

## VISION IMPAIRMENT AND FALL RISK IN OLDER PEOPLE

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Vision is important for balance and gait and visual impairments are significantly associated with poor balance, mobility problems and falls in older people. There is a large body of research linking falls and fall-related injuries with visual problems, some of which can be remedied by surgery or appropriate eyewear. However there is also evidence that the kind of refractive correction provided (in terms of single-vision or multifocal correction) can also have an effect on fall risk.

### The prevalence of vision impairment in older age

The main vision problems in older age are refractive error<sup>1</sup>, age related cataracts, macular degeneration, diabetic retinopathy and glaucoma (Pelletier, Rojas-Roldan, & Coffin, 2016). Reports from the US, UK and Canada suggest that around 10% of people aged 65 to 75 years and 20% of those aged over 75 years have impaired visual acuity (Evans et al., 2002; Schiller, Lucas, & Peregoy, 2012). The 2016 National Eye Health Survey (NEHS) funded by the Australian Government estimated that 432,800 non-indigenous Australians aged over 50 years or older and 18,300 indigenous Australians aged 40 years and over were living with vision impairment or blindness (Foreman et al., 2016). The main causes of vision impairment in these populations are presented in Table 1.

**Table 1 NEHS Causes of bilateral vision impairment**

Vision impairment causes	Percentage with vision impairment	
	Indigenous	Non-indigenous
Refractive error	63.4	62.7
Cataracts	20.2	13.9
Age related macular degeneration	8.9	1.1
Diabetic retinopathy	5.7	1.5
Glaucoma	1.5	0.5
Multiple causes	1.6	0.5

### Refractive error and correction

Refractive error is the major cause of visual impairment across the lifespan, and as indicated in Table 1 affects 2 in 3 people over the age of 50 years (Foreman et al., 2016). Refractive error can often be corrected with individually prescribed glasses or contact lenses, however multifocal (bifocal, trifocal or progressive lenses) have been shown to increase fall risk (Lord & Dayhew 2001). Wearers of multifocal glasses view their forward movement through the lower lens segments of their glasses resulting in blurred vision, poor depth perception with a resultant impaired ability to detect and discriminate floor-level hazards or objects such as steps and footpath edges (Stephen R. Lord, Dayhew, & Howland, 2002). Multifocal glasses wearers have been shown to fall significantly more than non-multifocal glasses wearers in the 1-year follow-up period (when adjusted for age and known physical risk factors for falls) and experience more falls when outside their homes and when walking up or down stairs (Stephen R. Lord et al., 2002). The recommendation is for older people to

<sup>1</sup> Refractive error means that the shape of the eye does not bend light correctly, resulting in a blurred image. The main types of refractive errors are myopia (near-sightedness), hyperopia (far-sightedness), presbyopia (loss of near vision with age) and astigmatism.

wear single vision glasses when walking outdoors or negotiating steps in unfamiliar places to decrease their risk of falling (M. Haran et al., 2009).

### **Eye disease**

The presence of cataracts leads to impaired contrast sensitivity and several studies have found that the presence of cataracts is significantly associated with fall risk (Ivers et al 2003, (Lacharez & Lord, 2016). The evidence for risk of falls in AMD (Age-related Macular Degeneration) is mixed; some studies have found no association between AMD and falls (Felson et al., 1989; Ivers, Cumming, Mitchell, & Attebo, 1998; Ivers, Cumming, Mitchell, Simpson, & Peduto, 2003) whereas some recent studies have reported AMD increases and fall risk (Szabo, Janssen, Khan, Potter, & Lord, 2008; Wood et al., 2011). Glaucoma leads to visual field loss and there is mixed evidence if it is associated with an increased fall risk; some studies have reported an increase (Guse & Porinsky, 2003; Ivers et al., 2003) whereas in other studies there was no increased fall risk (Lacharez & Lord, 2016). Some medications used for glaucoma can increase the risk of falls, therefore confounding association between glaucoma and falls (Lacharez & Lord, 2016). One study found that mild to moderate diabetic retinopathy was associated with an increased risk of falls (Gupta et al., 2017). Systemic effects of diabetes such as lower limb neuropathy and concurrent vascular disease may also have an effect on gait and increase the risk of falling (Dhital, Pey, & Stanford, 2010).

