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ORIGIANL RESEARCH

Association of hearing impairment with balance and functional decline in elderly individuals with knee osteoarthritis: A cross-sectional study

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ABSTRACT

Age-related hearing impairment is common among older adults and has been linked to slower gait, impaired balance, and increased fall risk. Knee osteoarthritis (OA) contributes independently to functional decline through pain, stiffness, muscle weakness, and impaired proprioception. However, the combined effect of hearing impairment and knee OA on balance and functional performance remains underexplored. This study aimed to evaluate the association of hearing impairment with balance and functional decline in elderly individuals with knee OA. A cross-sectional observational study was conducted at the District Disability Rehabilitation Centre, Pradhanmantri Divyasha Kendra, Ahilyanagar, Maharashtra, India. Sixty participants aged ≥55 years with confirmed knee OA were allocated by purposive sampling into two groups: Group A (knee OA with hearing impairment; n = 30) and Group B (knee OA without hearing impairment; n = 30). Functional disability was assessed using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and dynamic balance was evaluated using the Timed Up and Go (TUG) test. Between-group comparisons were performed using the Mann–Whitney U test, and associations between variables were examined using Pearson's correlation coefficient. Statistical significance was set at $p < 0.05$.Group A exhibited significantly higher WOMAC scores (79.51 ± 10.40) than Group B (75.65 ± 6.10, $p = 0.0087$), indicating greater functional impairment. TUG times were prolonged in Group A (20.25 ± 4.65) compared to Group B (12.80 ± 2.07, $p < 0.001$), reflecting reduced dynamic balance and mobility. These results suggested that hearing impairment compounded functional decline in elderly individuals with knee OA. Elderly individuals with knee OA and hearing impairment showed significantly poorer balance and functional performance compared to those without hearing loss. Therefore, integrating auditory assessment and management into physiotherapy interventions to reduce fall risk and enhance functional independence in this population.

Keywords: Hearing impairment, knee osteoarthritis, balance, functional decline, WOMAC, Timed Up and Go

INTRODUCTION

One of the most common sensory impairments in old age is age-related hearing impairment also known as presbycusis, which affects about 40-50% of people over the age of 65 years [1]. In addition to the effects of hearing loss on communication and social engagement, hearing loss has been still more widely recognized as a major factor in physical functional loss. It has been shown by meta-analytics that older adults with hearing impairment are at a significantly increased risk of falls (51%) and longitudinal fall risk (17 %) than their hearing peers [2].

The hearing loss is also related to reduce gait, worse sit-to-stand, and impaired physical functioning, which are the traits of frailty and the lack of independence [3]. This connection can be described through a number of mechanistic pathways. First, hearing impairment can lead to the loss of spatial awareness and accessibility to sounds in the surrounding environment that is a component of postural stability maintenance. Second, there is a diversion of attentional resources to auditory processing at the expense of cognitive requirements of postural control known as cognitive-motor interference.

Third, hearing impairment can be accompanied by subclinical vestibular dysfunction or central neurodegenerative processes both of which involve the simultaneous dysfunction of auditory and balance systems [4].

At the same time, the knee osteoarthritis (OA) is a very common degenerative joint disorder of aging individuals, which is manifested by the loss of articular cartilage, chronic knee pain, joint stiffness, and weakness of muscles around the joints. All these characteristics deteriorate the proprioception, lower limb neuromuscular control and joint mechanics, leading to deficiency in both the static and dynamic balance and significantly increasing the risk of falls [5]. The patients who have higher Kellgren-Lawrence grades of knee OA fare much worse in functional tests, such as Timed Up and Go (TUG) test, and experience greater postural sway [6]. The TUG test is a dynamic balance and functional mobility validated test. It involves making the participant stand up after sitting down, walk three metres, turn, walk back, and go down. A score more than 12-13.5 seconds is an indicator of decreased mobility and is strongly correlated with gait speed, scores on the Berg Balance Scale, and fall risk [7].

The patient-reported outcome measure of Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) is the gold-standard measure of knee OA that includes pain, joint stiffness, and physical function in validated subscales; a higher score demonstrates a higher disability [8].

Although there is a lot of independent research on hearing loss and knee OA, the interactive effects of both conditions on balance and functional performance are not well comprehended. Their coexistence is yet to be determined to cause compound, possibly synergistic functional deficits beyond the effect of each condition separately. The clinical implications of this gap are significant: assuming that hearing impairment worsens functional impairment in knee OA, a more holistic, interdisciplinary rehabilitation approach, with auditory rehabilitation and musculoskeletal physiotherapy, can be justified.

