

# Presbyopia, Related Functional Impairment, and Spectacle Use in Rural Kenya

a report by

Justin C Sherwin, MBBS, BMedSc<sup>1</sup> and Wanjiku Mathenge, MMed, MSc<sup>2</sup>

1. Centre for Eye Research Australia, Department of Ophthalmology, University of Melbourne, and Faculty of Medicine, Monash University, Victoria; 2. International Centre for Eye Health, London School of Hygiene and Tropical Medicine, Fred Hollows Foundation, Sydney, and Eye Unit, Rift Valley General Hospital, Nakuru  
DOI: 10.17925/USOR.2007.03.00.8

Presbyopia is the age-related loss of accommodation and is often associated with a progressive inability to read fine print and to write. Worldwide, it is estimated that 45 million people are blind, but this figure does not take into account the number with uncorrected presbyopia, the estimate of which is unknown.<sup>1</sup> The International Centre for Eyecare Education (ICEE) states that presbyopia affects 170 million people in sub-Saharan Africa, with over 7 million presbyopes in Kenya from a population of approximately 30 million,<sup>2</sup> of whom the majority will be uncorrected.

The last few years have seen a discernible rise in research investigating the epidemiology, impact on quality of life, and management of presbyopia in low- and middle-income regions. Burke et al., authors of a large population-based study of presbyopia in Tanzania, concluded that the 'VISION2020: The Right to Sight' refractive error agenda should place increased emphasis on targeting presbyopia.<sup>3</sup> As such, the second phase of the VISION2020 global initiative for the elimination of avoidable blindness, outlining the proposed plan for 2006–2011, has recognized uncorrected presbyopia as a significant cause of avoidable visual impairment.<sup>4</sup> The current study sample was a rural population in Kenya and the presented research assessed the prevalence of presbyopia, resulting functional impairment, and spectacle use among persons with presbyopia.<sup>4</sup> The data were collected as part of the Nakuru District Blindness Study.

## Methods

Nakuru District is situated in the Rift Valley in Kenya, where a large percentage of the rural population are subsistence farmers earning less than \$2 per day. For the purposes of our study, we selected clusters of people

over 50 years of age through probability proportionate to size, and individuals were selected within clusters through compact segment sampling. Of those enumerated, 134 (93.1%) were willing to participate. Four were excluded because they did not see at least 3/60 (best corrected visual acuity [BCVA]) in either eye.

Participants were given a short questionnaire evaluating their near-vision-related functional impairment and history of spectacle use. Patients were also examined for presbyopia using a near-vision chart in English and local languages, but were not corrected for distance vision. Patients were excluded if they were bilaterally blind (BCVA <3/60 with a Logmar 'E' chart at 6m). All participants were given free spectacles for near vision if they required them and if they wanted them. We only assessed functional presbyopia, which we defined as 'requiring at least +1.00 diopter (D) in order to read the N8 optotype at a distance of 40cm in the participant's usual visual state.' Subsequently, subjects included myopes who were able to see N8 despite having lost the ability to accommodate. Subjects who were not functionally presbyopic but who had presbyopia following distance correction (objective presbyopes) were not included. Participants were also tested for near vision with reading glasses if they owned them and had them present at the time of the examination.

## Prevalence

We examined 130 subjects, and found that the prevalence of presbyopia in the >50 years of age population was 85.4%. Of the participants with presbyopia, the mean age was 61.5 years and 39.6% were male. Due to differences in the age range of the subjects (see *Table 1*) and in the definition of presbyopia,<sup>5</sup> it is difficult to compare our estimated prevalence of presbyopia with the few reported findings of other population-based studies from low- or middle-income regions. With increasing age, we found an increased severity of presbyopia. More specifically, the mean D required to see N8 at 40cm was 1.65D in subjects in their 50s, and rose to 1.97D in those >70 years of age. The expected worsening in the severity of presbyopia >60 years of age is due to the lost ability to accommodate at this age.<sup>6</sup>

## Risk Factors

Although the age of onset of presbyopia is variable, presbyopia is virtually universal before 50 years of age.<sup>7</sup> In Kongwa, the odds of developing presbyopia increased by 16% per year of age from 40 to 50 years of age, but the increase was not significant after 50 years of age, at 1% per year.<sup>3</sup> This suggests that the majority of changes in the lens involving the development of presbyopia occur before 50 years of age. In order to assess the risk factors for the development of presbyopia, Lavers studied subjects between 40 and 50 years of age in a Tanzanian population. Risk factors for presbyopia were living



Justin C Sherwin, MBBS, BMedSc, is a Research Assistant at Nkhoma Eye Hospital, Malawi and the Centre for Eye Research Australia in Melbourne. He has a special interest in public health ophthalmology and was a Research Assistant for the Nakuru District Blindness Study in Kenya. Dr Sherwin graduated in medicine with honours from Monash University, Victoria in 2008 and will commence his internship in 2009.