### **Visual impairments**

There are multiple ways in which visual function can change with age or disease, including changes in visual acuity, contrast sensitivity and visual field loss. Additionally, each eye may be impaired to a different extent, leading to changes in binocular depth perception (stereoacuity).

There is limited evidence that poor visual acuity increases fall risk; only distance visual acuity has been shown to increase the risk of falls in large cross-sectional studies of people living in assisted care accommodation and those living independently in the community (Ivers et al., 1998; Klein, Moss, Klein, & Lee, 2003; Stephen R. Lord, Smith, & Menant, 2010). Several studies have found that poor contrast sensitivity (which is important for seeing edges in the environment, e.g. steps, footpath cracks and misalignments) significantly increases the risk of falls and fractures in older people (Lacharez & Lord, 2016; Stephen R. Lord & Dayhew, 2001; S.R. Lord & Ward, 1994). Binocular depth perception or stereopsis affects the ability to judge distances and spatial relationships of objects in the environment. The risk of multiple falls and fall related injuries increased when there are reductions in binocular depth perception (Felson et al., 1989; Stephen R. Lord & Dayhew, 2001) (Lord & Dayhew 2001, Felson et al 1989, (Ivers et al., 2003). Visual field loss has been found to be a significant risk factor for falls and fractures in recent studies with one study showing a two-fold risk of falls and fractures for people with this condition (Klein et al., 2003; Lacharez & Lord, 2016).

### **Interventions for preventing falls for people with vision impairment**

A small number of randomised-control trials (RCTs) investigated one or more visual interventions in terms of their ability to prevent falls. One RCT evaluated a targeted home safety assessment and modification intervention program for older adults with severe visual impairment (Campbell et al., 2005; La Grow, Robertson, Campbell, Clarke, & Kerse, 2006). Three hundred and ninety one visually impaired people aged 75 years and over living in the community were randomised to either a home safety program (n=100), an exercise program with vitamin D supplementation (n=97), both interventions (n=98), or a social visit control group (n=96). Falls were reduced by 41% in the group

randomised to the home safety program (Campbell et al., 2005). The authors attributed the success of this intervention to: (i) the effectiveness of the reduction of home hazards (for hazard-related falls); (ii) participants' increased awareness regarding home hazards; and (iii) possible increased fear of falling leading to activity restriction and in turn, reduced exposure to risk (La Grow et al., 2006).

The effect of cataract surgery in reducing fall incidence has been investigated in two prospective RCTs. The first, involving 306 women aged 70 years and over, examined the efficacy of cataract surgery on the first eye (Harwood et al., 2005). Participants were randomly allocated to receive either expedited (approximately 4 weeks wait) or routine (12 month wait) surgery, and it was found the fall rate in the expedited group was reduced significantly by 34% compared with the controls. A follow-on study by the same authors evaluated whether surgery on the second eye led to further reductions in falls (Foss et al., 2006). Again, participants (239 women aged over 70) were randomised to either expedited (approximately 4 weeks wait) or routine (12 months wait) surgery. The one-year prospective rate of falls was again reduced by 32% in the operated group, although this was a non-significant reduction in this sample, likely due to reduced power from the smaller sample size. A more recent longitudinal population study examining over 28,000 hospital records for participants who had received cataract surgery found that the rate of hospital admissions for fall-related injuries *increased* in the two years following surgery to each eye (Meuleners, Fraser, Ng, & Morlet, 2014). It is worth noting, however, that this is in comparison to their fall rate before surgery and not in comparison to a control group. In marked contrast, a population study conducted in the USA that examined over one million records including those who did and those who did not receive cataract surgery, found that cataract surgery effectively reduced the rate of falls (Tseng, Yu, Lum, & Coleman, 2012).

