

## Section two: The epidemiology and impact of blindness and vision loss in Australia

Worldwide, the leading causes of blindness and low vision are cataracts, onchocerciasis ('river blindness'), trachoma, leprosy, and vitamin A deficiency.

In Australia ageing is the major contributing factor to visual impairment and blindness. The most prevalent causes of blindness and vision loss in Australia are age-related macular degeneration, cataract, glaucoma, diabetic retinopathy, uncorrected or under-corrected refractive error, eye trauma and trachoma in some remote areas.

Other causes of blindness and vision loss in Australia include retinal diseases such as retinitis pigmentosa, amblyopia, eye cancers, stroke, complications of premature birth and various infective agents such as herpes zoster and cytomegaly virus in people with HIV/AIDS. However at a population level the prevalence of these conditions is small compared with vision problems associated with ageing towards the end of life.

This section provides a brief overview of the major causes of blindness and low vision in Australia, including a brief description of the signs and symptoms, and an indication of the prevalence, risk factors and interventions for each condition. Prevalence data have in most cases been taken from the AIHW Bulletin 'Vision Problems Among Older Australians' which was released in July 2005. Readers interested in accessing further information about the methodologies involved in determining these prevalence figures are referred to that publication.

### Age-related macular degeneration

Age-related macular degeneration (AMD) is a progressive condition affecting the central part of the retina (macula) which is the area at the back of the eye that provides fine vision for daily tasks such as reading, recognising faces and driving. The early stage of the disease is sometimes referred to as age-related maculopathy (ARM). In this stage vision is unaffected and people may be unaware that they have the condition.

If the disease progresses to AMD, irreversible loss of central vision occurs, usually in both eyes. People with advanced AMD often maintain sufficient peripheral vision to be able to move around independently, but they are legally blind and their capacity to undertake normal daily activities is limited.

AMD is classified as either dry (geographic atrophy) or wet (neovascular AMD). Dry AMD is the most common, caused by fatty deposits (drusen) formed in the macula. Large drusen are associated with an almost 6% risk of developing AMD over 5 years in the involved eye (Friedman et al. 2004a). Wet AMD is less common, resulting from abnormal blood vessels forming and leaking into the macula. Vision loss tends to be gradual for those with the dry form, but is often sudden for those with the wet form and vision loss may be severe.

### Prevalence of AMD

It is estimated that 3.1% (147,000) of the population aged 55 years or more have AMD (AIHW 2005). Rates are similar between men and women and increase markedly for men and women older than 80 years. A further 491,900 Australians aged 55 or more (10.4%) have early ARM defined by large drusen in at least one eye. Thus 638,900 Australians aged 55 or more have either the late (147,000) or early (491,900) stage of ARM (720,900 aged 40 or more) (AIHW 2005).

### Risk factors for AMD

AMD is strongly related to advancing age and family history, and the most important known preventable risk factor is tobacco consumption. The Blue Mountains Eye Study showed that current smokers had a four-fold increased risk of ARM compared to past or non-smokers (Smith, Mitchell, Leeder 1996).

Findings from a number of human studies suggest that people with low levels of carotenoids and the antioxidant vitamins C and E in their blood and who also smoke are at increased risk of developing macular degeneration (NHMRC 2003).

Experimental studies indicate that two carotenoids in particular – lutein and zeaxanthin – appear to be accumulated by the macula, and in a human study, when the dietary intake of carotenoids was analysed, the sum of the intake of lutein and zeaxanthin had the strongest protective effect against macular degeneration. Taken together, these findings suggest that in many cases macular degeneration may be prevented by eliminating smoking and ensuring an adequate intake of fruit and vegetables (NHMRC 2003).

Of particular interest are several recent reports on the presence of lutein and zeaxanthin in precise but different orientations in the membranes of the macula, which suggest that these two carotenoids may serve a special role in reducing the risk of AMD (NHMRC 2003).

There is some evidence that in people with particular indications of AMD, taking a supplement of antioxidants and certain minerals may reduce the risk of progression to advanced AMD (AREDS Research Group 2001).

### **Interventions for AMD**

There are currently no treatments available to reverse the effects of dry MD. There are two currently available treatments for some forms of wet MD - laser photocoagulation and photodynamic therapy with verteporfin. These treatments are not a cure for wet MD, but can help reduce the risk of advancing vision loss in selected cases. A third treatment, injections of vascular endothelial growth factor blocker, has been approved in the USA.

