

REVIEW ARTICLE

Hearing loss in the elderly: a series of risk factors for imbalance and falling

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Abstract

Background and Aim: The elderly afflicted with hearing loss experience the consequent problems of falling and imbalance. Some reasons have been reported for the relationship between hearing loss and imbalance. However, a large part of the population of the elderly does not experience hearing assessments and if such assessments are done, the right rehabilitation services are not offered. This study aimed to analyze the research information in which implying the relationship of hearing loss with imbalance and falling in the elderly had been investigated.

Recent Findings: The search for the information was done for the time span of 1989 to the July of 2015. The result of the conducted search included 574 articles on imbalance, falling and hearing loss. After removing duplicates and review of titles and abstracts of articles as well as compliance with the inclusion and exclusion criteria, the articles were studied in details. Among the reviewed articles, 36 relevant articles with either direct referring to the relationship between hearing loss and

balance and falling or indirectly related matters discussing the issue in other forms were extracted. Eleven articles which have directly referred to the issue have finally been selected.

Conclusion: The results of this review study showed that the hearing loss of the elderly can be one of the factors leading to their imbalance and falling.

Keywords: Hearing loss; imbalance; postural control; falling; the elderly

Introduction

Hearing loss in the elderly is one of the three most common chronic disorders in this period after arthritis and hypertension [1]. The prevalence of hearing loss in speech frequencies is equal to 49% in people in their 70s [2]. Presbycusis is often the underlying cause of hearing damage at old ages. The term of presbycusis just means hearing loss due to growing old; thus, the use of a broader definition and so-called age-related hearing loss (ARHL) seems to be more appropriate to describe the impact of internal and external factors and their interaction with each other throughout life, which makes it impossible to separate other factors affecting auditory [3,4]. Reduction of acoustic information due to hearing loss (HL) in the elderly can cause

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complications such as a decrease in speech understanding, damage to the ability to locate the sound source, reduced central processing of acoustic information, further dependence in activities of daily living (ADL), decreased physical tasks, movement loss, social isolation and developing depression symptoms [3,5-16]. It is estimated that 10 percent of the population of Western countries are suffering from hearing loss, which can affect their daily lives [15].

On the other hand, one of the problems that elderly are facing, is inability to maintain balance. Imbalance in the elderly can be due to a variety of physiological mechanisms and different factors such as vision loss, decreased muscle tone of the lower extremities, cerebellar and vestibular disorders, arthritis, side effects of drugs, etc. Some reasons have been reported in studies reviewed for the association between hearing loss and imbalance. The first reason is that the hearing leads to receiving of acoustic information from the spatial environment, enabling us to orientate in the space around us and timely respond to the environmental stimulants. However, in old age, relying on this sense to receive information and pay attention to the environment increases, but hearing loss will reduce this ability [6,13,17]. The second reason implies that hearing is effective in the process of postural control and maintaining balance, attention and recognition. Some studies have shown that hearing loss affects cognitive processes and attention [18-22]. Another reason is that as both hearing and vestibular areas are close together, a disorder may involve both at the same time. In addition, aging affects hearing and vestibular function as well, and hearing loss is associated with a reduced trial function, and can also be regarded as a sign of loss of vestibular function [6,13,17,23]. However, Enrietto et al. concluded in a study that age-related changes in two auditory and vestibular sections are not linked together [24]. Another indirect cause explains that isolation and reduced physical and social activities of elderly with hearing loss may influence the muscles strength and their balance negatively and increase the risk of their falling [25]. Some

studies also noted that hearing loss in the elderly is associated with changes happening in the ear bone tissue. Simultaneously, some changes occur in other bones of the body, and the fractures caused by falls in the elderly are probably due to their actual common origin [26,27]. Approximately, 25% to 35% of people 65 years and older experience one or more falls per year. Falls can cause physical injuries, fractures, especially hip fractures, restricted activity, reduced independence, increased hospital costs and reduced quality of life, and is one of the main causes of mortality in the elderly [28-31].

Using the keywords of hearing impairment/loss, imbalance, postural control, falling, elderly and older, the published articles about the relationship between the imbalance and falls in the elderly with hearing loss were reviewed. The inclusion criteria were used for separation of related articles.

The study inclusion criteria were as the following

- 1) The article study should include the analysis of balance and falling in the elderly with hearing loss.
- 2) They had to be written in English.
- 3) The age of patients needed to be 60 years and older.
- 4) The study used, must be conducted on human subjects.
- 5) The studies conducting time had to occur since the beginning of 1989 to July 2015.

In compliance with these criteria, the relevant studies were selected.

The result of the conducted search included 574 articles on imbalance, falling and loss of hearing. After removing duplicates and reviewing the titles and abstracts of articles as well as compliance with the inclusion criteria, the articles were studied in details. Among the reviewed articles, 36 relevant articles with either direct referring to the relationship between hearing loss and balance and falling or indirectly related discussing the issue in other forms were extracted.

