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Effect of usual footwear on balance and mobility while performing dual task in elderly women attending a day care hospital of Pitampura, Delhi

Vanshika Singh , Anshu Singh, Mandeep Narula

Physiotherapy department, GRTC Parmarth mission hospital, Pitampura, Delhi

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ABSTRACT

Background- Elderly women, especially those 65 years of age or older are known to be at high risk of disequilibrium. Many anatomical and physiological changes have been suggested as reasons for the decrease in equilibrium found in the elderly population. Footwear, being at the interface between the body and the supporting surface has the potential to affect balance and subsequently, the risk of falling. Older people who perform poorly under dual-tasks are at increased risk of falls. We limited our focus to elderly women because they are at higher risk for disablement than are men. Objective- To determine whether footwear affected performance of balance and mobility while performing dual task in elderly women aged 60 to 80 years. Methods- A Total of 30 subjects were invited to participate in the study. Subjects performed the tasks (TUG and BBS) under dual task condition barefooted and with footwear. The mean and standard deviation of the collected data was calculated. Further, t value, p value was calculated to know the level of significance. Result- Result of the mean scores of TUG under dual task (motor + cognitive) showed significant decrease in time while performing it with footwear. Similarly while performing balance activity with dual task (motor + cognitive) during barefoot or with footwear it showed significant changes when wearing footwear. Conclusion- It was found that wearing footwear as compared to going barefoot was associated with significant changes in balance and mobility scores under dual task condition in elderly women aged 60 to 80 years attending a day care hospital. Taking into account the findings of increased falls risk in elderly women who go barefoot, we recommend that elderly women at risk of falls do not go barefoot while walking.

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1. Introduction

Elderly women, especially those 65 years of age or older, are known to be at high risk of disequilibrium. This loss of balance is correlated with an increased number of falls. Injury to elderly individuals secondary to a fall may result in a decrease of their quality of life, permanent limitation of their activities, or death. Unfortunately, those individuals who have fallen once are prone to fall again.

Many anatomical and physiological changes have been suggested as reasons for the decrease in equilibrium found in the elderly population. Abnormalities have been identified in both the central and the peripheral nervous systems. Circulatory changes (e.g., atherosclerosis) may reduce blood flow to the brain stem, cerebellum, or cerebrum, potentially resulting in ischemic signs and symptoms or lesions of the nervous system. Musculoskeletal

abnormalities in the cervical region may affect the perception of the head's position in space. Muscle atrophy and weakness, especially of the postural muscles, are prevalent in the aged¹

Falls are the leading cause of nonfatal injury among the elderly² and are the 6th leading cause of death in individuals over 65. Falls are the most common causes of hip fractures and admission to nursing homes³.

The literature consistently identifies multiple risk factors for falling among the community-based elderly population, including having a history of previous falls, being functionally impaired, being of advanced age, being female, using various medications or multiple medications, having specific conditions, diseases, or physiological limitations and comorbidity, having cognitive impairments, having factors contributing to postural instability and gait impairments, performing activities such as bed transfers, climbing stairs, and night urination, and environmental influences or engaging in routine activities (i.e., walking on stairs). Tinetti and colleagues concluded that the risk factors for multiple fallers as compared to one-time fallers were the same; however, the magnitude of the associations were stronger for recurrent fallers.⁴

* Corresponding Author : **Dr. Vanshika Singh**HOD, Physiotherapy department
GRTC Parmarth mission hospital
Pitampura, Delhi
singhvanshikaphd@gmail.com

Footwear, being at the interface between the body and the supporting surface, has the potential to affect balance and, subsequently, the risk of falling.⁵ A potential risk factor for falls and fractures that has not been addressed in detail is the wearing of inappropriate footwear. It is known that many older people wear footwear with features that are potentially hazardous or at least offer sub-optimal support.⁶