E: justincsherwin@gmail.com



Wanjiku Mathenge, MMed, MSc, is a Consultant Ophthalmologist at the Rift Valley General Hospital in Kenya and Chief Investigator of the Nakuru District Blindness Study in Kenya. She also works for The Fred Hollows Foundation as a Medical Adviser. Dr Mathenge is a PhD candidate at the London School of Hygiene and Tropical Medicine, and completed an MSc in community eye health in 2002.

in a rural location, female gender, and being illiterate.<sup>8</sup> The discovery that residing in a rural location is associated with the development of presbyopia has been replicated elsewhere.<sup>9</sup> In the same way, our study was undertaken exclusively in rurally located clusters, and our mean prevalence of presbyopia was higher in females. Female gender is consistently regarded as a risk factor for presbyopia,<sup>7,10</sup> which is an important revelation, because females are often less likely to receive ophthalmic treatment in low-income settings. Following a multivariate analysis in the Andrah-Pradesh Eye Study, further risk factors for presbyopia included myopia, hyperopia, and lens opacities greater than grade II (lens opacities classification system [LOCS] III).<sup>9</sup> Geographical location has also been suggested as a risk factor for presbyopia.<sup>11</sup>

### Quantifying the Presbyopic Need

Ramke et al. conducted a population study of presbyopia in Timor-Leste, and introduced some practical definitions, which can be valuable when quantifying the burden of presbyopia in a given population. These definitions included the met and unmet presbyopic need and the presbyopia correction coverage. Unmet or undercorrected presbyopic need is the number unable to see N8 binocularly, with near-vision correction if used. Met presbyopic need is a measure of the distribution of spectacles for near vision in order to binocularly correct those with presbyopia to N8 or better. Presbyopic correction coverage is a measure of presbyopia requiring correction with spectacles in order to see N8 or better binocularly. We found a high unmet presbyopic need of 80%. Our met presbyopic need was low at 5.4%, and the presbyopic correction coverage was also low at 6.3%. Our estimate of met presbyopic need was higher than in Timor-Leste, where a met presbyopic need of 11.5% was found.<sup>12</sup> The unmet presbyopic need and presbyopia correction coverage in Timor-Leste were 32.3 and 26.2%, respectively. Risk factors for a lower presbyopic correction coverage in Timor-Leste included living in a rural domicile, illiteracy, and farming.<sup>12</sup>

### Functional Impairment and Quality of Life

In the US, McDonnell et al. found that presbyopia is associated with worse vision-targeted health-related quality of life compared with younger subjects with emmetropia.<sup>13</sup> Patel et al. were the first authors to demonstrate the impact of presbyopia on quality of life in sub-Saharan Africa.<sup>14</sup> Similarly, we were able to demonstrate that presbyopia is associated with near-vision-associated functional impairment in a low-income population in which only 63% of presbyopes could read (any language) and only 54% of presbyopes could write (any language). The most common activity requiring near vision in respondents was harvesting grains. The capacity to adequately perform this activity is indispensable, given the ubiquity of poverty in Nakuru District and the dependence on subsistence farming. At a population level, the inability to accomplish farming tasks may hamper socioeconomic development. Other analogous farming tasks include sorting grains, winnowing grains, and weeding. The degree of presbyopia is associated with increasing difficulty with various activities of daily living ( $p < 0.0001$ ), and with tasks requiring near vision there is a progressive increased risk of reporting a higher degree of difficulty with problems with activities requiring near vision.<sup>15</sup>

We calculated the degree of near-vision-associated difficulty in various tasks in persons with presbyopia in order to establish which activity was associated with the highest degree of near-vision-associated functional impairment. We found that 51.6% had moderate or severe difficulty with sewing, 46.3% with recognizing small objects, 39% with reading, 37.4% with harvesting grain, and 32.3% with writing. In Andrah-Pradesh, 19.3%

**Table 1: Prevalence of Presbyopia in Selected Population Studies in Low- and Middle-income Regions**

Location	Age (years)	Prevalence (%)	Reference
Andrah-Pradesh (India)	>30	55.3	9
Kongwa (Tanzania)	>40	61.7	3
Nakuru District (Kenya)	>50	85.4	4
Pelotas (Brazil)	>30	54.7	19
Zanzibar (Tanzania)	40–50	89.2	8

of those with uncorrected presbyopia had moderate to severe difficulty in reading small print, 76.3% had moderate to severe difficulty in recognizing small objects, and 38.6% were unable to manage any near work.<sup>9</sup>