## **Cataract**

A cataract is a clouding of the eye's naturally clear lens. When the lens becomes opaque, the amount of light that passes through it is reduced and scattered, and the image cannot be correctly focused on the retina at the back of the eye, leading to blurred vision. The eyes may be more sensitive to glare and light, and colours may seem faded or yellowed. Double vision may also occur.

There are three types of age-related cataract: nuclear cataract (in the centre of the lens), cortical cataract (in the outer shell or periphery of the lens) and posterior subcapsular cataract (at the back of the lens in the central axis). The three types of cataract often occur together.

### **Prevalence of cataract**

It is estimated that, in 2004, almost 1.5 million Australians aged 55 or more had cataracts, which represents 31% of that population (AIHW 2005). Age-specific rates for cataract increase with age for men and women and are well over 70% for men and women aged 80 or more. Prevalence rates are higher among women than men (AIHW 2005).

It is estimated that in 2004 there were 429,600 Australians aged 55 or more who had had cataract surgery, which represents 9.1% of that population (AIHW 2005). Cataract surgery is the main type of eye surgery needed by Indigenous Australians.

### **Risk factors for cataract**

Cataracts are largely related to the ageing process. There is some evidence that long-term exposure to sunlight, tobacco, and heavy alcohol consumption may be associated with cataract formation. Systemic diseases such as diabetes and vascular disease may increase the risk of cataract development, as may eye injury or the use of some medications, including corticosteroids.

Several studies in humans have reported that the risk of developing ocular cataracts is significantly higher in people with low dietary intakes of fruit and vegetables, vitamins C and E and betacarotene (NHMRC 2003).

Experimental studies with model systems have added further support to the notion that above average intakes of antioxidant nutrients may delay the onset of senile cataract. More recently a modest protective effect against the development of cataracts has been observed for higher intakes of the carotenoids lutein and zeaxanthin (NHMRC 2003).

### **Interventions for cataract**

When symptoms begin to appear, visual aids such as glasses, strong bifocals or magnifying glasses may be used to improve vision for a while. When the condition becomes serious enough to affect daily life, a surgical procedure becomes necessary to restore vision. The operation is a simple and effective procedure that can restore vision. The cloudy lens is removed and replaced with a clear, permanent intra-ocular lens. Cataract surgery is generally performed under local anaesthetic as day surgery.

## **Glaucoma**

Glaucoma is a disease involving damage to the optic nerve and subsequent vision loss or blindness. The condition is often associated with increased intraocular pressure; however it can also occur with normal or even below-normal eye pressure.

Most cases of glaucoma are open-angle glaucoma (OAG), also called chronic glaucoma. OAG usually begins with the loss of peripheral vision, which is often unnoticeable. As permanent nerve damage occurs, symptoms become obvious. Tunnel vision might develop, and only objects that are straight ahead can be seen.

Primary closed-angle glaucoma is less common and usually occurs in an acute form, which presents with the sudden onset of symptoms such as decreased vision, extreme eye pain, headache, nausea and vomiting, and glare and light sensitivity.

### **Prevalence of glaucoma**

The prevalence rate for glaucoma in 2004 was estimated to be 2.3% (109,300) for the Australian population aged 55 years or more (AIHW 2005). There is no statistically significant difference in prevalence rates between men and women.

### **Risk factors for glaucoma**

Advancing age is associated with the development of glaucoma, although it can occur at any stage of life. Other risk factors include high intra-ocular pressure, heredity, extreme short-sightedness, conditions such as diabetes and hypertension, eye injury and the use of steroids.

Although high intra-ocular pressure is often associated with glaucoma, it is now considered a risk factor rather than a diagnostic criterion for the condition.

### **Interventions for glaucoma**

Automated visual field testing (perimetry) is used to assess the progress of glaucoma.

There are a range of treatments that have been shown to be effective in slowing down or halting the progress of glaucoma, including the use of medications such as prostaglandins, or surgical techniques, including laser surgery. The medicinal use of cannabinoids needs to be ascertained for the treatment of intra-ocular pressure in cases of glaucoma where individuals may be refractory to traditional methods of managing the disease.

