Effect of Footwear on Balance and Fall Risk of Elderly Individuals in Selected Old Age Homes

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Abstract

Background & Purpose: Falls in older people is a major public health problem, with 1 in 3 people in the community aged over 65 years falling each year. To perform daily activities under both static and dynamic conditions , maintenance of balance and stability plays an important role to prevent slip and falls. Maintenance of balance is essential to prevent falls and fall related injuries. Balance is maintained by visual, vestibular and somatosensory senses coupled with an intact, musculoskeletal system along with a higher level of cognitive neural function. Degradation in one system increases the chances of lowering balance performance with resultant possibility of a fall. The type of footwear plays a major role for maintaining balance and stability as it serves as the medium between foot and the surface and contributes to somatosensory feedback mechanisms. Design features of footwear such as mid sole hardness , heel elevation play an important role in posture and balance. The aim of present study was to measure the effects of footwear on balance and fall risk in older population. METHODOLOGY: Subjects were selected from R.V. College of Physiotherapy OPD Bengaluru, Dignity Foundation Bengaluru. Elderly population above 60 years were recruited for the study. Purposive sampling technique was used to recruit sample size of 80 subjects. FUNCTIONAL REACH TEST (FRT): (Group A)=40 subjects and BERG BALANCE TEST: (Group B)=40 subjects were analyzed. Results: The result was expressed in asymptotic Z-value because for both the groups sample size was more than 20.Hence the median was tested between the two scales and asymptotic Z-value was 7.852 with P value of $p<0.001$.This shows that those with footwear have maintained better balance as compared those without footwear.

Conclusion: The present study concluded that respondents recruited for Berg balance scale with footwear showed better balance and stability as compared to bare foot performing Functional reach test

Keywords: *Fall Risk, Elderly Population, Balance, Functional Reach Test, Berg Balance Scale, Footwear.*

Introduction

Falls in older people is a major public health problem, with 1 in 3 people in the community aged over 65 years falling each year. Up to 15% of falls result in serious injury such as head trauma , fractures, dislocations, lacerations, making falls the leading cause of injuries-related hospitalizations and mortality in older people.[1]

As humans age , they become less adept at recovering stable equilibrium after encountering environmental factors that produce instability . This is mainly due to slowing of compensatory behavioral response to perceived unstable equilibrium. External factors play a dominant role in both initiating falls and impairing recovery.[2]

To perform daily activities under both static and dynamic conditions , maintenance of balance and stability plays an important role to prevent slip and falls. Maintenance of balance is essential to prevent falls and fall related injuries. Balance is maintained by visual, vestibular and somatosensory senses coupled with an intact ,musculoskeletal system along with a higher level of cognitive neural function. Degradation in one system increases the chances of lowering balance performance with resultant possibility of a fall.[3]

Footwear has a vital role in improving the well-being of an individual. Previous studies reported an association between footwear and balance. Footwear facilitates sensory information to the foot and control postural stability through touch and proprioceptive system. The tactile stimulation is detected by cutaneous mechanoreceptors of the plantar surface of the feet and gives information of plantar pressure distribution to the central nervous system. Types of footwear may influence of the sensory feedback from the feet. Few studies have reported postural stability in elderly population who has poor footwear type and poor footwear characteristics.[4] Many authors feel that footwear sole construction is an external factor that substantially influences instability during locomotion in older individuals.[2]

Several laboratory based studies have demonstrated that elevated heels and thick, soft soles are detrimental to balance, while footwear with high collars and firm soles are beneficial. Prospective studies have also shown that wearing shoes with slippery soles high heels and reduced sole contact area increase the risk of falls in older people.[5]

Although falls are complex and multifactorial, the risk factor is high in women than in men. The indoor footwear tends to be less supportive than outdoor footwear and is selected primarily for comfort.[1]

