

## **Hearing impairment and falls – a mini-review**

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Falls are a major issue for people aged 65 years and over, living in the community, with one in three experiencing a fall each year (1). In Australia, 75% of all injury-related hospitalisations in older people are as a result of a fall, incurring both economic and social costs (2).

### **Falls risk factors**

Risk factors for falls in older people include both intrinsic (person-centered) and extrinsic (environmental) factors. Intrinsic factors can include impairments in balance, muscle strength, gait, vision, cognition, depressive symptoms, fear of falling, postural hypotension, arthritis, the use of 4 or more medications and certain medications that increase falls risk such as psychoactive medications (3). The most common extrinsic factors include slippery surfaces, loose rugs, poor lighting, and clutter or other trip hazards (3,4). Identifying modifiable falls risk factors is important and assessment tools have been developed to aid in identifying these risk factors.

This mini-review will examine the evidence for hearing impairment as a risk factor for falls.

### **Hearing Impairment**

Hearing impairment is the third most common chronic condition in older adults (>65 years) with prevalence rates ranging from 29% in those > 60 years to 72% in those > 70 years (5, 6). Hearing impairment has been associated with decreased quality of life and independently associated with walking difficulties, impaired cognition, functional decline and social isolation (5, 7, 8). Hearing aid use is low (<20%) in those classified as having a hearing loss (9).

### **Hearing Impairment as a risk factor for falls**

A number of studies have examined hearing impairment in relation to fall risk and these findings are summarised in Table 1 (8, 10-16). Most of the studies included large samples from longitudinal studies. Some studies measured hearing impairments using audiometric measurements (8,11,14,16) whereas others based their hearing impairment measure on self-report (10-13,15). As self-reporting underestimates hearing loss, the studies that measured hearing loss using audiometry are therefore likely to yield more valid results (9). Some studies have used retrospective designs, basing their analyses on a single question about past falls (usually in the past year). Others have collected prospective falls following the hearing assessment; a preferred outcome measure in fall prevention trials due to its greater precision and reduced reliance on good memory (17,18).

Four retrospective studies (13-16) and the prospective Finnish Twin study (8) found hearing impairment increased fall risk, whereas one retrospective study (10) and two large studies using prospective falls data did not find this to be the case (10-12). Most studies performed analyses to adjust for a range of confounders (such as age, gender, cardiovascular risk factors, diabetes) to determine whether there was an independent effect of hearing impairment and falls, but many studies have been conducted in selected populations which may not have been representative of the community population as a whole. Although no meta-analysis was undertaken as part of this review, the study findings presented in Table 1, when taken together, do indicate that hearing impairment contributes to falls in older people.

### **Mechanisms for why hearing impairments may cause falls**

Older people with hearing impairments often have balance problems which can increase the risk of falls but whether these are due to the hearing impairment or other concomitant intrinsic risk factors is difficult to differentiate. However, several mechanisms have been proposed for why hearing impairment may lead to falls. The simplest, direct mechanism is that people with hearing impairments may fail to detect environmental hazards outside their line of sight (i.e. a broom falling, a wheeled toy approaching, spilling liquid etc.) (8, 14-16). It has also been suggested that people with hearing impairment require more attention for detecting and processing auditory cues, leaving reduced attentional resources for other tasks such as balance control. A third mechanism is that impaired hearing is also a marker of vestibular impairment. The vestibular system, contained within the inner ear, detects head movements and accelerations and is important for head and neck stability and balance control (19). Thus, if generalised inner ear dysfunction occurs due to disease or degeneration, both hearing and balance impairments would ensue. Finally, it has been reported that poor hearing may lead indirectly to falls by reducing participation in activities with subsequent deconditioning and decreased health related quality of life and or documented fall risk factors (8).

### **Improving hearing as a fall prevention strategy**

To the best of our knowledge, there have been no hearing improvement trials undertaken as a single fall prevention intervention and strategies for improving hearing have not been included in multi-component fall prevention trials. Addressing hearing loss, however, is no doubt good practice and ensuring working hearing aids are within easy reach for a dependent older person should form part of routine care.

## Conclusion

Hearing impairment may contribute to an increased risk of falling in older people, although the evidence for this sensory impairment is less strong than for other sensory systems (impaired vision and reduced sensation in the feet and legs). Strategies that may reduce fall risk in older people with a hearing impairment could include increasing the use of hearing aids and supporting them with safer mobilizing techniques in their environment; although these strategies have not been evaluated in fall prevention randomized controlled trials.

