

Population growth is wide and varied and influenced by various determinants of ageing. Global estimates of population growth are grouped by geographical region, and for further statistical clarification and convenience are summarised into two main groups of developing and developed/industrialised countries.¹

Most regions and countries of the world are experiencing extraordinarily rapid changes in demography.² It is estimated that population will peak at around 10bn later in the 21st century.² Nearly all future population growth is expected to occur in the South, ie in Africa, Asia (excluding Japan, Australia and New Zealand) and Latin America, while a more stable forecast for growth is predicted for the North (Europe, North America, Japan, Australia/New Zealand). Sub-Saharan Africa, which bears the greatest brunt of the HIV/AIDS epidemic, is surprisingly still seeing a rapid increase in population possibly due to the birth rate exceeding that of the death rate on the continent.³

The major drivers or determinants of demographic change include fertility, mortality and migration. Fertility rates in developed countries are lower than those of their developing counterparts since many women marry later, use contraception and abortion to prevent child bearing, and work outside the home.⁴ Mortality or death rates are highest among infants, young children and the elderly. Developed countries have more old people than developing countries, usually due to good health services.⁴

The life expectancy of individuals is affected by factors such as adequate nutrition, clean water and sanitation, and good health and immunisation services. Migration includes geographic population changes within nations and across borders. Migration is less predictable and can occur in sudden waves or slowly over years. Migration leads to ethnic mixes and has a tendency to put strain on social services.⁴

Current global statistics on life expectancy

In all regions of the world, life expectancy has increased since the 1950s.² The South experienced dramatic increases in life expectancy, while Europe and North America had fairly stable life expectancy. Africa bore the detrimental effects of HIV/AIDS between the years 2000 to 2005 but still remains below the life expectancy

Global vision

Part 3 - Demands of an ageing population

In this part of our series on the impact of global trends on eye health, **Professor Kovin Naidoo** and **Pirindhavellie Govender** look at how population growth and demographic changes will affect future eye care provision



Age related eye disease affects near activities, especially reading.

of countries like Asia and Latin America. The regions with the largest proportion of individuals in the age category of 65 years and older were Europe and North America while Asia and Africa had the lowest in this ageing category. In contrast, the latter regions had higher proportions of younger individuals between 0 to 14 years of age. This finding has significant social and economic impact on both ends of the age spectrum in terms of education, health and social security resources.²

Factors contributing to longer life expectancy

Life expectancy has been on a steady increase although punctuated by epidemics of infectious conditions, war and famine.⁵ The Australian Institute of Health and Welfare states that life expectancy is a measure of general population health.⁶ Higher life expectancy reflects low infant and child mortality rates, a greater ageing population and better health care systems.⁶

General factors contributing to longer life expectancy include improved education, medical advances, economic well-being, health care, nutrition and sanitation.⁷ However, increasing life expectancy results in

people living more years in old age and with possible disability.⁸ The global burden of disease has moved from infectious to non-communicable diseases and from premature death to 'years lived with disability'.⁹

New approaches needed

The increasing percentage of elderly people in many countries raises concerns as to whether societies have the capacity to deal with the challenges that an increasing ageing population poses. The report by the United Nations Population Fund and HelpAge International⁷ states that the challenges call for 'new approaches to the way societies, workforces, and social and intergenerational relations are structured' and that they 'must be sustained by a strong political commitment and a solid data and knowledge base that ensure an effective integration of global ageing within the larger processes of development'. Income security, access to quality health care and enabling environments are among some of the major concerns of the ageing population.

Implications for eye care

The increasing state pension age in many countries implies that there will be more old people in the labour force. Of particular concern is a possible decrease in productivity due to ill health and the deterioration of vision and hearing with age. Besides the longer working years, the tendency of the ageing population to engage in recreational and leisure activities requiring precision vision in retirement age, also poses a challenge as does the need for independent living in old age.

