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Refractive Error in Nigerian Adults: Prevalence, Type, and Spectacle Coverage

Christian Ezelum,1 Hessom Razavi,2 Selvaraj Sivasubramaniam,3 Clare E. Gilbert,3 Gudlavalleti V. S. Murthy,4 Gabriel Entekume,4 Tafida Abubakar,5 and Nigeria National Blindness and Visual Impairment Study Group6

PURPOSE. To provide data on prevalence and types of refractive error and the spectacle-wearing rate among adults in Nigeria and the degree to which the need for distance correction could be met by off-the-shelf spectacles.

METHODS. Multistage, stratified, cluster random sampling with probability proportional to size was used to identify a nationally representative sample of 15,027 persons aged ≥40 years. Distance vision was measured using a reduced logMAR tumbling-E chart. All participants underwent autorefraction, and those with presenting acuity of <6/12 in one or both eyes had their corrected acuity measured and underwent detailed clinical examination to determine the cause.

RESULTS. Included in the survey were 13,599 (89.9%) of the 15,122 persons aged ≥40 years who were enumerated. Uncorrected refractive error was responsible for 77.9% of mild visual impairment (<6/12–6/18), 57.1% of moderate visual impairment (<6/18–6/60), 11.3% of severe visual impairment (<6/60–3/60), and 1.4% of blindness (<3/60). The crude prevalence of myopia (≤0.5 D) and high myopia (≥5.0 D) were 16.2% and 2.1%, respectively. Spectacles could improve the vision of 1,279 (9.4%) and 882 (6.5%) participants at the 6/12 and 6/18 level, respectively, but only 3.4% and 4.4% of these individuals wore spectacles to the examination site. Approximately 2,140,000 adults in Nigeria would benefit from spectacles that improved their vision from <6/12 to ≥6/12.

CONCLUSIONS. Uncorrected refractive errors are an important cause of visual impairment in Nigeria, and services must be dramatically improved to meet the need. (Invest Ophthalmol Vis Sci. 2011;52:5449–5456) DOI:10.1167/iovs.10-6770

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Refractive error (RE) is a priority for the global VISION2020: The Right to Sight initiative. Worldwide, uncorrected RE is the main cause of moderate and severe visual impairment (VI) and the second leading cause of blindness, accounting for an estimated 153 million and 8 million affected persons, respectively, despite the fact that correction of RE with appropriate spectacles is one of the most cost-effective interventions in eye health.

RE is a significant cause of low vision in African countries, but available data are limited. Nigeria is the most populous country in Africa. Small, population-based studies in Nigeria have shown uncorrected RE, along with cataract and glaucoma, to be among the leading causes of blindness. VI, and low vision. Hospital- or industry-based Nigerian studies have shown RE to be the commonest ocular condition, and associated with increased absenteeism and reduced productivity. However, these studies were not nationally representative and cannot be extrapolated to the entire country due to their limited geographic scope, small sample sizes, and lack of validated methodology.

RE is a complex and multifactorial condition that varies in prevalence across populations with different genetics, demographics, ocular, and extrinsic factors, such as education. The Nigerian National Blindness and VI Survey indicated that uncorrected RE accounts for 57.1% of moderate VI (visual acuity [VA] >6/18–6/60). Economic consequences are likely to be considerable, as uncorrected RE affects people in the working-age group. To our knowledge, no national survey of RE has been undertaken in Africa, whereas some have been undertaken in Asia. This article reports data on the prevalence and types of RE among adults aged 40 or more years in Nigeria.

METHODS

The Nigeria survey was conducted over 30 months from 2005 to 2007. The methods have been described in detail elsewhere, and therefore we include only the pertinent elements here.