Accordingly, this study aimed to (i) assess balance and functional status in elderly individuals with knee OA using WOMAC and TUG, and (ii) compare these outcomes between individuals with and without concomitant hearing impairment. A secondary objective was to examine whether the severity of hearing loss correlated with functional outcomes.

MATERIALS AND METHODS

Study Design and Setting: A cross-sectional observational study was conducted at the District Disability Rehabilitation Center (DDRC), Pradhanmantri Divyasha Kendra (PMDK), Ahilyanagar, Maharashtra, India—a government-funded rehabilitation facility operated by the Artificial Limbs Manufacturing Corporation of India (ALIMCO) under the Ministry of Social Justice and Empowerment, Government of India. Data collection was completed over a one-month period following ethical approval and institutional permission.

Participants Sixty participants aged ≥55 years with a confirmed clinical and radiographic diagnosis of knee OA were recruited using purposive sampling. Participants were allocated into two groups of 30: **Group A:** comprised elderly individuals with knee OA and confirmed hearing impairment (hearing aid users), and **Group B** comprised elderly individuals with knee OA and normal hearing.

Inclusion criteria: Age ≥55 years; confirmed diagnosis of knee OA based on clinical and radiographic criteria; ability to ambulate independently with or without an assistive device; willingness to provide written informed consent; and, for Group A, confirmed hearing impairment with current hearing aid use.

Exclusion criteria: Diagnosed neurological disorders (e.g., stroke, Parkinson's disease); confirmed vestibular disorders; recent knee surgery or fracture within the preceding six months; and cognitive impairment precluding reliable questionnaire completion.

Outcome Measures: Functional disability was assessed using the WOMAC index, a self-administered 24-item questionnaire evaluating pain (5 items), stiffness (2 items), and physical function (17 items) in individuals with knee OA. Each item is scored on a Likert scale and aggregated to a total score, with higher scores reflecting greater disability [8].

Dynamic balance and functional mobility were assessed using the TUG test. Participants were instructed to rise from a standard armchair (seat height ~45 cm), walk three metres, turn, return, and sit down. Time was recorded with a digital stopwatch from the verbal command "Go" to the moment the participant was fully seated. A TUG time >13.5 seconds is considered indicative of increased fall risk [7]. Three practice trials were permitted prior to the recorded assessment.

Procedure: Following eligibility screening, demographic and clinical data were collected, including age, sex, body mass index (BMI), OA duration, and comorbid conditions. Written informed consent was obtained from all participants prior to enrolment. Both outcome measures (WOMAC and TUG) were administered sequentially during a single assessment session by trained physiotherapists blinded to group allocation. Hearing impairment was confirmed through self-report of hearing aid use and DDRC audiological records.

Statistical Analysis: Data were analyzed using SPSS version 21.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD). Because outcome data (WOMAC and TUG) did not satisfy the assumption of normality on preliminary assessment, between-group comparisons were performed using the non-parametric Mann–Whitney U test. The association between hearing impairment severity and outcome measures was examined using Pearson's correlation coefficient.

RESULTS

Participant Characteristics Sixty participants were enrolled and completed the study. No participants withdrew or were lost to follow-up. Demographic and clinical characteristics of both groups are summarized in Table 1.

Table 1. Groups were comparable in age, sex distribution, BMI, and OA duration Table caption

Characteristic	Group A (n = 30)	Group B (n = 30)
Age (years),	67.4 ± 6.2	65.9 ± 5.8
Female, n (%)	18 (60%)	17 (57%)
BMI (kg/m²),	27.3 ± 3.1	26.8 ± 2.9
Duration of OA (years)	5.2 ± 2.4	4.9 ± 2.1

The Mann–Whitney U test revealed a statistically significant between-group difference in WOMAC total scores ($U = 628.0$, $p = 0.0087$). Participants in Group A (knee OA with hearing impairment) recorded markedly higher mean WOMAC scores (79.51 ± 10.40) compared with Group B (75.65 ± 6.10), indicating a greater degree of overall functional disability in individuals with concurrent auditory impairment. Results are presented in Table 2.

Table 2. Between-Group Comparison of WOMAC Scores (Functional Disability)

	Mean±SD	U Value	P value	Significance
Group A KOA with hearing aid	79.515±10.404	628	0.0087	Very significant
Group B: KOA without hearing aid	75.657±6.102		0.0087	Very significant

The comparison of TUG scores between the two groups also showed a highly significant difference ($U = 42.00$, $p < 0.0001$). The median scores were unequal, indicating that hearing impairment had a measurable negative effect on functional mobility. A highly significant difference was also found between groups ($U = 42.00$, $p < 0.0001$). Group A had a higher mean TUG score (20.25 ± 4.65) than Group B (12.80 ± 2.07), reflecting poorer balance and mobility (Table 3).