Inappropriate footwear has been identified as a contributor of up to 45% of falls, and a recent study of people who had suffered a fall-related hip fracture reported that 75% were wearing poor footwear at the time of the injury. Walking barefoot does not appear to provide a safe alternative for older people, as it has been found that walking barefoot or in socks also elevates fall risk⁷ because the foot provides the only source of direct contact with the ground during walking, it is reasonable to expect that any modification to the interface between the sole of the foot and the ground may affect postural stability and therefore the risk of falling.⁸

Wearing inappropriate footwear may also impair balance and alter gait patterns in the elderly.⁹

Even small improvements in the areas of mobility, balance, and gait may contribute valuable benefits in terms of quality of life.¹⁰

Activities of daily living (ADL) require balance maintenance during the concurrent performance of two or more tasks. Older people who perform poorly under dual-tasks are at increased risk of falls.¹¹

A variety of factors have been found to exert a major effect on an individual's ability to divide attention between two tasks. Among them are intrinsic factors such as age, executive function, and physical status and external factors such as the tasks difficulty. The ability to perform dual task deteriorates with aging, which results in higher rates and risk of falls and functional decline.¹²

Dual-task - related gait changes - for example, reduced gait speed - are associated with increased falls risk¹³

Epidemiological evidence suggests that fall risk increases among older adults with impaired cognitive function.¹⁴

During many activities of daily living, people need to perform more than one task at a time; the capacity to do a second task (Dual Task performance) is highly advantageous during walking because it allows for communication between people, transportation of objects from one location to another and monitoring the environment so that threat to balance can be avoided.

Dual task performance is also known as concurrent performance and involves the execution of primary task which is the major focus of attention and a secondary task performed at the same time.¹⁵

We limited our focus to older women because they are at higher risk for disablement than are men.¹⁰

However, to date, little attention has been paid to examining the effect of usual footwear on balance and mobility while performing dual task in elderly women. Exploration of these associations is important for guiding the development of intervention for elderly females who have a high risk of falls while at the same time trying to encourage functional ambulation especially in the community settings.

Consistent with this idea, we put forward experimental hypothesis and null hypothesis, as most of the previous studies in this area did not consider the effect of usual footwear v/s barefoot performance on TUG and BBS while performing dual task in elderly women.

Review of Literature:

Previous studies have shown that, with advancing age, performing an attention demanding task while walking interferes with gait performance and there is increasing evidence that a strong relationship exists between dual task related gait changes and risk of falling among older adults. Walking requires more attention among older adults as compared to young adults. Thus, for older individuals, walking while performing an attention demanding task represents a divided attention task and dual task related gait changes results from interference between gait and attention splitting task.

Vanshika sethi & Ravi Raja (2012) did a study to check the efficacy of dual task training with variable priority instructional set and fixed priority instructional set in improving balance and Activities of Daily Living(ADLS) in Patients with Parkinson's Disease and concluded that Exercise programmes can be carried out safely in Parkinson's disease patients. The balance and functional independence of Ambulatory Parkinson's Disease patients can be improved by specific type of balance training.¹⁵

Shmuel Springer, Nir Giladi et al (2006) The objectives of this study was to test the hypothesis that the dual-tasking effect on gait variability is larger in healthy older adults than it is in healthy young adults; that this effect is larger in idiopathic elderly fallers than it is in healthy older adults; and that the dual-tasking effects on gait variability are correlated with executive function (EF). Young adults and older adults who were classified as fallers and non fallers were studied. Gait speed, swing time, and swing time variability, a marker of fall risk, were measured during usual walking and during three different dual-tasking conditions. EF and memory were evaluated. When performing dual tasks, all 3 groups significantly decreased their gait speed. Dual tasking did not affect swing time variability in the young adults and in the non fallers. Conversely, dual tasking markedly increased swing time variability in the fallers. While memory was similar in fallers and non fallers, EF was different. The faller specific response to dual tasking was significantly correlated with tests of EF. These findings demonstrate that dual tasking does not affect the gait variability of elderly non fallers or young adults. In contrast, dual tasking destabilizes the gait of idiopathic elderly fallers, an effect that appears to be mediated in part by a decline in EF.¹⁶

AIM / Purpose of the Study

The purpose of the study is to determine the effects of usual footwear on TUG scores and BBS scores while performing dual task in elderly women. We limited our focus to elderly women because they are at higher risk for disablement than are men

Material and methods:

Methodology: It's an Observational, single blinded study which intends to find out the Effect of usual footwear on balance and mobility while performing dual task in elderly women attending a day care hospital.