Definitions

Refractive Error. The WHO categories of VI were used. Blindness was defined as a presenting VA of <3/60 (<20/400, logMAR >1.30) in the better eye, severe visual impairment (SVI) as VA <6/60 to 3/60, and moderate visual impairment (MVI) as <6/18 to 6/60. We also used the term “near normal” to describe VA of <6/12 (<20/40, logMAR >0.3), but ≥6/18 in the better eye. Spherical equivalent (SE) was calculated as half the cylinder plus the spherical component. Low myopia was defined as SE worse than −0.5 D (i.e., −< −0.5 D), but better than or equal to −5 D (i.e., ≥−5 D), and high myopia as SE worse than −5 D (i.e., −< −5 D). Low hypermetropia was defined as SE worse than +0.5 D (i.e., ≥+0.5 D), but better than or equal to +5 D (i.e., ≤+5 D), and high hypermetropia as worse than +5 D (i.e., >5
Refraction

All participants had non-cycloplegic refraction by an optometrist using an autorefractor (ARKK, Takagi Soko, Japan) that was regularly calibrated. If autorefractor readings could not be obtained, or both eyes had been measured by subjective refraction, readings were done manually. All participants had non-cycloplegic refraction by an optometrist using an autorefractor (ARKK, Takagi Soko, Japan) that was regularly calibrated. If autorefractor readings could not be obtained, or both eyes had been measured by subjective refraction, readings were done manually. If autorefractor readings could not be obtained, or both eyes had been measured by subjective refraction, readings were done manually.

Visual Acuity Measurement

Visual acuity was measured by an ophthalmic nurse at the central examination site, using a reduced log MAR tumbling-E chart to take three separate measurements. This method was used to ensure that both eyes together (unaided VA) were measured. If both eyes were measured, the higher VA was used. If only one eye was measured, the VA of that eye was recorded. If VA was measured with both eyes, the VA of the better eye was recorded. The VA of both eyes was measured in all cases

Sampling Process, Enumeration, and Registration

Enumerated respondents were invited to attend the "temporary clinic" at the examination site, where they were screened for eligibility and underwent an extensive examination, including dilated funduscopy, visual field testing, and blood pressure measurement. Those who met the criteria for inclusion were then invited to participate in the study. After obtaining informed consent, a comprehensive ophthalmic examination was performed, including subjective refraction with subjective

Table 1. Age- and Sex-Specific Prevalence of Refractive Errors in Nigerian Adults

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Low Myopia (≤ −0.5 D)</th>
<th>Low Hypermetropia (0.5 to 5 D)</th>
<th>High Hypermetropia (≥ 5 D)</th>
<th>Emmetropia (−0.5 to +0.5 D)</th>
<th>Astigmatism (&lt; −0.5 D)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40–49</td>
<td>155</td>
<td>5.6</td>
<td>15</td>
<td>0.6</td>
<td>1347</td>
</tr>
<tr>
<td>50–59</td>
<td>160</td>
<td>8.7</td>
<td>25</td>
<td>1.4</td>
<td>1268</td>
</tr>
<tr>
<td>60–69</td>
<td>270</td>
<td>20.7</td>
<td>46</td>
<td>3.5</td>
<td>773</td>
</tr>
<tr>
<td>70–79</td>
<td>227</td>
<td>35.0</td>
<td>39</td>
<td>6.0</td>
<td>266</td>
</tr>
<tr>
<td>80+</td>
<td>93</td>
<td>44.3</td>
<td>15</td>
<td>7.1</td>
<td>59</td>
</tr>
<tr>
<td>Total</td>
<td>905</td>
<td>13.4</td>
<td>140</td>
<td>2.1</td>
<td>3715</td>
</tr>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40–49</td>
<td>140</td>
<td>6.9</td>
<td>14</td>
<td>0.7</td>
<td>681</td>
</tr>
<tr>
<td>50–59</td>
<td>145</td>
<td>9.3</td>
<td>13</td>
<td>0.8</td>
<td>903</td>
</tr>
<tr>
<td>60–69</td>
<td>200</td>
<td>17.4</td>
<td>42</td>
<td>3.7</td>
<td>613</td>
</tr>
<tr>
<td>70–79</td>
<td>250</td>
<td>34.8</td>
<td>32</td>
<td>4.9</td>
<td>244</td>
</tr>
<tr>
<td>80+</td>
<td>124</td>
<td>46.4</td>
<td>18</td>
<td>6.7</td>
<td>68</td>
</tr>
<tr>
<td>Total</td>
<td>859</td>
<td>14.8</td>
<td>119</td>
<td>2.1</td>
<td>2509</td>
</tr>
</tbody>
</table>