Two RCTs have evaluated the efficacy of visual assessment and provision of new glasses as an intervention to prevent falls. Day et al (2002) assessed the separate and combined effects of interventions aimed at vision improvement, home hazard reduction and group exercise in 1090 participants aged 70 years and over. In the visual improvement intervention, participants with impaired vision were provided a referral to their usual eye-care provider if they exhibited poor visual acuity, decreased stereopsis and/or reduced field of view. The 12-month prospective falls rate was reduced by 4.4% for those in the visual intervention group, a non-significant reduction. It is worth noting, however, that of the 547 participants randomly assigned to receive the vision intervention, only 26 received a treatment they would not otherwise have had.

In the second study (Cumming et al., 2007), 616 older people aged 70 years and over, were randomised to either an intervention group (n=309) or a control group (n=307). Of the intervention group, 44% (n=92) received vision-related treatments (most often a new pair of glasses). During the 12-month follow-up period, participants in the intervention group reported significantly *more* falls than those in the control group. This was a highly unexpected finding given the hypotheses of the study. The authors conjectured that since the participants in the intervention group often received prescriptions quite different to their current glasses, they might have needed more time to adapt to their new glasses (Elliott & Chapman, 2010) alternatively they may have become over-confident, adopting more risk-taking activities (thus increasing the exposure to falls) as a result of experiencing better vision. As evidence of the former, the authors observed that fall-risk was higher among those who had a larger change in prescription, than for those who had a smaller change. Thus, some period of adaptation and it is recommended that optometrists gradually change prescriptions and to counsel patients as to the likely short term risks of a new prescription (Elliott, 2014).

A recent RCT (M. J. Haran et al., 2009), involving 606 older people and 13 months follow-up, assessed whether fall rates among regular multifocal users could be reduced by facilitating participants to wear single-vision correction when active outdoors or unfamiliar indoor settings. Participants were provided with an additional pair of single-vision spectacles and counselled to wear these for walking or outdoor activities (participants were counselled to restrict their use of their multifocal glasses to activities that require changes in focal length, including everyday tasks of driving, shopping and cooking which pose little risk for falls). Overall, there was a non-significant 8% reduction in all falls as a result of the intervention and a significant 40% reduction in the sub-group who more regularly undertook outside activities. However, outside falls increased in those who habitually undertook less outside activity in the intervention group. The authors suggest that single-lens may be beneficial for those who take part in regular outdoor activities but may increase risk for those with low levels of outdoor activity.

Finally, a recent network meta-analysis of vision interventions found that interventions that addressed vision as well as other identified risk factors was more effective in the prevention of falls than addressing vision alone or in combination with either exercise and/or home hazard interventions (Zhang, Shuai, & Li, 2015).

### Summary

Vision makes an important contribution to balance, and impaired vision resulting from eye disease (AMD, glaucoma and cataracts) is a significant independent risk factor for falls and fractures in older people. Restricted visual field size and reduced ability to detect low contrast hazards, judge distances and perceive spatial all appear to be the major visual risk factors for falls. Multifocal glasses can add to fall risk because their near-vision lenses impair distance contrast sensitivity and depth perception in the lower visual field reducing the ability of an older person to detect environmental hazards. There is now randomised controlled trial evidence that maximising vision through restricting multifocal glasses use to active older people and cataract surgery for the first eye are effective fall prevention strategies. Occupational therapy interventions involving home hazard reductions are also effective in preventing falls in severe visually impaired older people. It is therefore important older people undergo regular eye examinations by eye care providers (optometrists and ophthalmologists).

### Resources

CEC NSW Falls Prevention Program – *Falls Prevention – Eyesight* flyer, access at <http://www.cec.health.nsw.gov.au/patient-safety-programs/adult-patient-safety/falls-prevention/information-for-patients> (scroll down)

*Staying active and on your feet* booklet – page 9, access at <https://www.activeandhealthy.nsw.gov.au/your-active-and-healthy-guide/>

Macular Disease Foundation Australia – resources on AMD, low vision and diabetic retinopathy access at <https://www.mdfoundation.com.au/content/macular-disease>

Vision Australia - <https://www.visionaustralia.org/business-and-professionals/medical-and-health-professionals>

Guide Dogs NSW/ACT - <https://www.guidedogs.com.au/education>

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