Sample: A sample of 30 subjects was taken from different day care hospitals including Jaipur Golden Hospital, Bhagwan Mahavir Hospital, GRTC Parmarth mission hospital, Delhi. Subjects were enrolled according to the criteria included. All subjects signed consent form and were ready to take part in the study. The subjects were given the instructions regarding the procedure and the subjects who fulfilled the inclusion criteria and were ready to attend the exercise program regularly were selected.

Inclusion Criteria

- Subjects including elderly female of 60-80 years of age.
- Wearing their usual footwears.
- Having previous history of fall.
- They should have at least 90 degrees of shoulder flexion,
- Transferred independently,
- Stood unsupported for 30 seconds or more,
- Subjects should walk independently at least 20 m and turn 180 degrees, with or without an ambulatory aid.
- Subjects should not be wearing a lower-extremity brace or orthosis.

Exclusion Criteria

- Exclusion criteria based on performance criteria but not on the basis of medical diagnosis.
- Subjects that required medical attention.
- Subjects having any serious visual or hearing impairments.
- Subjects with <90° of shoulder flexion.
- Additional exclusion criteria included any inability to follow standardized test instructions or to perform the TUG and BBS while performing dual task under all footwear conditions.

Tools & Instrumentation used

- A pair of their preferred usual footwears.
- A Chair of 44 cm of height
- A cup of water
- Measuring tape length > 3m
- Foot stepper
- Micropore
- Stop watch
- An Inch tape
- Weighing machine

Procedure:

A Total of 30 subjects were invited to participate in the study, subjects performed the tasks (TUG and BBS) under dual task condition without footwears/ barefooted and with their usual footwears.

All Subjects (patients/ their relatives) from different day care hospitals were invited to participate in the study. The purpose of this study was explained to them. A detailed verbal description of the procedure was given to the subjects and query on their part was solved before the commencement of the study.

Prior to the beginning of the study, complete evaluation was done and demographic data including age, weight, height, medical history etc were collected. A baseline assessment of the subjects was done prior to the study by evaluating following parameters: Timed up and Go Test (TUG), Berg Balance Scale (BBS) while performing dual task without footwear and with their usual footwear

BERG BALANCE with Dual task (cognitive)

Subject sat comfortably with their back against the chair and was asked to perform the 14 tasks, one task at a time while counted backwards by three from any number between 20 to 100. subject performed the following tasks like sitting-to-standing, standing-to sitting, transferring bed to chair, sitting and standing unsupported, standing eyes closed, standing feet together, tandem standing, single limb standing, reaching, picking up an object from the floor, alternating foot on stool, looking over the shoulders, and turning 360°. In most items, the subject is asked to maintain a given position for a specific time and In the tasks which required the subject to place the foot on a step or to reach forward, the choice of which leg to stand on was decided by the subjects. Each item is scored on a five-point ordinal scale (0–4), which gives a total score ranging from 0 to 56 points with higher scores indicating better balance.

BERG BALANCE with Dual task (motor)

Subject sat comfortably with their back against the chair and was asked to perform the 14 tasks as mentioned above, one task at a time while holding a cup of water.

Dual Task (Motor) TUG

In this Subject sat comfortably with their back against the chair while holding a glass full of water with their dominant hand. When the researcher said "Go," they stood up from the chair, walked 3 meters with a comfortable speed, turned 180 degree towards the right/left, walked 3 meters back to the chair, and sat down. This was repeated for 3 trials. During the testing, participants were instructed to hold the glass without spilling the water (prioritized cup holding) or else the trial would be considered as a failed trial and need to be repeated.¹⁶

Dual Task (Cognitive) TUG.