Data are for right eyes, excluding eyes with cataract surgery.
Eye Examination

Participants had an initial anterior segment examination using a torch, including grading lens opacities (LO) against the red reflex, using the Mehra-Minassian (MM) system. Information on the location and type of cataract surgery was elicited, as well as on the use of aphakic correction. Participants proceeded to a more detailed examination by a clinical ophthalmologist if they met certain criteria, including presenting VA <6/12 in one or both eyes. For these participants, the ophthalmologists determined the cause(s) of visual loss by using the principles outlined in the WHO Prevention of Blindness Performa (Version III). All participants with VI were referred to the nearest eye facility.

A detailed examination was performed with a slit lamp microscope (SL 115 Classic Slit Lamp; Carl Zeiss Meditec AG, Jena, Germany), 81-D aspheric condensing lens (Volk Optical, Mentor, OH), Goldmann applanation tonometer, a two-mirror lens (Volk) with no flange for gonioscopy, and a digital camera (Visucam Lite Desktop Fundus Camera; Carl Zeiss Meditec AG).

Approvals

The study adhered to the tenets of the Declaration of Helsinki and was approved by Ethics Committee of London School of Hygiene and Tropical Medicine and Nigeria’s Federal Ministry of Health. Informed consent was obtained from the head of the household and all adult responders.

Statistical Analysis

There was a high correlation between right and left eyes (Pearson’s correlation 0.72; P = 0.001), and therefore, data are reported only for right eyes. All those with no recorded autorefraction results and those who were pseudo/aphakic in their right eyes were excluded. To ascertain effects of LO on RE, a further analysis excluded participants with significant LO, defined as grade 2B or more (MM grading). The odds ratio (presented with the 95% confidence interval) was used in univariate analysis of spectacle use with key variables, such as sex, literacy, education, occupation, and location of residence.

The following analyses were undertaken to determine proportion of individuals with significant RE who could potentially benefit from off-the-shelf spectacles. Individuals with presenting VA <6/12 in the better eye but improving to 6/12 or better were identified first. Individuals who had undergone procedures for cataract in both eyes (cataract surgery with or without IOL, or couching) were then excluded. Prevalence increased significantly with age (P < 0.001; Fig. 2).

Distribution and Prevalence of Refractive Error

The distribution of SE refractive error for right eyes was lep- tokurtotic (Fig. 1). The overall mean and median SE were +0.36 D (95% CI, 0.32–0.41) and +0.63 D (IQR –0.13, 1.25), respectively. After excluding participants with significant LO, these were +0.67 D (0.63, 0.70) and +0.63 D (IQR: 0.13, 1.38), respectively (Fig. 1).

Myopia. The crude prevalences of myopia (< –0.5 D) and high myopia (< –5.0 D) were 16.2% (n = 2003; 95% CI, 15.2–17.1) and 2.1% (n = 299; 95% CI, 1.8–2.4), respectively (Table 1). After excluding participants with significant lens opacities, the crude prevalence of myopia was 9.4% (95% CI, 8.7%–10.2%) and of high myopia 0.7% (95% CI, 0.5–0.9%). The men had a significantly higher prevalence of myopia (16.9% versus 15.5%; OR 1.29, 95% CI, 1.14–1.47). The prevalence of myopia increased steadily with increasing age (P < 0.001; Fig. 2).