Of the extracted papers, 11 articles fully

referring to the subject, including the relationship between hearing loss and imbalance as well as the relationship between hearing loss and falling were selected. The findings of these 11 articles were listed separately in two different sections:

The relationship between hearing loss and imbalance and the association of hearing loss with falling. It should be noted that the studies examining the relationship between hearing loss and falling (due to the imbalance associated with hearing loss) are also given in the section of studies on hearing loss and falling. The studies evaluating the impact of multi-sensory damages (hearing and vision senses) at the same time and not just one sense (hearing) were also included in the study. In some studies, evaluations of hearing and balance had been performed with specific tests, but in some other studies, the self-reporting by individuals about their hearing problem, balance and rate of falling had been used.

The full details of these 11 studies collected in a designed table format, including age, gender, type of study, assessment tool used in the study and the results are also shown in Table 1.

Relationship between hearing loss and imbalance in the elderly

In a longitudinal study with an 8 to 10 year follow-up, Baloh et al. concluded that hearing and vestibular function decrease with increased age, but among the hearing frequencies, only the hearing loss the eve of 1 kHz is mainly associated with changes in balance and walking score [32]. Gerson et al. also found that the imbalance report has been among the elderly who reported hearing damage [33]. Koh et al. indicated in their study, there is a significant correlation between hearing loss and static balance [34].

The results of Hosseini et al. study showed that hearing damage alone is ineffective on imbalance, but it will affect it if associated with visual impairment [16].

Zuniga et al. in a study examined the relationship between hearing loss and functional impairment of vestibular system in the elderly and

concluded that hearing loss in the elderly is associated with dysfunction in saccule, which is effective in static balance. Hearing loss in high frequencies has a larger share of this association [23].

Relationship between hearing loss and falling in the elderly

Viljanen et al. showed in a 12-month follow-up on twin elderly women, it was found that the elderly experiencing hearing loss showed a higher rate of falling within these 12 months. This higher rate of falling risk was associated with poor postural control in these people [17]. Lin and Ferrucci reported that there is a relationship between hearing loss and falling, and per 10 dB increase in hearing loss, 1.4-fold increase was seen in reports of falling [35].

Grue et al. showed that falling is associated with hearing loss and not with decreased vision; but damage to both hearing and vision together will double or increase the risk of falls [6]. Kulmala et al. also concluded that the visual impairment alone is not associated with the fall of people in a one-year follow-up; however, together with hearing impairment it would show a relationship [36]. Skalska et al. indicated that sensory impairment (visual or auditory) can slightly increase the risk of falling in older adults [28]. In contrast, Purchase-Helzner et al. found no relationship in their study between hearing loss and increased risk of falls as well as subsequent fractures in the elderly [37].

Discussion

Based on the author's knowledge, no systematic review study has been done so far to examine the association between hearing loss and imbalance and falling among the elderly. This can lead to more attention to hearing problems in the elderly. It can also indicate the need to include audiometric screening examinations and evaluations in the elderly and rehabilitation measures to prevent some of the subsequent complications of imbalance and falls.

The results of reviewed studies were somewhat different. Although in some studies, the relationship found between imbalance and falls

Table 1. Details of included studies

Author	Study Type	Age	Number of Individuals	Assessment Tools	Results
Baloh et al. (2003)*	Longitudinal study	Average age was 78 years	Aggregate of 59 individuals (34 men and 25 women)	Audiometric test for assessing hearing thresholds and Tinetti test for assessing imbalance	Hearing loss in the frequency of 1kHz is connected with the reduction of imbalance score
Gerson et al. (1989)*		65 years old and over	Aggregate of 1139 individuals (353 men and 786 women)	Making use of the slightly modified version of the Older Americans'	Hearing loss increases the likelihood of reporting imbalance.
Koh et al. (2015)*		65 years old and over	46 elderly (29 men and 17 women)	A hearing test, the speech frequency Pure tone average in the better ear was checked. a criterion of hearing loss if the better ear hearing level [BEHL] value was 25 dB or more. Cognition ability was evaluated using the Korean minimal state examination [K-MMSE]. Dynamic balance ability was evaluated by the timed up and go [TUG] test, and static balance ability was tested using a one-leg stance test [OLST].	There is a significant correlation between hearing loss and static balance. But no correlations among hearing, dynamic balance, and cognitive functions were found.
Hosseini et al. (2010)#	Cross-sectional study	Between 65 to 85	36 elderly (men and women)	Audiometric test for assessing hearing thresholds and Berg balance scale for assessing balance.	Hearing loss in the elderly is not impressive balance unless accompanied by visual impairment.
Zuniga et al. (2012)*	Cross-sectional study	70 years old and over	Aggregate of 51 individuals (25 men and 26 women)	Making use of cervical vestibular evoked myogenic potential (c-VEMP), head thrust dynamic visual acuity (ht DVA) and ocular vestibular evoked myogenic potential (o-VEMP) for assessing the vestibular system and the audiometric test for assessing hearing thresholds	Hearing loss of the elderly is connected just with the functions of saccule not utricle or semicircular canals. Also, hearing loss at higher frequencies has a larger share in this regard
Lin and Ferrucci (2012)*	Cross-sectional study	40-69 years old	2017 individuals	Making use of the audiometric test for assessing hearing thresholds and using interviews, questions and reports given by the individuals themselves of their falling rates	For every 10 dB increase of the hearing loss, there was a falling increase rate of 1.4 in a 12 months period
Viljanen et al. (2009)*		63-67 years old	417 women	Making use of the audiometric test for assessing hearing thresholds and using the Force Plate by measuring the three parameters of mean mediolateral, anteroposterior sway velocity (mm/s) and the velocity moment (mm ² /s) for assessing balance and gathering information using call interview and reports of the individuals themselves of their falling rates	The elderly with hearing loss showed higher rate of falling in 12 months and this high rate of the falling risk has been connected with the weaker postural control of these people

