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The Global Burden of Potential Productivity Loss from Uncorrected Presbyopia

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Purpose: The onset of presbyopia in middle adulthood results in potential losses in productivity among otherwise healthy adults if uncorrected or undercorrected. The economic burden could be significant in lower-income countries, where up to 94% of cases may be uncorrected or undercorrected. This study estimates the global burden of potential productivity lost because of uncorrected functional presbyopia.

Design: Population data from the US Census Bureau were combined with the estimated presbyopia prevalence, age of onset, employment rate, gross domestic product (GDP) per capita in current US dollars, and near vision impairment disability weights from the Global Burden of Disease 2010 study to estimate the global loss of productivity from uncorrected and undercorrected presbyopia in each country in 2011. To allow comparison with earlier work, we also calculated the loss with the conservative assumption that the contribution to productivity extends only up to 50 years of age.

Participants: The economic modeling did not require the use of subjects.

Methods: We estimated the number of cases of uncorrected or undercorrected presbyopia in each country among the working-age population. The number of working-age cases was multiplied by the labor force participation rate, the employment rate, a disability weight, and the GDP per capita to estimate the potential loss of GDP due to presbyopia.

Main Outcome Measures: The outcome being measured is the lost productivity in 2011 US dollars resulting from uncorrected or undercorrected presbyopia.

Results: There were an estimated 1.272 billion cases of presbyopia worldwide in 2011. A total of 244 million cases, uncorrected or undercorrected among people aged <50 years, were associated with a potential productivity loss of US $11.023 billion (0.016% of global GDP). If all those people aged <65 years are assumed to be productive, the potential productivity loss would be US $25.367 billion or 0.037% of global GDP. Correcting presbyopia to the level achieved in Europe would reduce the burden to US $1.390 billion (0.002% of global GDP).

Conclusions: Even with conservative assumptions regarding the productive population, presbyopia is a significant burden on productivity, and correction would have a significant impact on productivity in lower-income countries. *Ophthalmology 2015;122:1706-1710 © 2015 by the American Academy of Ophthalmology. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).*

Presbyopia is an impairment of near vision that is common among older adults.[1] It can be divided into 2 types: functional presbyopia and objective presbyopia. Functional presbyopia describes the situation whereby the person has vision of <N8 at near (i.e., <6/18 visual acuity) that can be restored to ≥N8 with near addition lenses, but does not include moderate myopes who can read without the aid of spectacles. Objective presbyopia occurs when a person is fully corrected for distance vision but reduction in accommodation has resulted in near vision <N8. In objective presbyopia, near vision can be improved to ≥N8 with near addition lenses and it includes myopes. For the population above the average age of onset (found to be 40 for some countries and 45 for the remainder), prevalence of functional presbyopia is estimated to range from 43.8% in southern and eastern Asian countries to 83.0% in western Asia, Australia, New Zealand, North America, and Europe.[2] On the basis of these rates, 1.044 billion people were estimated to have presbyopia in 2005, and this is expected to increase to 1.782 billion by 2050.[2] The rates for objective presbyopia would be significantly higher.

Given the difficulty that people with presbyopia experience with reading and other near vision tasks, it is not surprising that presbyopia has been found to be associated with negative impacts on quality of life in the US population even when corrected.[3,4] In addition to reading, presbyopia is associated with negative impacts on quality of life and visual function; difficulties with activities, such as harvesting sorghum, threading a needle, writing letters, weeding, winnowing grain, cooking, and sorting rice in a rural Tanzanian population[5]; difficulties with activities of daily living, functional dependence, and social functioning in a rural Chinese population[6]; and difficulties with near vision tasks, such as seeing keys and displays on mobile phones, sewing or weaving baskets or mats, and sorting or cleaning lentils, rice, or other grains in a Fijian population.[7]

Although the negative impact of presbyopia can be minimized through relatively inexpensive correction with

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near-vision spectacles, rates of correction range from an estimated 96% in Europe to as low as 6% in Africa.[2] Thus, uncorrected or undercorrected presbyopia may be hampering economic development, through both productivity losses among older otherwise healthy working adults and barriers to literacy improvements in developing countries.[1,8]

A study of the potential global productivity loss due to uncorrected or undercorrected refractive error estimated an impact of US $202 billion; however, this estimate did not include the potential productivity loss associated with presbyopia due to absence of the necessary data.[9,10] Since that time, global estimates of the prevalence of presbyopia have been published,[2] and the Global Burden of Disease (GBD) study has produced a disability weight for near vision impairment for the first time.[11] By using these new data, the objective of this study is to estimate the global burden of potential productivity loss associated with presbyopia.