Hypermetropia. The crude prevalence of hypermetropia (> +0.5 D) was 50.7% (n = 6283; 95% CI, 49.5–51.9), showing an inverse J-shaped distribution with age (Fig. 2). Excluding those with significant LO did not significantly affect prevalence of hypermetropia (51.2%; 95% CI, 50.8–53.3). Prevalence of high hypermetropia was 0.5% (0.4%–0.6%). The women had a significantly higher prevalence of hypermetropia (55.6% versus 44.7%; OR 1.55; 95% CI, 1.43–1.68).

Astigmatism. The crude prevalence of astigmatism was 63.0% (95% CI, 61.8–64.1), which decreased to 58.7% (95% CI, 57.5–59.9) after those with visually disabling lens opacity were excluded. Prevalence increased significantly with age (P = 0.001). After adjusting for age, the prevalence of myopia was 14.1% and of hypermetropia was 51.1%, which changed to 9.7% and 55%, respectively, when LO were excluded (Table 2).

Sex, Literacy, Residence, and Occupation

Univariate analysis showed that the men had a greater risk of myopia (OR 1.29, 95% CI, 1.14–1.47), but a lower risk of hypermetropia (OR 0.61, 95% CI, 0.55–0.66) than did women.

RESULTS

Demographics

A total of 15,122 eligible adults aged 40 years and older were enumerated, 13,599 of whom were examined (89.9% response rate, which was similar across all geopolitical zones). The age and sex of those enumerated and those examined were similar, but younger men (40–49 years) were underrepresented (Pearson R = 3.94; P < 0.001).

Of the 13,599 participants examined, eight had no VA data, and 890 (6.5%) had no information on RE because of ocular factors including corneal opacity, ptihesis, and inability to undergo refraction because of blindness. A further 299 (2.2%) participants who had undergone cataract surgery were excluded, leaving 12,402 participants for analysis. Some analyses also excluded 1,715 participants with significant LO, leaving 10,687 participants for analysis.
Illiteracy was associated with myopia (OR 1.37, 95% CI, 1.19–1.58), hypermetropia (OR 1.35, 95% CI, 1.23–1.48), and astigmatism (OR 1.57, 95% CI, 1.44–1.72). Residence in a rural area was associated with an increased risk of myopia (OR 1.35, 95% CI, 1.11–1.63) and astigmatism (OR 1.21, 95% CI, 1.08–1.35). Manual occupation was also associated with myopia (OR 1.57, 95% CI, 1.35–1.84) and astigmatism (OR 1.50, 95% CI, 1.38–1.63; Table 3; Fig. 3).

**Spectacle Wear**

Only 1.2% (169) of phakic participants (1.2%) wore distance spectacles to the examination site. Another 38 claimed to own distance spectacles, but did not habitually wear them and were classified as nonwearers. Of the 2003 adults identified as having myopia, only 28 (1.4%) were wearing spectacles, and none of those had high myopia (n = 258). Of the 6823 participants identified with hypermetropia, 79 (1.3%) were wearing spectacles. The prevalence of spectacle wear increased with age (0.69% in 40–49-year-olds, 0.97% in 50–59-year-olds, 1.22% in 60–69-year-olds, and 1.47% in ≥80-year-olds). The 299 participants who had undergone cataract surgery were also more likely to be wearing spectacles (14.4% versus 0.9% in phakic participants).

**Improvers and Incorrect Prescriptions**

A total of 2248 (16.5%; 95% CI, 15.7–17.4) participants were improvers. We estimate that 3,890,000 (95% CI, 3,700,000–4,100,000) adults over 40 years of age would require optical correction to improve VA status by at least one vision category. Just over half (n = 80, 51.0%) of the spectacle wearers had an incorrect prescription at the 6/12 cutoff; this number was lower at the 6/18 cutoff (n = 65, 41.4%).