Visual and anatomical changes are typical in the ageing population. These changes are accompanied by functional disruptions of visual acuity, contrast sensitivity, dark adaptation, colour vision, visual fields and binocular vision. Hornick¹⁰ cites visual



Quality of life and independent living are important in older people

disturbance as the third most prevalent condition causing disturbance in the elderly after arthritis and heart disease. Visual impairment has been seen to disproportionately affect the elderly. The most common visual or refractive challenge in the ageing population is uncorrected or under-corrected distance or near vision while the ocular challenges include several ocular disease conditions such as cataracts, glaucoma, age-related macular degeneration and ocular manifestations of non-communicable diseases such as diabetes.^{11,12}

An estimated 65 per cent of the world's visually impaired and 82 per cent of those who are blind are 50 years and older.¹³ With an increase in the ageing population, the prevalence of visual impairment is expected to increase.¹⁴ According to Thylefors *et al*¹⁵ the increase in blindness statistics in Africa and Asia, where 75 per cent of the world's blind reside, could be attributed to the high population growth in the elderly population. Loss of vision in the elderly is expected to create a significant impact on independent living and quality of life.¹⁴ This effect can be minimised with appropriate and timely interventions.

The Global Burden of Disease Study 2010 presented 'years lived with disability (YLDs)'.⁸ According to the study, visual impairment was responsible for 21.1m YLDs or 2.7 per cent of the global total of YLDs in individuals 45 years and older. The major causes of YLDs as a result of visual impairment included conditions such as trauma, occupational hazards and idiopathic disorders (29.5 per cent), while uncorrected refractive error was

the second largest cause (26.5 per cent) and cataracts the third largest (22.4 per cent). A small percentage (2.1 per cent) of YLDs as a result of vision loss was due to glaucoma and macular degeneration. A significant change was noted in the YLDs from 1990 to present as a result of changes in the population's age structure.

Sub-Saharan Africa revealed a slightly different pattern of causes of YLDs compared to the more industrialised countries. Conditions like uncorrected refractive error, trachoma, onchocerciasis and vitamin A deficiency predominated in Africa. Diseases related to increasing age and non-communicable disease predominated in the industrialised regions and included conditions such as macular degeneration, glaucoma, diabetes and other vision loss.⁸

Refractive error, presbyopia and ageing

Refractive error (spherical ametropia and astigmatism) changes throughout life, including the adult and later adult years.¹⁶ Rosenbloom¹² states that according to the Gullstrand's simplified eye model, a 70 year old should have approximately 3.00D of hyperopia. Changes in the refractive indices of the lens or vitreous have been attributed as possible causes for these hyperopic changes. Against-the-rule astigmatism has also been noted to increase with age.¹² Presbyopia begins at the age of 40 years and continues to 75 years when accommodation reaches a value of zero.¹⁶

According to Holden *et al*,¹⁷ significant near vision disability is experienced by 420m people of whom 67 per cent are presbyopic,

and 94 per cent of people with significant near vision disability due to uncorrected presbyopia live in less- or least-developed countries. If left uncorrected, these refractive changes have a significant social and economic impact.¹⁸ While Kempen¹⁹ states that refractive conditions can be easily diagnosed, measured and treated with spectacles, contact lenses or refractive surgery, the statistics remain significantly high.^{13,17} Novel, effective and sustainable solutions and strategies need to be implemented to alleviate the refractive demands and public health challenge that this ageing population presents.

Clinical considerations for refraction of the elderly

The refractive changes that occur with old age are usually accompanied by physiological and pathological changes to the ocular structures which can complicate what are seemingly simple procedures in refraction. Therefore, clinically, special considerations need to be given to the detection, diagnosis and management of refractive problems in the elderly.