Certain type of footwear such as slippers, socks without shoes, and going barefoot increases the risk of fall among elderly. Few studies have reported that going barefoot , wearing socks without shoes and wearing slippers are associated with increased risk for falls particularly indoor falls. Although wearing shoes with high heels is also likely to increase the risk for falls, very few elderly people wear such shoes.[6]

Several studies have shown that wearing slippers is a risk factor for falls and fall related injury in older people. In response to these several authors have suggested that older people should wear more supportive footwear inside the home thus there is need to develop indoor footwear that is both comfortable and safe for older people at risk of falling. Thus primary aim of this study is to asses balance.[1]Number of other pathologies such as diabetes, neuropathies and dementia also contribute for the imbalance and fall.

The incidence of dementia worldwide continues to increase as the world's population ages. For the community dwelling elderly with dementia or cognitive impairment, their fall risk is higher compared to their peers with normal cognition, and their risks of sustaining serious injuries after falls are trebled or quadrupled.[7]

People with diabetes and neuropathy are 15 times more likely to report to an injurious fall than those without neuropathies. In addition to the obvious physical burden , the physiologic consequence of falling has been associated with significant loss of independence and decreased quality of life . The prevention of fall is , therefore important to reduce morbidity and mortality in people with diabetes. Therapeutic footwear and insoles offer an external modifiable additional factor with the potential to influence balance. Footwear characteristics , including heel collar height, sole hardness and sole geometry have been found to influence quantitative measures of balance and gait.[8]

The type of footwear plays a major role for maintaining balance and stability as it serves as the medium between foot and the surface and contributes to somatosensory feedback mechanisms. Design features of footwear such as mid sole hardness , heel elevation play an important role in posture and balance. [3]

Aim and Objectives of the Study

AIM: To measure the effects of footwear on balance and fall risk in older population

Objectives:

1. To assess balance performance on Functional Reach test (FRT) and Berg Balance Scale in elderly.

2. To assess and compare the balance performance among elderly those wearing flat footwear and barefoot.

Hypothesis: The balance with and without footwear may be the same

Alternate hypothesis: The balance with footwear may be better compared to without footwear

Methodology

Materials and Method

Source Of Study:

Subjects were selected from R.V. College of Physiotherapy OPD Bengaluru, Dignity Foundation Bengaluru,

Definition of the study subjects:

Elderly population above 60 years were recruited for the study.

Methods of Data Collection:

The investigator personally contacted corresponded concerned authorities and obtained permission and with the subjects signed consent form. Subsequently after obtaining the permission, the investigator screened the subjects for meeting the requirements of inclusion criteria and exclusion criteria the study was continued.

The subjects were assigned in to two groups. Group A (N=40) Berg Balance Test and Group B (N=40) Functional Reach Test(FRT) was recorded.

Research Design:

Comparative study

SAMPLE AND SAMPLING TECHNIQUE

•**Sample size** – Total 80 samples were recruited from which they were divided equally into two groups. Group A(n=40) and Group B(n=40). Number of elderly patients treated in Musculoskeletal OPD and Neurological and Psychosomatic disorders for interval period of one week duration at R.V. College of Physiotherapy was total number N=44 out which 11 subjects fulfilled inclusion and exclusion criteria .

Sample size calculation made on formula

P=11/44=0.25

N=72

+10%Non-response errors

N=72+8=80

Sampling technique – Purposive sampling.

Duration of the study:

Data was collected over a period of approximately 3months

Materials Required:

- A ruler
- 2 standard chairs (one with arm rests, one without)
- A foot stool or step
- Stopwatch
- Inch tape
- Screening form
- Stationaries
- Yard stick

Inclusion Criteria:

- Elderly above 60 years of age
- Subjects willing to participate and ready to sign consent form.
- Owns at least one pair of flat footwear and also is used to walking barefoot.
- Have at least 90 degrees of shoulder flexion.
- Transfer independently.
- Stand unsupported for 30seconds or more.
- Could walk independently and turn 180 degrees, with or without an ambulatory aid.