**Spectacle Coverage**

A need for spectacles was identified in 1279 (9.4%) and 882 (6.5%) individuals at the 6/12 and 6/18 cutoffs, respectively, only 43 and 39 of whom were wearing appropriate spectacles. The overall spectacle coverage was 3.4% (95% CI, 2.9–4.4) and 4.4% (95% CI, 2.9–5.9) at the 6/12 and 6/18 cutoffs, respectively.

There were 1190 individuals with significant RE at the 6/12 level who were phakic in one or both eyes (Table 4). The proportion of the need that could be met by off-the-shelf spectacles, using different criteria for anisometropia and astigmatism, ranged from 33.9% to 44.4% (Table 4).

**Unmet Need**

Over 90% (OR 96.6%, 95% CI, 95.5–97.7) of participants who needed spectacles did not own them, owned a pair but did not use them routinely, or used an incorrect prescription. Our results show that 9.1% (95% CI: 8.5–9.6) of all Nigerian adults over 40 years (2,140,000 individuals), have an unmet need for spectacles, which would improve their distance vision from <6/12 to ≥6/12.

**DISCUSSION**

This survey provides the first population-based data on the magnitude of RE in Nigeria. The two main findings are the

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**Table 2. Age-Adjusted Prevalence of Different Refractive Errors among Nigerian Adults**

<table>
<thead>
<tr>
<th>Refractive Error</th>
<th>N</th>
<th>Prevalence (%)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Crude</td>
<td>Adjusted</td>
</tr>
<tr>
<td>Myopia</td>
<td>12,402</td>
<td>16.2</td>
<td>14.1</td>
</tr>
<tr>
<td>Emmetropia</td>
<td>12,402</td>
<td>33.2</td>
<td>34.8</td>
</tr>
<tr>
<td>Hypermetropia</td>
<td>12,402</td>
<td>50.7</td>
<td>51.1</td>
</tr>
<tr>
<td>Myopia LO</td>
<td>10,687</td>
<td>9.4</td>
<td>9.7</td>
</tr>
<tr>
<td>Emmetropia LO</td>
<td>10,687</td>
<td>35.5</td>
<td>35.3</td>
</tr>
<tr>
<td>Hypermetropia LO</td>
<td>10,687</td>
<td>55.1</td>
<td>55.0</td>
</tr>
<tr>
<td>Astigmatism</td>
<td>12,402</td>
<td>63.0</td>
<td>60.3</td>
</tr>
<tr>
<td>Astigmatism LO</td>
<td>10,687</td>
<td>58.7</td>
<td>59.2</td>
</tr>
</tbody>
</table>

(−)LO, excluding lens opacities (cataract).
occupational and educational groups were described and compared with those of the adult black population in Barbados. The prevalence of high myopia (2.1%) was similar to the adult black population in Barbados (2.19%) (Table 5). A similar trend was evident, even after participants with visually significant cataract were excluded. In contrast, most studies of RE have not examined the prevalence of astigmatism. The prevalence of astigmatism was 63.0% (58.7%, after excluding those with visually significant cataract). Many studies of RE have not examined the prevalence of astigmatism. The prevalence in our survey was similar to findings from South India and elsewhere.26,37,39,49

The crude prevalence of myopia in Nigeria (16.2%) was lower than that in Asia (Pakistan, Bangladesh, India, Singapore, and Myanmar),25,26,51–55 but comparable to Western populations (Netherlands, United States, and Australia).54,55,57 and similar to the adult black population in Barbados (21.9%). The prevalence of high myopia (2.1%) was similar to the rate in white Australians aged 40 years and older,37 higher than findings in the Baltimore Eye Study (1.4% overall)35 and in a study in Bangladesh (1.8%).26 It is likely that these population differences are partly accounted for by a genetic mechanism for myopia, as demonstrated in multiple familial, familial aggregation, and twin studies that suggest the involvement of multiple genes rather than a single major gene effect.40 More data on the genetic basis of RE are needed from African populations.