Methods

The prevalence of presbyopia and age of onset were estimated for each United Nations member country on the basis of regional estimates[2] and combined with age-specific population estimates sourced from the US Census Bureau[12] to estimate the number of cases of presbyopia. Population data were not available for Niue from this source, so the total population was sourced from the Central Intelligence Agency (CIA),[13] and age structure was estimated to be equivalent to that in the Cook Islands. Numbers of cases without adequate correction in each country were calculated on the basis of the proportion estimated to be uncorrected or undercorrected in each region.[2]

Because the earlier study[1] on the burden of uncorrected distance vision used a conservative assumption that the working-age population includes only those aged 16 to 50 years, we also calculated the burden of presbyopia for this section of the population. We estimated the number of cases of uncorrected or undercorrected presbyopia in each country among the working-age population for the population up to age 50 years and up to age 65 years. The number of working-age cases was multiplied by the labor force participation rate, the employment rate, a disability weight, and the gross domestic product (GDP) per capita to estimate the potential loss of GDP due to presbyopia. To estimate the potential reduction in lost GDP as a result of full correction, we assumed that the maximum possible rate of correction was 96% of the presbyopic population, which is the estimated rate for Europe.

Labor force participation rate estimates for the population aged ≥15 years in 2011 were sourced from the International Labor Organization.[14] For the 17 countries not included in this database, we substituted the most recent labor force estimates from the CIA for 15 countries,[13] the rate for Sudan for South Sudan, and census population and labor force data from the Nauru Bureau of Statistics for Nauru.[15] Census population data for Niue for the denominator in this calculation were sourced from Niue Statistics.[16]

Employment rates were calculated on the basis of the unemployment rates published by the CIA for 2011.[13] Where countries did not have a published rate for 2011, the average for the applicable World Health Organization region was used.

Per capita GDP data for 2011 (in current US dollars) were sourced from the World Bank.[17] When a 2011 figure was not available, 2011 total GDP figures from the United Nations Statistics Division were used,[18] divided by the estimated population for 2011 (Fig 1).

Labor force participation rates	
Source	Countries or regions covered
International Labor Organization	246
CIA World Factbook	15
Sudan's data	South Sudan
Nauru Bureau of Statistics	Nauru
Niue Statistics	Niue

Employment rates	
Source	Countries or regions covered
CIA World Factbook	203
Average of WHO region	Remaining countries and regions

Per capita GDP	
Source	Number of countries or regions covered
World Bank	213
UN Statistics Division (total GDP/population)	Remaining countries and regions

Figure 1. Selection of country economic data. CIA = Central Intelligence Agency; GDP = gross domestic product; UN = United Nations; WHO = World Health Organization.

The GBD 2010 study's disability weight of 0.013 for near vision impairment was used for uncorrected or undercorrected presbyopia.[19] The lay description of this state used for the survey in the GBD survey was "has difficulty seeing things that are nearer than 3 feet, but has no difficulty with seeing things at a distance."[11] The description suggests that it applies to uncorrected presbyopia, so we applied this weight to uncorrected or undercorrected presbyopia and a weight of 0 for corrected presbyopia.

The formula used to calculate the total productivity loss was TPL = TC × population × UC × LPR × (1 − UR) × DW × GDP (PC), where TPL is total productivity loss, TC is total cases, UC is undercorrected presbyopia, LPR is labor force participation rate, UR is unemployment rate, DW is disability weight, and PC is per capita.

The study did not involve human subjects, so it did not require adherence to the guidelines of the Declaration of Helsinki or review by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

Results

Table 1 shows the numbers of cases of presbyopia in various groups by region in 2011. There were an estimated 1.272 billion cases of presbyopia worldwide in 2011. Of these, one-third of cases were among working-age people aged 40 or 45 years (depending on the age of onset in the applicable country) to 49 years, and a further 41% were aged 50 to 64 years. The proportion of cases occurring among people aged <50 years ranged from a low of 17% in parts of Europe (EUR A and EUR C) to 43% in parts of Africa (AFR E). This variation may be explained by the