Objective refraction may be critical, especially in much older individuals with neurological deficits. Static retinoscopy, autorefractometry and keratometry may be used to support estimates or the practitioner's theories of vision loss in the elderly individual. In many cases, standard static retinoscopy may be complicated with media opacities and radical retinoscopy evaluation may be required.¹² Subjective refraction may be more time consuming. Elderly patients tend to be less sensitive to blur due to small pupils, media opacities and retinal changes affecting visual discrimination.¹²

Ocular disease conditions in the elderly

The ageing person is susceptible to several ocular disease conditions such as age-related macular degeneration (AMD), glaucoma, diabetic retinopathy and cataract. While these conditions may be found in the elderly in various regions of the world, they tend to predominate in the developed countries where lifespan is increased and there are large numbers of people in the older age categories. The exception is cataract which, due to the lack of ophthalmologists as well as clinical facilities, has become the leading cause of avoidable blindness.

Quillen²⁰ stated that in the US, one in three elderly people presents

with vision-debilitating disease by the age of 65 years. The significance of age-related eye disease is the effect and implications on the quality of life of the elderly, independent living and risk of injury. Cataract and AMD reduce central vision and affect near activities, especially reading, and glaucoma insidiously reduces peripheral vision thereby impacting on mobility.²¹

AMD is a bilateral, progressive, visually debilitating disease with an elusive aetiology and several known risk factors such as advancing age, gender, race, cardiovascular disease and smoking.²² A meta-analysis of population-based studies in the US suggested that as the prevalence of macular degeneration was steadily increasing with population growth, significant efforts would need to be made to develop preventative strategies.²³ Smoking has been identified as the major preventable risk factor associated with AMD.²⁴ A majority of patients have the 'dry' or atrophic type of AMD which is slowly progressive and not as visual debilitating as the 'wet' type (also referred to as neovascular).²⁵

There have been advancements in treatment of macular degeneration, especially with wet AMD. The angiogenesis promoted by Vascular Endothelial Growth Factor (VEGF) that is characteristic and devastating in wet MD has been the focus of various treatment methodologies. Anti-VEGF medications have been successful in reducing the amount of vision lost in wet MD.²⁶ In addition, technological advancements are being trialled to monitor remotely the retinal visual function of patients who have wet AMD in at least one eye.²⁷ More research in this area can lead to elderly people retaining their visual function and quality of life for longer periods before the devastating effects of the disease set in. In the interim, optometry has a significant role to play in the detection of the disease and management of the accompanying visual impairment.

The incidence and prevalence of glaucoma increases with advancing age.²⁸ According to Lee,²⁸ 10 per cent of the elderly have undiagnosed visual disorders, many of whom have glaucoma and could benefit from screening. Screening for glaucoma can be as simplified as modern technological advancements become available, especially those designed for resource limited countries, for example, the Moorfields Motion Displacement Tester (MMDT). As the prevalence of



Low vision services have been a low priority in developing countries.

glaucoma increases, there is a greater pressure to provide medical therapies that control intraocular pressure. Optometrists play a critical role in the co-management of glaucoma patients, especially in developing countries where there is a significant paucity of human resources available for ocular disease management.

The Rotterdam Study²⁹ found that age-related cataracts increased the risk of mortality. The increase in the prevalence of age-related cataract as one ages confirms the need for effective and appropriate medical services and preventative interventions.³⁰ Poor health-seeking behaviour has been demonstrated for visual health in the elderly since research has indicated that they have a tendency to over-estimate their quality of vision.²⁸ It is therefore imperative that we educate the elderly on the importance of regular follow-up examinations and seeking interventions when visual health is compromised. In order to encourage health-seeking behaviour amongst the elderly, it has been suggested that screening, interventions or awareness programmes be conducted at pension pay points, senior living facilities or out-patient clinics.²⁸

The prevalence of diabetic retinopathy amongst the elderly in the US has increased, with a concomitant increase in prevalence of obesity.³¹ Kincaid³² found that 25 per cent of patients over the age of 75 presented with retinopathy. Methods for screening ageing patients with diabetes are needed. In developing countries where resources are limited, latest technology may be unaffordable to conduct regular, widespread screening programmes. Research and development are therefore crucial in the development of cost-effective screening solutions to limit the potentially blinding consequences of diabetes.

How can we cater for the changing demands of the population in eye care?