*Significant difference,# no significant difference

Table 1. Details of included studies- Continue

Author	Study Type	Age	Number of Individuals	Assessment Tools	Results
Grue et al. (2009)*	Observational study	75 years and over	770 individuals	Utilizing the hearing-related items from minimum data set for acute care (MDS-AC) for assessing hearing and making use of questions and individuals' reports of the history of their falling	Falling is connected with hearing loss, but the concurrent impairment of the two senses of vision and hearing doubles or more the risk of falling.
Kulmala et al. (2009)#	Prospective study	63-67 years old	428 women	Making use of the audiometric test for assessing hearing thresholds and using interviews, questions and reports given by the individuals themselves of their falling rates	Vision loss is not by itself connected with the individuals' falling in one follow-up year, but it is relevant when it is accompanied by hearing loss
Purchase-Helzner et al. (2004)#	Prospective study	75 years and over	6480 women	Making use of the audiometric test for assessing hearing thresholds and using interviews, questions and reports given by the individuals themselves of their falling rates	Hearing loss has no relationship with falling
Skalska et al. (2013)#	Cross-sectional, multicenter study	Two groups of 55-59 years old and over 65 years old	4920 individuals	Making use of Whisper Test within the distance of three meters for assessing hearing and making use of questions and reports given by the individuals themselves of their falling rates	Although the study showed that for the age group of over 65 hearing loss is connected with falling, when variables were conformed in the logistic regression, it was resulted that there was no significant relationship between hearing and visual impairment with falling. In fact, hearing and vision losses increase a little the risk of falling.

*Significant difference, # no significant difference

in the elderly with hearing loss was weak or even non-existent [16,24,38,39], but such a relationship has been seen in many studies [6,17, 23,32,35,36]. It was even mentioned in a study that despite the difference in the prevalence of hearing impairment in elderly men and women, the hearing impairments associated with falling and the decline in physical and mental components of health-related quality of life (HRQOL) in both genders. This means the relationship is seen in both men and women [2]. It was mentioned in some studies that the risk of falling among the elderly with hearing loss is several times more than the elderly with no hearing loss. Thus, one study has shown a seven-fold increase in risk of falling in the elderly with hearing loss compared to the normal elderly [40]. Another study's result has mentioned the tripling of risk of falls leading to injury in the elderly with hearing loss [41]; however, if the

risk of all falls, including those not resulted in damage is added, the risk rate would exceed the mentioned rate. Stevens et al. reported that one in three people with experience of falling has suffered from hearing loss [42]. Evci et al. also mentioned that 30% of seniors with hearing loss compared to the elderly without hearing loss showed more prevalence rate in accidents inside the house that the majority of them were caused by falling [43]. Criter and Honaker also showed that the elderly referred to hearing clinic had higher prevalence of hearing loss than other previous general populations; however, no relationship between hearing loss and falling was mentioned in their study [44]. In other studies examining the important factors in falling, hearing loss has been mentioned as an important factor in some [28,45-48], while it was considered as an unimportant factor in some others [37,49-51]. The contradiction in results could be due to

the lack of using objective evaluations and audiometry to determine the rate of hearing. For example, no difference was observed in experience of falling between people with and without hearing loss in the age range from 59 to 68 years in one study [52]. In this study, the hearing status was only reported by asking the person, and was not evaluated by audiometer. The samples for comparison between the two groups were not equal. The group with a history of falling (aged 59 to 68 years) was smaller than those without a history of falling. In addition to the physical injuries caused by falling, falling itself can cause the fear of falling in the future. The synchronization of visual impairment and hearing loss can be associated with the fear [53]; but the coincidence of these two damages is not associated with the subsequent falls of people with hip fractures [54].

Conclusion

Studies have shown that although hearing loss is seen more in communication problems, but it causes a wider range of problems such as impotence, decreased activity, participation and quality of life of the elderly. It can also reduce the balance in the elderly. On the other hand, reduced balance is one of the relevant internal factors and a strong predictor for falling. Then, if we want to significantly prevent imbalance and falls in the elderly, along with the other effective factors, we should also pay attention to hearing loss and do some interventions to mitigate its effects.

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Conflict of Interest

There are no conflicts of interest.

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