Akinsola FB. Visual impairment and ocular morbidities among schoolchildren in Southwest, Nigeria. Niger Postgrad Med J. 2018;25(3):166–171. https://doi.org/10.4103/npmj.npmj_85_18