Unlike developed countries, developing countries suffer a dire need for human resources for eye health. Significant investment must be made by civil society and governments not only to supply the appropriate human resources but to utilise existing trained eye-health cadres to fill the void that currently exists. Before determining the costs associated with providing appropriate and sufficient human resources, best practice strategies to delivery of eye care must be investigated.

Experience by the authors in the KwaZulu-Natal Province in South Africa suggests that a team approach to human resources with various cadres of eye care personnel is the best approach to effective, appropriate, comprehensive eye care services. Notably, such strategies have to be located within the public sector with government covering the bulk of the infrastructure costs. Within this structure, effective referral strategies can be implemented to ensure service delivery at all levels of care for all visually debilitating conditions in the elderly population.

Human resource development is most effective with defined roles and responsibilities of the various cadres of eye care delivery. Not only will this encompass basic training of all cadres, but also sub-speciality training to ensure a more cohesive approach to provision of services. For example, this might mean training optometrists in refraction but also in the detection and diagnosis of glaucoma. Optometrists could receive further training to co-manage glaucoma patients together with the ophthalmologist, in order to allow more equitable use of ophthalmologists' time to address the dire needs of cataract surgery, laser treatment of diabetic retinopathy, etc. In parallel, training optometric technicians can, to a certain extent, lift the refractive error burden from optometrists so that they can function at a secondary and tertiary level of eye care rather than only at a primary level.

The provision of low vision services must be well established in dealing with visually debilitating conditions associated with the elderly. In developing countries, since the focus has been on primary care, low vision has had a low priority, primarily due to shortages of human and financial resources.³³ In developed countries, like the Americas where low vision

services are more advanced, lack of familiarity of the existence of such services has contributed to poor uptake. It is therefore important that all practitioners are capable of providing low vision services, whether in the private or public sector, and that they are able to access affordable low vision devices. Much of this can be achieved by undergraduate training for new practitioners or through continuing professional education programmes for practitioners already practising.

While creation of appropriate human resources remains a priority, it cannot happen in isolation of providing infrastructure and technology to support the various cadres in their respective roles in the eye health equation.

A systematic method is required in order to determine and develop appropriate and effective solutions to respond to the global vision crisis that is growing with the changing demographics due to ageing. It begins with research to determine the epidemiological evidence which will drive the development of strategies for delivery of eye health services and the human resources required. In combination, necessary infrastructure to support the delivery of services needs to be planned for the present and future demands. ●

References

- 1 United Nations. World Population Ageing: 1950-2050. Report. New York: United Nations, Division of Economic and Social Affairs; 2002. Report No: Contract No: ST/ESA/SER.A/207.
- 2 Bongaarts J. Human population growth and the demographic transition. Philosophical transactions of the Royal Society of London Series B, *Biological sciences*. 2009 Oct 27;364:1532-2985-90.
- 3 UNAIDS. AIDS Epidemic Update. Geneva: Joint United Nations Programme on HIV/AIDS and World Health Organization 2007 UNAIDS/07.27E/JC1322E.
- 4 2013 ed. Indiana, USA: Annenberg Learner; 2013. Habitable Planet.
- 5 Olshansky SJ, Passaro DJ, Hershow RC et al. A potential decline in life expectancy in the United States in the 21st Century. *New England Journal of Medicine*. 2005;352:11138-45.
- 6 Australian Institute of Health and Welfare. Life Expectancy. Australia: Australian Institute of Health and Welfare; 2013 [24 April]. Available from: <http://www.aihw.gov.au/life-expectancy/>.
- 7 United Nations Population Fund, HelpAge International. Ageing in the Twenty-First Century: A Celebration and A Challenge. New York and London: United Nations Population Fund and Help Age International

2012.