Participants sat comfortably with their back against the chair. The researcher verbally gave them a number (any number from 20 to 100). The participants then counted backwards by three from the number consecutively and gave verbal responses. When they heard "Go," they stood up from the chair, walked 3 meters with a comfortable speed, turned 180 degree towards the right/left, walked 3 meters back to the chair, and sat down. This was repeated for 3 times. Trials that were considered failed needed to be repeated. This may happen when participants made error on the counting backward task.¹⁶

DATA ANALYSIS:

The mean and standard deviation of the collected data was calculated, further t value, p value was calculated to know the level of significance. Spss version 12 is used to calculate the results

Table 1 : Comparison of the values of TUG (M+C) while dual task barefoot v/s with footwears

Mean of TUG(Dual task M+C)	S.D.	t value	P value	Level of significance
Barefoot 21.77	3.44	57.4	** 1	* =Significant at ≤ 0.05 ** not significant
With footwear 15.71	3.33			

Table 2 : Comparison of the values of TUG (M+M) while dual task barefoot v/s with footwears

Mean of TUG in Seconds (Dual task M+M)	S.D.	t value	P value	Level of significance
Barefoot 23.09	3.87	5.80	** 1	* =Significant at ≤ 0.05 ** Not significant
With footwear 17.08	4.15			

Table 3 : Comparison of the values of BBS (M+C) while dual task barefoot v/s with footwears

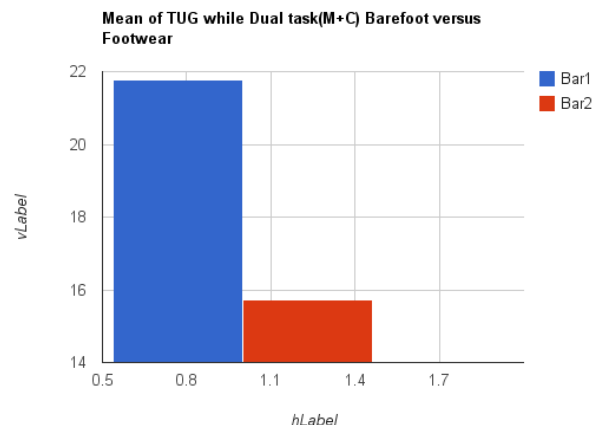
Table 3 : Comparison of the values of BBS (M+C) while dual task barefoot v/s with footwears

Mean of BBS (Dual task M+C)	S.D.	t value	P value	Level of significance
Barefoot 42.9	6.58	-3.11	* 0.00	* =Significant at ≤ 0.05
With Footwear 48.2	6.62			

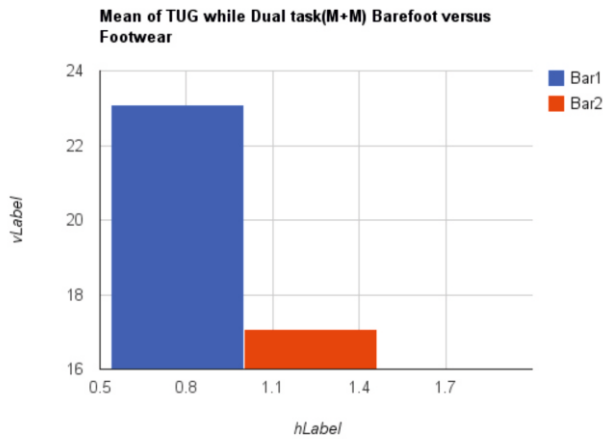
Table 4: Comparison of the values of BBS (M+M) while dual task barefoot v/s with footwears

Mean of BBS (Dual task M+M)	S.D.	t value	P value	Level of significance
Barefoot 42.4	6.63	-3.35	* 0.00	* =Significant at ≤ 0.05
With Footwear 48.1	6.55			