The Blue Mountains Eye Study found that only half of the cases with signs of glaucoma in the population surveyed had previously been diagnosed (Mitchell, Smith, Attebo and Healey 1996). Vision loss caused by glaucoma cannot be restored.

## **Diabetic retinopathy**

Diabetic retinopathy (DR) is a common diabetes complication that affects the small blood vessels of the retina. It remains one of the leading causes of vision loss despite the availability of effective treatment.

In the early stages, known as non-proliferative DR, the blood vessels of the retina swell and leak fluid. This stage is not usually associated with visual impairment and there are no symptoms. As the disease progresses (known as proliferative DR) abnormal blood

vessels grow on the surface of the retina and, without treatment, these can bleed causing cloudy vision or blindness. Abnormal fibrous tissue may also develop, leading to retinal detachment and severe vision loss. Blurred central vision may occur when the macula swells from leaking fluid (called macular oedema) or due to macular ischaemia from poor perfusion consequent upon perifoveal capillary loss.

### **Prevalence of diabetic retinopathy**

It is estimated that about 133,900 Australians aged 55 or more had diabetic retinopathy in 2004, which represents 2.8% of that population (AIHW 2005). The prevalence of DR was greater in the older age groups. Published results from the Diabetes, Obesity and Lifestyle Study reported that the prevalence of DR was similar in men and women (Tapp et al. 2003). Also, any form of DR occurred in 22% of those with known type 2 diabetes and 6% in those who had not previously been diagnosed.

The prevalence of proliferative retinopathy was 2.1% in those with known type 2 diabetes and there were no cases identified among those who had not been previously diagnosed (Tapp et al. 2003). DR is the primary vision-threatening condition for Aboriginal and Torres Strait Islander people (OATSIH 2001).

### **Risk factors for diabetic retinopathy**

Everyone with diabetes is at risk of developing DR. People with diabetes who are most at risk include those who have had diabetes for many years; those whose diabetes is poorly controlled; those with kidney damage; and those with high blood pressure or high blood cholesterol (NHMRC 1997).

Poor control of blood sugar is the most critical risk factor for the development and progression of DR (NHMRC 1997).

### **Interventions for DR**

The efficacy of timely laser photocoagulation in preventing vision loss from DR is well established. Early detection of sight-threatening retinopathy by regular eye exams is the key to reducing avoidable blindness and low vision from DR (NHMRC 1997). All people with diabetes need to have an eye examination on diagnosis and at least every two years if no retinopathy is present and more frequently if retinopathy is found. Annual eye examinations are recommended for Aboriginal and Torres Strait Islander people with diabetes (NHMRC 1997).

## Refractive error

Refractive errors are optical defects that result in light not being properly focused on the eye's retina. The most common are hypermetropia (long-sightedness), myopia (short-sightedness), astigmatism (uneven focus) and presbyopia (an age-related problem with near focus). It is estimated that nearly 300,000 Australians may have visual impairment because of under-corrected refractive error.

With the exception of presbyopia, refractive errors usually develop during childhood, when the eyes are growing. The exact causes of refractive errors are still being studied, but it is known that both hereditary and environmental influences can affect their development.

Although long-sightedness and short-sightedness are not specifically age-related, they remain common conditions in later life. Long-sightedness, short-sightedness and presbyopia were included among the five most common long-term medical conditions reported by people aged 55 years or more in the 2001 National Health Survey (AIHW 2005).

As refractive error is the most common cause of visual impairment in Australia, access (both cost and physical) to affordable corrective devices such as spectacles is an important issue. Spectacles (glasses) and contact lenses are commonly provided through optical dispensers at market prices. Some private health insurance schemes provide a subsidy for the cost of the appliances. State and Territory governments have schemes to provide spectacles at low cost for people on low incomes.

### Laser surgery

Several surgical techniques have been developed to treat refractive error in suitable candidates. The two most common types of laser refractive surgery in Australia are PRK (PhotoRefractive Keratomy) and LASIK (Laser-Assisted In-Situ Keratomileusis). Many factors can affect the outcomes of surgery, including surgical skill, clinical equipment (blades, lasers, controlling computers) and clinical conditions (the presence of dust, use of aerosols, humidity etc).

The cost of laser refractive surgery in Australia is usually borne by the patient, since laser surgery is not usually covered by private health insurance.