Exclusion Criteria:

- Wearing any lower extremity brace or orthosis.
- Subjects with any Musculoskeletal issues of lower limb and lower back, spine deformities.
- Subjects with neurological disorder affecting balance such as stroke, movement disorders.
- Presence of any foot abnormalities including hallux valgus, hallux rigidus, hammertoes, claw toes, overlapping of toes.
- Painful corns in feet.
- Foot Ulcers.

- Foot pain.
- Diabetic neuropathy
- Gout arthritis with involvement of heel pain.

Procedure:

FUNCTIONAL REACH TEST (FRT): (Group A)=40 subjects

Functional reach test was measured with the subjects in a standing position, with her/his dominant upper extremity next to a wall. The dominant arm is used for consistency with procedures described by Duncan et al for development of the FRT. The selection of dominant arm would be based on the subject's self-report of the hand used for writing. He/she would be asked to attain a comfortable standing position, and the position of her/his feet would be marked on the floor for each footwear condition. A measuring stick with a built-in level would be placed on the wall at acromion height, levelled, and secured to the wall with marking tape. The subject would make a fist and raise her dominant arm to approximately 90 degrees of shoulder flexion. In this position, the placement of the end of the third metacarpal bone along the measuring stick would be recorded to the closest centimeter as position 1. The subject would be then instructed to reach as far forward as possible without taking a step or losing balance, and the location of the end of the third metacarpal would be recorded to the closest centimeter as position 2. Functional reach is defined as the difference between the 2 positions. After 2 practice trials, 3 measurements of functional reach would be recorded and averaged to establish the FRT measure.

BERG BALANCE TEST: (Group B)=40 subjects

This ordinary scale(0-4: 0-unable to perform, 4-able to perform the task safely and independently). Evaluates patient performance on 14 tasks commonly performed in day to day life. Subjects were asked to perform the test and according to the items of the scale it is recorded.

Items of scale are-

- Sitting to standing
- Standing unsupported
- Siting unsupported
- Standing to sitting
- Transferring
- Standing with eye closed
- Standing with feet together
- Reaching forward without stretched arm
- Retrieving object from floor
- Turning to look behind
- Turning 360^0
- Placing alternate foot on stool
- Standing with one foot in front
- Standing on one foot

Result Analysis

Statistical Analysis:

The data collected in this study was analyzed statistically and presented as follows: The categorical variables like age and gender are presented in the form of frequency tables and along with graphs.

Age (yrs)	Functional reach test		Berg balance scale	
	No.	%	No.	%
60 – 64	13	30.95	17	41.46
65 – 69	13	30.95	10	24.39
70 – 74	9	21.43	7	17.07
75 – 79	7	16.67	7	17.07
Total	42	100.00	41	100.00

Table 1 :The descriptive statistics of age was observed in this study that majority of the respondents in Functional reach test were between the age of 60-69 ie 30.95% where as in Berg balance scale 41.46% were 60-64.

It was observed in this study that majority of the study subjects were in the age group of 60-69 years both for Functional reach test and Berg balance scale with respective percentages 61.9% and 65.85%

Gender	Functional reach test		Berg balance scale	
	No.	%	No.	%
Male	22	52.38	21	51.22
Female	20	47.62	20	48.78
Total	42	100.00	41	100.00

Table 2. Gender distribution of Functional reach test and Berg balance scale

It was noticed in this study that the distribution of gender was almost similar in both the study groups.

The above Table 2 shows that out of 42 subjects in Functional reach test, 52.38% (n=22) were male, 47.62% (n=20) were female and in Berg balance scale out of 41 subjects, 51.22% (n=21) were male, 48.78% (n=20) were female.