### Management

In rural low-income communities, access to healthcare services is usually poor, and refractionists and other auxiliary ophthalmic personnel are paramount in the management of presbyopia. The World Health Organization (WHO) has set a target ratio of one trained refractionist to 100,000 of the population by 2010 and 1:50,000 by 2020.<sup>1</sup> Suitably trained staff should work in areas of high uncorrected refractive error, including presbyopia. According to the WHO, adults over 40 years of age are a principal target group for near spectacles, as are children with myopia.<sup>16</sup>

Testing for presbyopia is simple, quick, and easy to perform. Du Toit<sup>17</sup> has outlined an approach for prescribing spectacles for presbyopia in low-income regions. In brief, it involves taking a history, finding the patient's working distance, measuring near and distance vision, and identifying the correct lens power and type of lens that is suitable for the patient (simple lens versus bifocal). It is also essential to ensure regular follow-up. Our experience suggests that current users of reading glasses in Africa do not need complicated refractions in order to obtain reading glasses, and distance vision is not as heavily relied on as near vision. Instead, participants mainly require, for example, seeing their baskets for weaving, their mobile phones for typing text or numbers, and grains for sorting. There are many options to assist in the supply and provision of simple plus-powered spectacles in low- and middle-income communities. In our study, nearly two-thirds of spectacles worn by participants, for either near vision or other indications, were from either a hospital eye unit or a local healthcare center, with the remainder being from a shop. Twenty-two percent of persons with spectacles for near vision were uncorrected for presbyopia and the mean time for which participants had owned their glasses was 4.7 years.

One novel approach to increasing the availability of spectacles for presbyopia is through distribution schemes. In Rwanda, the Fred Hollows Foundation has trained military nurses who are involved in other health initiatives in the community (including immunizations for vaccine-preventable infections and the distribution of condoms for the prevention of HIV/AIDS) to carry out simple refractions and distribute the glasses. To date, this program has proved popular with the nurses and the community involved. A similar distribution scheme in Zanzibar achieved similar success in managing presbyopia, with more than three-quarters willing to participate.<sup>8</sup> Given that only one-quarter of the population had previously seen an eye-care professional (ophthalmologist or auxiliary ophthalmic personnel), efforts should be made to provide more accessible refractive services in rural regions.

## Spectacle Use and Associated Barriers

We found that a low percentage of persons with presbyopia had spectacles (6%) and an even smaller percentage had spectacles that were able to correct presbyopia. Comparably low percentages have been found in other areas in sub-Saharan Africa, with a higher coverage in India and Timor-Leste. We also discovered that one-quarter of participants did not want spectacles for near vision, despite them being available free of charge. In contrast, 96.0% of subjects in Timor-Leste were willing to wear near-vision spectacles.<sup>12</sup>

Overwhelmingly, we found that cost was the principal barrier to spectacle use and was a feature in 62% of respondents. This was followed by the notion that presbyopia is unimportant (28%). Cost has also been heralded as the main barrier to cataract surgery in Nakuru District, along with a lack of awareness.<sup>18</sup> However, we did not weigh up the willingness of respondents to pay for spectacles. Nonetheless, this has been performed elsewhere, such as in Timor-Leste, where approximately half of the people surveyed were prepared to pay US\$1 for spectacles, with women and rural residents less likely to pay this amount.<sup>12</sup> In Zanzibar, participants were, on average, prepared to pay approximately US\$2.<sup>8</sup>

## Conclusion

Presbyopia is a universal condition of aging and affects all geographical and socioeconomic regions of the world. As we begin to understand more about the epidemiology of presbyopia in low- and middle-income regions, attention should now turn to ensuring that those in need of management receive suitable care. Increasing the met presbyopic need should involve screening those over 40 years of age, distribution of economically friendly spectacles, and follow-up of recipients of spectacles. The low uptake of presbyopic correction is because a large proportion of the age group that require glasses are illiterate. The term 'reading glasses' reinforces an assumption that because they do not read, they do not need the glasses. However, even without too much intervention by the ophthalmic community, the demand for presbyopic correction will rise by itself as the next generation is much more literate. Nowadays, the use of mobile phones as the main means of telecommunication in Africa will naturally increase demand for reading glasses. Perhaps in low-income regions, including sub-Saharan Africa, the use of the term 'reading glasses' should be abolished. This may reduce the stigma associated with illiteracy, and instead focus on alleviating the near-vision-associated visual impairment. ■