## Presbyopia

Presbyopia is a condition in which the natural lens of the eye loses its flexibility so that focusing on close objects becomes difficult. It develops over a number of years and usually becomes noticeable during middle age, beginning in the 40s.

The signs of presbyopia include tendency to hold reading materials at arm's length, blurred vision at normal reading distance, and fatigue, eyestrain or headache when performing close work.

### Prevalence of presbyopia in Australia

Based on the latest National Health Survey, the prevalence of presbyopia in 2004 among older Australians (aged 55 or more) is estimated to be 1,317,000, which represents 27.9% of that population (AIHW 2005). There is a clear increase in the prevalence rate with age, from 15.3% of those aged 45-49 to 40.1% of those aged 80 and over, with men and women having similar patterns (AIHW 2005). It should be noted that these figures are based on self-report and are likely to be significant underestimates and are perhaps best considered as estimates of symptomatic presbyopia (AIHW 2005).

### Risk factors for presbyopia

Presbyopia is believed to be part of the natural process of ageing. However several factors are thought to increase the likelihood of developing presbyopia, including long-sightedness, an occupation which has near vision demand, ocular disease or trauma which causes damage to lens or its surrounding muscles, conditions such as diabetes and multiple sclerosis, and use of drugs such as alcohol, anti-depressants and antihistamines. Greater exposure to ultraviolet radiation and higher temperature climate may also increase the risk of the condition.

### Interventions for presbyopia

The most common treatment for presbyopia is eyewear such as reading glasses, bifocal glasses or progressive addition lenses (multifocal glasses). Contact lenses may also be used.

## Myopia (short-sightedness)

Myopic people do not see distant objects clearly. This can make it hard, for example, for affected people to read road signs, play ball games and recognise people in the distance.

This is because a myopic eye is longer than normal or has a cornea that is too steep (thick), so that light is focussed in front of the retina and the image is blurred.

People with high myopia have a higher risk of detached retina or AMD. They therefore need regular eye examinations to watch for changes in the retina. People with myopia can also develop cataract or glaucoma at an earlier age than people with normal vision.

### **Prevalence of myopia in Australia**

Myopia is very common in Australia; with about 15-20% of the adult population being short sighted (ABS 2003).

### **Risk factors for myopia**

The causes of myopia are unknown. Excessive amounts of reading, poor metabolism, poor diet; poor light, poor posture and genetic factors have been suggested.

### **Interventions for myopia**

The most common treatment for myopia is corrective eyewear. Laser surgery is becoming increasingly popular.

## **Hypermetropia (long-sightedness)**

### **Prevalence of hypermetropia in Australia**

The 2001 National Health Survey found that less than 8% of people in all age groups under 45 reported being long-sighted. However, 41% of those aged 45-49 reported being hypermetropic and a greater percentage again in age groups up to the sixties. Hypermetropia was reported in 43% of people aged 85 and over (ABS 2003).

### **Interventions for hypermetropia**

The most common treatment for hypermetropia is corrective eyewear. Laser surgery may also be used.

## **Astigmatism**

Astigmatism is a focusing error that causes asymmetric blur, so that some directions in an image are more out of focus than others. This causes images to appear distorted, or sometimes even double. It is possible to have astigmatism in combination with myopia or hypermetropia.

Astigmatism is usually caused by the shape of the front surface of the eye (the cornea) but it can also be caused by slight tilting of the lens inside the eye. It may be an inherited characteristic or a normal variation accompanying growth.

Astigmatism can be corrected by spectacles or contact lenses (hard and soft).

## Trachoma

Trachoma is a chronic conjunctivitis caused by repeated episodes of infection with the bacteria *Chlamydia trachomatis* that can lead to conjunctival scarring.

Trichiasis is a sight-threatening complication of trachoma where the lid margin and eyelashes turn inwards. The rubbing of the eyelashes on the cornea leads to corneal damage and blindness in later life. Secondary infections may also contribute to vision loss. However, active trachoma does not inevitably lead to cicatricial disease and blindness.

### Prevalence of trachoma in Australia

In Australia, trachoma and trichiasis affect mainly Aboriginal and Torres Strait Islander peoples in some remote areas. The exact prevalence of trachoma and trichiasis is not known.

### Risk factors for trachoma

Trachoma is strongly associated with sub-optimal housing and living environments. Routes of transmission include: conveyance by fingers, indirect spread on fomites, coughing and sneezing and by eye-seeking flies.