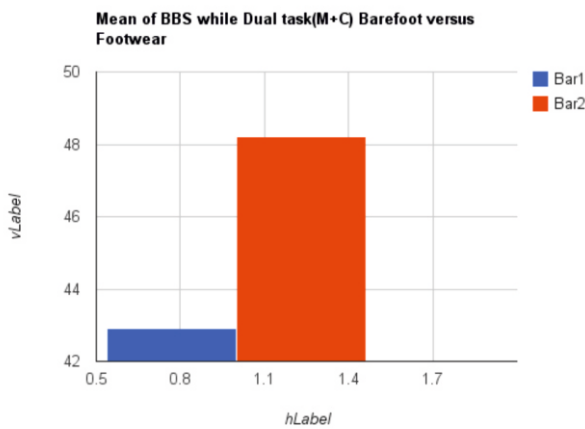
Graph 1 : Shows comparison of mean of TUG while dual cognitive task in barefoot and footwear conditions



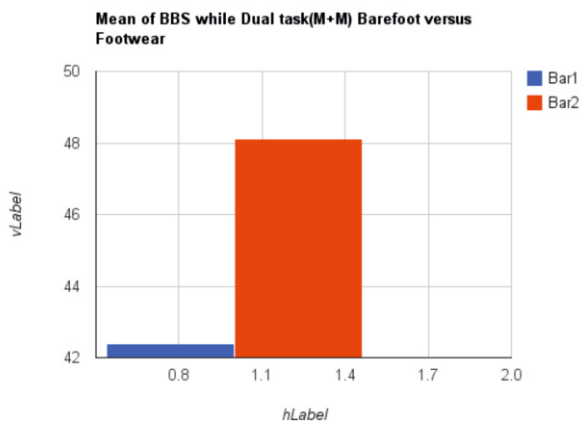
Graph 2 : Shows comparison of mean of TUG while dual motor task in barefoot and footwear conditions



Graph 3 : Shows comparison of mean of BBS while dual cognitive task in barefoot and footwear conditions



Graph 4: Shows comparison of mean of BBS while dual Motor task in barefoot and footwear conditions



DISCUSSION:

Our aim of doing this study was to check the effect of usual footwear on balance and mobility in elderly females under dual task conditions.

Results of the mean scores of TUG under dual task (motor + cognitive) showed significant decrease in time while performing it with their usual footwear. Similarly while performing balance activity with dual task during barefoot or with usual footwear it showed significant changes when wearing their usual footwear.

The better performance in their usual footwear compared with barefoot is consistent with the results from Dobbs et al,12 who reported faster self-selected walking speeds in shoes as compared with barefoot in subjects up to 89 years of age. The shock absorption provided by walking shoes may allow people to walk faster without increasing the impact loading of the body. The magnitude of the effect on individual TUG scores was generally less than 2 seconds, although 1 subject required almost 6 seconds longer to complete the TUG when barefoot than when wearing walking shoes.10

It showed that wearing their own footwear was associated with significantly improved balance compared to being barefoot. The finding of a protective effect of footwear on balance of elderly women is consistent with the work of Robbins et al. [16] who found that in a convenience sample of 25 healthy men (aged 60 years and older), being barefoot was associated with significantly more balance failure while walking along a beam.9

It is possible that patients with poorer balance have deficits in foot and ankle architecture that are compensated for by footwear. Koepsell et al. examined the risk of falls in a Washington state sample of community-dwelling older adults in relation to footwear in fallers and matched controls and found that fall risk was markedly increased when participants were not wearing shoes 9

Relevance to clinical practice

Falls are more common in elderly women which affects their daily routine activities, so emphasis on wearing their usual / comfortable footwear should be given to improve their balance and mobility and to prevent falls in rehab set ups.

A standard of testing balance and mobility with footwear may be set up to maintain the uniformity and to improve balance later on

Scope for Future Research

1. Study can be done on large population.
2. The comparison can be done between male and female subjects.

Conclusion:

In conclusion, it was found that wearing their own shoes, compared to going barefoot, was associated with a significant changes in balance and mobility scores under dual task condition in elderly women attending a day care hospital and that this effect

was independent of the individual characteristics of the shoes. Taking into account the findings of increased falls risk in elderly women who go barefoot, we recommend that elderly women at risk of falls do not go barefoot while walking. Further research is needed to more fully understand the effects of footwear on balance and falls after dual task training.

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