Table 3. Between-Group Comparison of TUG Test Performance (Dynamic Balance and Mobility)

	MEAN±SD	U Value	P value	Significance
with hearing aid	20.253±4.7	828	<0.001	Extrem significant
without hearing aid	15.3±17.626		<0.001	Extremsignificant

DISSCUSION

The current cross-sectional study examined the interactive effect of hearing loss and knee OA on functional disability and dynamic balance in the elderly population. The major results were that participants in both knee OA and hearing impairment (Group A) had significantly high WOMAC scores, and they had significantly longer TUG times than participants with knee OA only (Group B). These findings give new empirical data on an additive and even synergistic functional burden associated with the presence of both auditory and musculoskeletal impairments in elderly people.

All these findings are similar to and add to the available literature on the independent effects of each condition to physical decline. Previous studies have found that hearing loss risks falls by about 51%, and is linked with slower gait velocity, worsening physical functions, and poorer postural control, as well as co-occurs with subclinical vestibular dysfunction or central neurodegeneration of the auditory and balance systems [9]. Mechanistically, hearing loss will lead to reduced auditory spatial awareness and access to environmental balance cues, allocation of less attentional and more motor resources, and comorbid subclinical vestibular dysfunction or central neurodegeneration in both auditory and balance systems [10] .

At the same time, knee OA reduces the proprioceptive acuity, quadriceps strength, and joint movements, leading to worse outcomes in both functional balance assessments, such as the TUG, and greater postural sway [11]. Individuals with an elevated grade of Kellgren-Lawrence knee OA have the worse results in the functional balance test, including the TUG test, and have more postural sway [12].

The observed WOMAC difference in the current study supports the clinical relevance of hearing impairment as another aspect of disability that needs to be taken into account in the scale of the TUG disparity between the groups - about 7.5 seconds - is significantly greater than the set minimum clinically significant difference scales that have been documented in knee OA groups, supporting the practical importance of dual sensory-musculoskeletal impairment. That is consistent with findings that multimorbidity of sensory and musculoskeletal systems hastens frailty and functional impairment in elderly individuals [13].

Multimorbidity of environmental sound-related auditory system and musculoskeletal abilities could be beyond summative disability; there is less ability to offset musculoskeletal deficits with environmental auditory signals, and therefore might result in skewed deterioration of dynamic balance tasks. The current findings have critical clinical implications in the rehabilitation perspective. It is also evidenced that the usage of hearing aid is linked to increased postural stability, decreased cognitive load in walking, and a quantifiable decrease in the risk of fall [14]. Inclusion of regular audiological screenings in physiotherapy evaluation can thus help in earlier detection and referral of patients whose functional rehabilitation is getting impaired because of unaddressed hearing loss. Also, non-invasive methods like rhythmic auditory stimulation and metronome-guided gait cueing have also proved effective in the improvement of gait stability and time-related parameters in older adults, which indicates that auditory enhancement methods can be directly incorporated into the physiotherapy programs of this group [15].

There are a number of weaknesses to this study. The cross-sectional design is not causally inferential and the size of the single-centre sample is relatively small, which might be a limiting factor to generalization. The impairment of hearing was categorized not based on the audiometric degree but categorically, which did not allow dose-response analysis. There was no systematic assessment of vestibular function and systematics screening of cognitive status was not done. Further longitudinal research using bigger, multi-centre samples, objective audiometric classification, controlled vestibular and cognitive testing and intervention treatment of integrated auditory-musculoskeletal rehabilitation frameworks are justified.

CONCLUSION

This study showed that elderly individuals with knee osteoarthritis and hearing impairment experienced significantly greater functional decline than those without auditory deficits. Hearing loss increased frailty, reduced physical function, and fall risk, while knee osteoarthritis impaired proprioception, muscle strength, and mobility[46–48]. The coexistence of sensory and musculoskeletal impairments amplified disability reflected in higher WOMAC scores and prolonged TUG times.

Further research: The rehabilitation approach of elderly people with knee OA and hearing loss should be shifted to a Sensory-Integrated Mobility Training (SIMT) model, in which auditory-enhanced balance training, rhythmic cue-based gait training, and dual-task motor-auditory training are implemented by physiotherapists to lessen the cognitive load and enhance stability. Since hearing loss puts additional cognitive load on the movement process, SIMT will condition the patient to integrate proprioceptive input with auditory feedback and motor output, leading to better gait rhythm, decrease in fall risk, faster motor learning with sensory-impairs elderly.

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Conflict of Interest: None reported

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