- 8 Vos T, Flaxman AD, Naghavi M et al. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2012;380:9859-2163-96.
- 9 Murray CJL, Vos T, Lozano R et al. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2012;380:9859-2197-223.
- 10 Hornick TR. Surgical innovations: impact on the quality of life of the older patient. *Clinics in Geriatric Medicine* 2006;22:3499-513.
- 11 Congdon N, O'Colmain B, Klaver CC et al. Causes and prevalence of visual impairment among adults in the United States. *Arch Ophthalmol* 2004;122:4477-85.
- 12 Rosenbloom A. In Rosenbloom and Morgan Vision and Aging. St Louis, Missouri: Butterworth-Heinemann Elsevier, 2007.
- 13 Pascolini D and Mariotti SP. Global estimates of visual impairment: 2010. *Br J Ophthalmol* 2012;96:5614-8.
- 14 Taylor HR, Pezzullo ML and Keeffe JE. The economic impact and cost of visual impairment in Australia. *Br J Ophthalmol* 2006;90:3272-5.
- 15 Thylefors B, Negrel AD, Pararajasegaram R et al. Global data on blindness. Bulletin of the World Health Organization 1995;73:1115-21.
- 16 Grosvenor T. Primary Care Optometry. 5th Edition ed. St Louis, Missouri: Butterworth-Heinemann Elsevier, 2007.
- 17 Holden BA, Fricke TR, Ho SM et al. Global vision impairment due to uncorrected presbyopia. *Arch Ophthalmol* 2008;126:121731-9.
- 18 Bourne RR, Dineen BP, Huq DM et al. Correction of refractive error in the adult population of Bangladesh: meeting the unmet need. *Invest Ophthalmol Vis Sci* 2004;45:2410-7.
- 19 Kempen JH, Mitchell P, Lee KE et al. The



Subjective refraction can be more time consuming with elderly patients.

prevalence of refractive errors among adults in the United States, Western Europe, and Australia. *Arch Ophthalmol* 2004;122:4495-505.

- 20 Quillen DA. Common causes of vision loss in elderly patients. *American Family Physician* 1999;60:199-108.
- 21 Eichenbaum JW. Geriatric vision loss due to cataracts, macular degeneration, and glaucoma. *M Sinai J Med* 2012;79:2276-94.
- 22 Jackson AJ and Wolffsohn J. Low Vision Manual. Philadelphia: Butterworth Heinemann Elsevier, 2007.
- 23 The Eye Diseases Prevalence Research Group. Prevalence of age-related macular degeneration in the United States. *Arch Ophthalmology* 2004;122:4564-72.
- 24 Smith W, Assink J, Klein R et al. Risk factors for age-related macular degeneration: Pooled findings from three continents. *Ophthalmology* 2001;108:4697-704.
- 25 Solebo A, Angunawela R, Dasgupta S et al. Recent advances in the treatment of age-related macular degeneration. *Br J Gen Pract* 2008;58:550309-10.
- 26 Pavan-Langston D. Manual of Ocular Diagnosis and Therapy. Pavan-Langston D, editor. Philadelphia: Lippincott Williams & Wilkins; 2008.
- 27 Kaiser PK, Wang YZ, He YG et al. Feasibility of a novel remote daily monitoring system for age-related macular degeneration using mobile handheld devices: Results of a Pilot Study. *Retina* 2013 Apr 19. Epub 2013/04/24.
- 28 Lee A and Beaver H. Geriatric Ophthalmology: A Competency-based Approach. New York: Springer; 2009.
- 29 Borger PH, van Leeuwen R, Hulsman CA et al. Is there a direct association between age-related eye diseases and mortality? The Rotterdam Study. *Ophthalmology* 2003;110:71292-6.
- 30 Tsai SY, Hsu WM, Cheng CY et al. Epidemiologic study of age-related cataracts among an elderly Chinese population in Shih-Pai, Taiwan. *Ophthalmology* 2003;110:61089-95.
- 31 Mokdad AH, Ford ES, Bowman BA et al. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *JAMA* 2003;289:176-9.
- 32 Kincaid M. Ocular disease in the diabetic elderly. *Clinical Geriatric Medicine*. 1999;15:2279-92.
- 33 World Health Organisation. Low vision care for the elderly: report of a workshop. Geneva: 1996 WHO/PBL/96.57.

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