The prevalence of myopia showed a steady increase with age, similar to reports from Pakistan25 and Bangladesh.26 Much of the myopia in older age groups was the result of cataract, and participants with significant LO accounted for 41.5% of all myopes. Effect of age on prevalence of myopia has been observed in other studies.25,26,51–59,41–46 However, this age-related trend was evident, even after participants with visually significant cataract were excluded. In contrast, most studies of Western populations show a decrease in prevalence of myopia with age, followed by an increase at older ages (J-shaped relationship).37 There may be a U-shaped trend in Nigeria, with the decrease and subsequent increase in prevalence coming at earlier ages than Western populations. It would be instructive for future research in Nigeria to include refractive error in younger age groups as well, to elucidate the longitudinal changes and cohort effects that have been observed in other studies.42–45 The men in our survey had a slightly higher prevalence of myopia than the women, as has been reported in other studies.26,37,47–49

The prevalence of hypermetropia (50.7%) was considerably higher than that in most Asian studies, being closer to that in populations of predominantly European or African descent. The relationship between hypermetropia and age showed a pattern similar that in to studies from Asia and Barbados,25–27,31,33,39,49 with a rise to maximum levels in the 50- to 59-year-old group, followed by a decline in later years. Hypermetropia prevalence was significantly higher in women (55.6% versus 44.7%), which has been observed elsewhere.26,31,37,39,50

Astigmatism was prevalent in 63.0% (58.7%, after excluding those with visually significant cataract). Many studies of RE have not examined the prevalence of astigmatism. The prevalence in our survey was similar to findings from South India and elsewhere.26,37,47–49.
Participants who were illiterate were more likely to be myopic or hypermetropic and to have astigmatism. Participants with manual occupations and those living in rural areas were also more likely to be myopic and have astigmatism. Some of these findings contrast with other population-based studies, which have shown associations between myopia, higher education levels, professional occupations and residence in urban areas. There are, however, exceptions to these trends. The Baltimore Eye Study showed that the association between years of education and myopia was stronger for white persons than for black persons, the Chennai Study (India) showed a higher prevalence of myopia in participants living in rural areas, and the Bangladesh study showed a significantly lower risk of myopia with literacy, urban living, and nonmanual occupation.

The leptokurtosis and negative skewness of the distribution of spherical equivalent RE in this population was similar to that of other studies, but differs from some studies that included the worse eye in their analyses. Younger males were underrepresented, as they were more likely to be at work at the time of examination, which may have led to a slight overestimation of refractive error. The MM lens-grading system was used to provide some data on lens opacities in all participants, regardless of their visual acuity. Incorrect prescriptions were common among the few wearing spectacle correction. This suggests a need to improve both quality and affordability of optical and refractive services in Nigeria. Over one third of the need for distance correction among individuals who were phakic in one or both eyes could be met by off-the-shelf spectacles.

Spectacle coverage rates were significantly lower than reported among similar age groups in Bangladesh (3.0%), Pakistan (6.2%), and India (17.4%), although it should be appreciated that the definition of “unmet need” for spectacles does not necessarily equate with demand for correction. None of the participants with high myopia were wearing spectacles.