- World Health Organization, action plan 2006–2011, Geneva, 2007 (WHO/PBL/07.140 Rev 1).
- www.kcco.net/RefracterrortheAfricansituation.ppt. Accessed May 20, 2008.
- Burke AG, Patel I, Munoz B, et al., *Ophthalmology*, 2006;113:723–7.
- Sherwin JC, Keeffe JE, Kuper H, et al., *Clin Experiment Ophthalmol*, 2008;36:245–51.
- Walline JJ, Zadnik K, Mutti DO, *Optom Vis Sci*, 1996;73: 376–81.
- MacMillan ES, Elliott DB, Patel B, et al., *Optom Vis Sci*, 2001;78:381–5.
- Weale RA, *Ophthalmol*, 2003;48:515–43.
- Laviers H, *Community Eye Health*, 2007;20:73.
- Nirmalan PK, Krishnaiah S, Shamanna BR, et al., *Invest Ophthalmol Vis Sci*, 2006;47:2324–8.
- Pointer JS, *Ophthalmic Physiol Opt*, 1995;15:241–8.
- Miranda MN, *Trans Am Ophthalmol Soc*, 1979;77:603–21.
- Ramke J, du Toit R, Palagyi A, et al., *Br J Ophthalmol*, 2007;91:860–66.
- McDonnell PJ, Lee P, Spritzer K, et al., *Arch Ophthalmol*, 2003;121:1577–81.
- Patel I, West SK, *Community Eye Health*, 2007;20:40–41.
- Patel I, Munoz B, Burke AG, et al., *Ophthalmology*, 2006;113: 728–34.
- World Health Organisation, The right to sight: 1999–2005, WHO.
- du Toit R, *Community Eye Health*, 2006;19:12–13.
- Mathenge W, Kuper H, Limburg H, et al., *Ophthalmology*, 2007;114:599–605.
- Duarte WR, Barros AJ, Dias-da-Costa JS, et al., *Cad Saude Publica*, 2003;19:551–9.

## Editor's Recommendations—Presbyopia in East Africa

### Population-based Study of Presbyopia in Rural Tanzania

Burke A, et al., *Ophthalmology*, 2006;113 (5):723–7.

This study aimed to determine the prevalence of presbyopia in a rural African population by a cross-sectional method. One thousand, seven hundred and nine persons 40 years of age and older who resided in three villages or randomly selected neighborhoods in Kongwa town, Tanzania, were included. Eligible persons were refracted and given best distance correction. Near vision was tested and corrected to the nearest 0.5 diopter. Presbyopia was defined as at least one line of improvement on a near visual acuity chart with the addition of a plus lens. Of the eligible participants, 61.7% were presbyopic. A higher prevalence of presbyopia was associated with increased age, female gender, higher educational level, and residence in town (odds ratio 3.09; 95% confidence interval 2.46–3.90). The odds of developing presbyopia increased by 16% per year of age from 40 to 50 years of age, but the increase was non-significant at 1% per year after 50 years of age. More severe presbyopia was associated with female gender, and less with education. This study provides the first population-based data on the prevalence of presbyopia in a large, random sample of older Africans and suggests a high rate of presbyopia. Presbyopia plateaus after 50 years of age, and is more common in females. In addition, the three-fold increased odds in town versus village dwellers was unexpected and suggests that research of other factors, including environmental factors, is warranted. ■

### The Prevalence of Presbyopia and the Feasibility of Community Distribution of Near Spectacles in Adults in Zanzibar, East Africa

Laviers H, *Community Eye Health*, 2007;20(64):73.

A nationally representative sample of 400 people 40–50 years of age with distance visual acuity >6/18 was selected from a rapid assessment of avoidable blindness (RAAB) survey being conducted in Zanzibar. Visual function and quality of life questionnaires were administered, followed by clinical assessment by an optometrist. Near visual acuity (defined as the ability to read N8 at 40cm using a logMar E chart) was assessed with and without distance correction. The overall prevalence of presbyopia was 89.2%. Of those who needed correction, only 17.7% had spectacles. Barriers to accessing services included 'not considered a priority' (33%) and 'lack of money' (30.6%). Participants were, on average, prepared to pay \$2.13 for a pair of spectacles (spectacles distributed during the survey cost \$2.00) and 79.3% of those asked would be willing to participate in the distribution scheme if it were introduced in their village. After adjusting for age, presbyopia, and presenting visual acuity, there was an association between 'having difficulty with near tasks' and living in a rural area, being female, and being illiterate. Lower quality of life scores were associated with being older, being female, living in a rural area, and being illiterate, after adjusting for occupation, presenting visual acuity, and presbyopia. ■