Table 3. Distribution of age and mean, SD of Functional reach test and Berg balance scale

Age (yrs)	No. of subjects (n)	Minimum	Maximum	Mean	SD	Std. Error	95% Confidence Interval for Mean	
							Lower Bound	Upper Bound
Functional reach test	42	60	87	68.29	6.21	0.96	66.35	70.22
Berg balance scale	41	60	81	67.20	6.12	0.96	65.26	69.13

The present study showed that the mean ±SD for Functional reach test 68.29±6.21 and for Berg balance it was 67.20±6.12.With 95% confidence interval for Functional reach test is(66.35,70.22) and for Berg balance scale(65.26,69.13)

Table 4: Inferential analysis of both groups (Group A and Group B) and Z value comparative assessment of Functional reach test and Berg balance scale.

Total score	No. of subjects (n)	Min	Max	Mean	SD	Std. Error	95% Confidence Interval for Mean		Mann-Whitney test (Asymptotic Z – value)	P - value
							Lower Bound	Upper Bound		
Functional reach test	42	3.0	8.25	5.75	1.28	0.20	5.35	6.15	7.852	P < 0.001
Berg balance scale	41	32.0	54.0	44.39	5.44	0.85	42.67	46.11		

In the inferential statistics based on Functional reach test and Berg balance scores, even though the mean and SD for with in normal limits the range of scale was different and therefore instead of parametric student t test and non- parametric Mann -Whitney test was applied

The result was expressed in asymptotic Z-value because for both the groups sample size was more than 20.Hence the median was tested between the two scales and asymptotic Z-value was 7.852 with P value of $p<0.001$.This shows that those with footwear have maintained better balance as compared those without footwear.

Discussion

Comparative study was done at R. V. College of Physiotherapy OPD Bengaluru and Dignity Foundation Bengaluru among elderly population above 60 years. The aim of the study was to measure the effects of footwear on balance and fall risk in older population.

In this study the statistics observed that majority of participants in Functional reach test were between the age group of 60-69 ie 30.95% where as in Berg balance scale 41.46% were age group of 60-64.Gender distribution was noticed all most similar both the groups. Distribution age mean and SD of Functional reach test and Berg balance scale was 68.29±6.21 and 67.20±6.12.With 95% confidence interval for Functional reach test was (66.35,70.22) and for Berg balance scale(65.26,69.13). Earlier study by Kelsey JL et al [6] concluded that it may be advisable for older individuals to wear shoes in their homes whenever possible to minimize fall risk. Ven Der Cammen TJM et al[9] conducted a study to investigate the influence of 3 different types shoe models frequently worn at home to determine the gait parameter and associated fall risk. The study showed that gait velocity and stride length were significantly reduced. Kunkel D et al[10] conducted a study to explore balance and gait performance in people with Parkinson's using indoor and outdoor footwear. The study concluded that with indoor footwear walking speed was significantly slower and decreased stride length as compared to out-door footwear.

The interferential statistics expressed in asymptotic Z- value was 7.852 with P value $p<0.001$.Which showed subjects with footwear have maintained better balance as compared to those without footwear.

Scope of The Present Study Was:

1. To assess balance and fall risk

2. Awareness on effect of footwear on balance and fall risk

3. Design appropriate gait rehabilitation to prevent fall risk

4. Appropriate footwear use in geriatric rehabilitation

Conclusion

The present study concluded that respondents recruited for Berg balance scale with footwear showed better balance and stability as compared to bare foot performing Functional reach test

Further scope of the study: To assess balance fall risk and to create awareness on effect of footwear on balance and fall risk, To prescribe appropriate footwear and to design gait rehabilitation to prevent fall risk and study can be conducted in community set up to create awareness.

Limitation: Sample size could have been larger population, Both gender were not equally distributed ,It can be applied on vast population to identify fall risk in elderly as community cross sectional study, Study didn't focused on prescription of exercise on fall risk and to train balance .

Conflict of Interest: There was no personal or institutional conflict of interest for this study

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Ethical Clearance: Ethical clearance taken from R.V.COLLEGE OF PHYSIOTHERAPY ,Bengaluru

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