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Sample Size</th>
<th>Age Group (y)</th>
<th>Myopia</th>
<th>High Myopia</th>
<th>Hypermetropia</th>
<th>Astigmatism</th>
</tr>
</thead>
<tbody>
<tr>
<td>NBVIS</td>
<td>Pakistan</td>
<td>14,490</td>
<td>≥50</td>
<td>−0.5D; 36.5</td>
<td>−5.0D; 4.6</td>
<td>&gt;0.5D; 27.1</td>
<td>&gt;0.75D; 27.1</td>
</tr>
<tr>
<td>NBLVS</td>
<td>Bangladesh</td>
<td>11,624</td>
<td>≥30</td>
<td>−0.5D; 22.1</td>
<td>−5.0D; 1.8</td>
<td>&gt;0.5D; 20.6</td>
<td>&gt;0.5D; 34.6</td>
</tr>
<tr>
<td>APEDS</td>
<td>India</td>
<td>10,293</td>
<td>≥40</td>
<td>−0.5D; 34.6</td>
<td>−5.0D; 4.5</td>
<td>&gt;0.5D; 18.4</td>
<td>&gt;0.5D; 37.6</td>
</tr>
<tr>
<td>MES</td>
<td>Myanmar</td>
<td>1,865</td>
<td>≥40</td>
<td>−1.0D; 42.7</td>
<td>−6.0D; 6.5</td>
<td>&gt;1.0D; 15.0</td>
<td>&gt;1.0D; 30.6</td>
</tr>
<tr>
<td>SMES</td>
<td>Singapore</td>
<td>2,974</td>
<td>40–80</td>
<td>−0.5D; 38.7</td>
<td>−5.0D; 4.9</td>
<td>&gt;0.5D; 27.4</td>
<td>&lt;0.5D; 33.5</td>
</tr>
<tr>
<td>RES</td>
<td>Netherlands</td>
<td>6,543</td>
<td>≥55</td>
<td>−1.0D; 17.6</td>
<td>−5.0D; 4.0</td>
<td>&lt;3.0D; 17.6</td>
<td>Not studied</td>
</tr>
<tr>
<td>BES</td>
<td>United States</td>
<td>5,036</td>
<td>≥40</td>
<td>−0.5D; 19.4 (B)</td>
<td>−6.0D; 0.0–1.4 (B)</td>
<td>&gt;0.5D</td>
<td>&gt;0.5D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>41.0 (B)</td>
<td>15.8–38.3 (B)</td>
</tr>
<tr>
<td></td>
<td>United States</td>
<td>4,533</td>
<td>43–84</td>
<td>−0.5D; 26.2</td>
<td>−5.0D; 3.8</td>
<td>&gt;0.5D; 49</td>
<td>Not studied</td>
</tr>
<tr>
<td>MVIP</td>
<td>Australia</td>
<td>4,744</td>
<td>≥40</td>
<td>−0.5D; 17.0</td>
<td>−5.0D; 2.1</td>
<td>&gt;0.5D; 37.0</td>
<td>Not studied</td>
</tr>
<tr>
<td>BMES</td>
<td>Australia</td>
<td>3,654</td>
<td>49–97</td>
<td>−0.5D; 15.0</td>
<td>−4.0D; 5.0</td>
<td>&gt;0.5D; 37.0</td>
<td>&gt;0.5D; 37.0</td>
</tr>
<tr>
<td>BdES</td>
<td>Barbados</td>
<td>4,709</td>
<td>≥40</td>
<td>−0.5D; 21.9</td>
<td>−4.0D; 5.0</td>
<td>&gt;0.5D; 49</td>
<td>Not studied</td>
</tr>
</tbody>
</table>

Data are expressed as the spherical equivalent in diopters and the prevalence (%). NBVIS, National Blindness and Visual Impairment Survey; NBLVS, National Blindness and Low Vision Survey; APEDS, Andhra Pradesh Eye Disease Study; MES, Meiktila Eye Study; SMES, Singapore Malay Eye Survey; RES, Rotterdam Study; BES, Baltimore Eye Study; BDES, Beaver Dam Eye Study; MVIP, Melbourne Visual Impairment Project; BMES, Blue Mountains Eye Study; BdES, Barbados Eye Study; (B), black; (W), white participants.
Nigeria appears closer to that of white and black populations in Europe and America, and differs from Asian populations. Findings indicate a low prevalence of myopia in Nigeria, exceedingly low spectacle coverage, a large unmet need for spectacles, and a need to improve the quality, access and affordability of optical and refractive services—a VISION2020 priority.

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References


**APPENDIX**

**Additional Members of the Nigeria National Blindness and Visual Impairment Study Group**

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