Authors and Year	Study Design	Participant characteristics	Hearing assessment	Falls measurement	Main findings
Tromp et al 2001(10)	Longitudinal Prospective cohort study – Living arrangements and Social networks of Older Adults study (LASA)	1285 community dwelling ≥ 65 years, mean age 75.2 years (6.5 years, range 64.8-88.6 years), 51% female	Question regarding hearing impairment – ability to follow conversation in a group of 4 people	Prospective falls calendars over 12 months	Hearing impairment in 36% of participants, Univariate analysis found increased risk for falls or recurrent falls in those with hearing impairment ≥1 fall OR 1.4 (95% CI 1.1-1.8) ≥2 falls OR 1.8 (95% CI 1.3-2.5) In multiple regression analysis hearing impairment was not a significant risk factor for falls.
Purchase-Helzner et al 2004 (11)	Prospective study Study of Osteoporotic Fractures	6480 women , mean age 76.8 years (range 69-97 years)	Audiometric assessment	Prospective follow up for 3 years, quarterly postcard or phone contact	40% of participants had hearing loss, prevalence increased with age. No association between hearing loss and falling after adjusting for age. Unadjusted annual rate of falling was 0.59 in women with normal hearing, 0.54 in women with mild hearing loss and 0.59 in those with significant hearing loss.
Sihvonen et al 2004 (12)	Cohort from larger fall risk study	Subgroup of 40 women aged 50-68 years (mean age 54 years). who had injurious falls in previous 12 months and 96 non fallers participated in the study.	Question regarding hearing	Retrospective falls in previous 12 months	No significant difference between fallers and non-fallers with or without hearing impairment
Viljanen et al 2009 (8)	Finnish Twin Study on Aging	429 female mono or dizygotic twins (mean age 68.6 [SD 3,4])	Audiometric assessment	Prospective falls calendars for 12 months	Age adjusted IRR with best hearing quartile as reference was 1.2 (95% CI =0.4-3.8) in the second, 4.1 (95% CI = 1.1-15.6) in the third and 3.4 (95% CI = 1.0-11.4) in the poorest hearing quartile.

Authors and Year	Study Design	Participant characteristics	Hearing assessment	Falls measurement	Main findings
Lopez et al 2011 (13)	Longitudinal study, health in Men Study and Australian Longitudinal Study on Women's Health	2340 men (Age 76-81, mean = 78.1 years) 3014 women (Age 76-81, mean 77.9 years)	Self-reported hearing based on difficulty in hearing a conversation with or without a hearing aid	Self-reported retrospective falls question (previous 12 months)	30.1% men and 12.7 % women reported hearing loss. Hearing impairment associated with increased risk of falls (OR= 1.38 [CI = 1.08 -1.78] in men and OR=1.45 [CI = 1.08-1.93] in women
Lin & Ferrucci 2012 (14)	Longitudinal Study – National Health and Nutritional Examination Survey (NHANES)	2017 people aged 40-69 years, mean = 53.6 (SD 8.7) years, 52.2 % female	Audiometric assessment	Self-reported falls retrospective over previous 12 months	Hearing loss reported in 14.3% of participants. For every 10dB of hearing loss there was a 1.4 fold (95% CI, 1.3-1.5) increased odds of having a fall in preceding 12 months
Skalska et al 2013 (15)	Cross Sectional Study - PolSenior	4,920 participants, mean age 79.4 ± 8.7 (Range 65-104 years), 53.6% female	Respondent able to hear the sound of normal speech and whisper from 3 m (with or without hearing aid) – considered normal, hearing impairment if only able to hear loud speech or only single words spoken very loudly	Falls question re falls in past 12 months and their circumstances.	Higher proportion of fallers had moderately 23.7% vs 16.4% or severely (0.89% vs 0.29%) impaired hearing compared with non-fallers (p< 0.00001).
Kamil et al 2015 (16)	Longitudinal study, Health Aging and Body composition Study (Health ABC)	Cohort of 2,000 participants (Aged 70-79 years, 52.9 % women)	Audiometric assessment	Retrospective falls collected annually.	Participants with moderate or greater hearing impairment had: 1. Significant increased odds of falling over time (9.7% 95% CI [7.0, 12.4], compared with normal hearing (4.4%, 95% CI [2.6, 6.2]). 2. 63% increased risk of developing frailty compared with normal hearing individuals.

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