### Interventions for trachoma

Trachoma control in endemic regions requires a holistic, coordinated and sustained public health response with the involvement of public health units, primary health care services and housing and essential services in affected geographical regions to reduce the risk.

The WHO recommends the adoption of the SAFE strategy (Surgery, Antibiotics, Facial Cleanliness and Environmental improvement) for trachoma control. There are a range of surgical procedures currently in use to correct trichiasis. Antibiotic treatment may

reduce the transmission of infection. Face washing is likely to be effective in controlling trachoma, when promoted as part of a holistic program of personal hygiene.

Environmental factors associated with trachoma include household flies breeding unchecked in public latrines, uncollected household refuse and on neglected domestic animals; overcrowded housing; contaminated water supplied to households; community education around the importance of personal and community hygiene not re-inforced or maintained.

There is no national approach to trachoma control. In some states and in the Northern Territory where trachoma is still prevalent a variety of trachoma control activities are implemented.

The Department of Health and Ageing is currently working with the Communicable Diseases Network Australia (CDNA) to develop guidelines for a nationally consistent approach to the surveillance and public health management of trachoma within Australia. The CDNA is the peak national body for the public health management of communicable diseases. The CDNA reports to the Australian Health Ministers' Advisory Council through the National Public Health Partnership. The CDNA intends to consult with key national stakeholders before finalising the guidelines.

## Eye trauma

It is estimated that 500,000 blinding ocular injuries occur worldwide each year and that ocular trauma is a leading cause of monocular vision loss (Thylefors 1992).

The age distribution of ocular trauma is bimodal, with the greatest risk occurring among the young and people over 70 years of age. Most ocular trauma occurs in young people (Fong 1995) and could be prevented by proper use of safety eyewear. Alcohol is often a major contributing factor.

### Prevalence of eye trauma

A 1995 prospective survey of eye injuries treated in Victorian hospitals (Imberger, Altmann and Watson 1998) found that:

- the workplace accounted for 44% of all injuries and 19% of severe trauma, including ruptured globes and internal bleeding;
- sports injuries accounted for 5% of all injuries, but 19% of severe injuries;

- the incidence estimate for penetrating eye injuries was 3.6 per 100,000 population; and
- the incidence of eye injuries requiring hospitalisation was 15.2 per 100,000.

### Causes of eye trauma

Agents of eye damage may be broadly classified into the following four categories:

- impact or blunt force;
- foreign bodies;
- chemicals injurious to the eye; and
- radiation.

In a study of eye injuries presenting to emergency departments of hospitals, the National Injury Surveillance Unit (NISU) of the Australian Institute of Health and Welfare found a pattern of injury similar to that in the United States. Of the 1000 eye injuries estimated to occur in US workplaces each day, 70% are caused by flying particles smaller than a pin head and one fifth are caused by exposure to chemicals. Many of these injuries occurred when workers were not wearing appropriate eye protection, but more than 50% of workers injured while wearing eye protection felt that another type of eye protection could have better prevented or reduced the injury suffered (Research Centre for Injury Studies 1997).

### Risk factors for ocular trauma

There are many occupations where eyes are at risk. Workers at risk include those who work with:

- mechanical equipment;
- chemicals; and
- sources of radiation, mainly ultraviolet radiation from welding and infra-red radiation from furnaces.

Construction, automotive repair and manufacturing occupations have the highest rate of workplace eye injuries in the United States. Military personnel are also at risk in conflict settings, with injuries much more likely to be bilateral than in peacetime. The rate of penetrating eye injuries appears to be on the increase due to changing weaponry.

Sports are a common cause of severe ocular injuries in the developed world. Injuries range from abrasions of the cornea and bruises of the eyelids to internal eye injuries, such

as retinal detachments and internal bleeding. Many of these injuries lead to vision loss and permanent blindness. Sports presenting particular risks include basketball, baseball, football, soccer, hockey, tennis, golf, water sports and gun sports. Assault may also lead to ocular trauma, and often with a particularly poor outcome.

### **Prevention of eye trauma**

Nearly all cases of eye damage that occur in Australia each year are preventable. Damage to the eye can be avoided by suitable design and engineering controls, following well-established safe working and playing procedures and, where necessary, wearing suitable eye protection.

Australia has an Australian Standard for eye protectors for racquet sports (AS/NZS 4066:1992, amended 1994). This Standard specifies requirements for eye protectors designed for use by players of racquet sports; requirements for eye protectors for indoor and outdoor cricket are not included. AS4066 deals with materials, construction, attachment, optical properties, testing, labelling and marking, and optical, field of view, area of coverage and impact resistance requirements.

The Standards for eye protection in industrial applications are given in AS/NZS 1336 (1997) and AS/NZS 1337 (1992), and eye protectors for motor cyclists and racing car drivers are specified in AS 1609 (1981, amended 1982). Safety of laser products is given in AS/NZS 2211 (1997-2004) and AS 2397 (1993) sets standards for safe use of lasers in the building and construction industry.

AS1337 aims to assist in the provision of safe, efficient and comfortable vision in the industrial situation, including consideration of the need for protection against sunglare and optical radiation in the natural environment. The Standard specifies minimum requirements for eye protectors and associated lenses designed to protect eyes against common industrial hazards such as flying particles and fragments, dusts, splashing materials and molten metals, harmful gases, vapours and aerosols. Requirements for optical qualities and low, medium and high impact resistance are given and appendices describing appropriate test methods are included.

AS1336 sets recommended practices for protecting eyes against the same range of hazards as well as high-intensity radiation generated during welding operations and furnace work. It also gives guidance on selecting eye protectors appropriate to the use of particular lasers.

## Retinitis pigmentosa

Retinitis Pigmentosa is a progressive degeneration of the retina due to the inability or reduced ability of the body to provide the retina, in both eyes, with the necessary protein to sustain the health of the retina. The condition affects night vision and peripheral vision. Signs and symptoms usually appear first in childhood, but severe visual problems do not usually develop until early adulthood. Retinitis Pigmentosa is the leading cause of youth blindness in Australia.

### Risk factors

So far the only discovered risk factor for retinitis pigmentosa is family history. Over 150 specific genes have been identified in affected families. Family planning with genetic counselling can assist to determine the risk of the disease occurring.

### Interventions

There is currently no effective treatment for retinitis pigmentosa. However use of sunglasses to protect the retina from ultra violet light may have a vision preserving effect. Promising research advances include – transplantation of stem cells or retinal elements and effect on progression of injected growth factors, and, in the future, specific gene therapy.

## Amblyopia

Amblyopia, sometimes known as lazy eye, is a condition of reduced or dim vision in an eye which appears to be normal. It can be caused by any condition that leads one eye to be favoured and the image from the other eye to be suppressed by the brain. Common causes include squint (strabismus), different refractive errors in each eye and childhood cataract. The condition is thought to affect between 2% and 4% of the Australian population.

### Interventions

If amblyopia is detected early in childhood, near complete recovery of normal vision is usually possible. The most common treatment involves patching the good eye to force the child to use the amblyopic eye. In some instances, eyeglasses are prescribed to correct refractive errors. Sometimes muscle surgery may be necessary. Orthoptics therapy can re-train the eyes to work together.

## **The social and economic impact of blindness and vision loss in Australia**

Diseases of the visual system, and possible subsequent vision loss, represent substantial social and economic concerns to the Australian public. Based on the results of the 2001 National Health Survey, 9.7 million Australians had at least one sight problem (ABS 2002).

Vision loss is among the major causes of disability. According to the 1998 Survey of Disability, Ageing and Carers 'loss of sight' was the reason or part of the reason for disability given by 2% of the total population (349,800 people). It was the principal cause of disability in 113,200 people and about 39,600 people had a severe or profound 'core activity restriction' due to loss of sight.

Recent independent economic analysis undertaken by Access Economics for the Centre for Eye Research Australia estimated the total cost of vision disorders in Australia to be \$9.85 billion for 2004, including both direct and indirect costs (Access Economics 2004).

Direct health costs of visual impairment include health system costs, including pharmaceuticals, imaging and pathology, optometry and medical services, inpatient and outpatient procedures and aged care costs.

Indirect costs of visual impairment include financial costs, such as earnings and taxation forfeited and premature mortality rates, as well as the costs of carers, aids and building modifications. Non-financial indirect costs are difficult to measure and include the pain, suffering and loss of life quality that may result from visual impairment.