EFFECT OF FOOTWEAR ON BALANCE AND GAIT IN MEN AGED BETWEEN 60 TO 80 YEARS

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ABSTRACT

Background & Purpose: Decline in physical mobility is a major concern for many older people. Even small improvements in the areas of mobility, balance, and gait may contribute valuable benefits in terms of quality of life. Footwear, being at the interface between the body and the supporting surface, has the potential to affect balance and subsequently, the risk of falling. Hence the purpose of this study was to evaluate the balance & gait while wearing different type of footwear using functional reach test (FRT), time up and go test(TUG) and 10 meter walk test(10 MWT). Subjects: 50 older males aged between 60-80 years. Method: Demographic data, brief history and characteristics of different type of footwear were recorded. Each subjects performed FRT, TUG and MWT while barefoot, walking shoe and usual footwear (slipper). Each subject had performed all 3 tests without any difficulty. Three trials were given for each test and average of three trials was noted by therapist. One way repeated measure ANOVA and post-hoc analysis were done by SPSS. Results: One way repeated measure ANOVA showed that there was a significant difference between each footwear condition for all 3 tests. Post-hoc analysis revealed that walking shoes were having significant superior score than the barefoot & usual footwear for all 3 tests. Conclusion: Walking shoes improve balance and gait in older males. Walking shoes also provide shock absorption and allow people to walk faster without increasing the impact loading of the body. So Footwear intervention should be considered as a way of improving gait and balance in older males.

Keywords: Different footwear; Balance; Gait.

INTRODUCTION

The balance is the ability to maintain an upright position in human being. It is more appropriately defined as postural stability[1]. Postural stability can be described as the ability of an individual to maintain own centre of gravity (COG) within the base of support. Balance is a complicated process that includes recognition and structuralization of sensory information to achieve a good standing posture, which is necessary for performance of Activity of daily livings (ADLs)[2]. When standing up and moving, the foot is the first point of contact between the body and the external environment, providing sensory information to the central nervous system for stability and locomotion.

Footwear may influence the quality of sensory feedback from the feet and may act as a sensory filter between the feet and the external environment[3]. Footwear, being at the interface between the body and the supporting surface, has the potential to affect balance and subsequently, the risk of falling[4]. Different components of shoes have been studied in relation to their requested functions[5]. Walking barefoot does not appear to be a safe alternative because it has been found that walking barefoot or in socks also increases the risk of falling[6-8]. Despite the number of studies that have addressed the effects of footwear on balance[9,10], there are still no evidence-based guidelines to assist older people with regard to which specific shoe features are optimal for balance[4]. Because older people most often fall in response to unexpected perturbations when walking[11], it follows that the effects of footwear should be tested under such conditions[12].

Inappropriate footwear has been identified as a contributor of up to 45% of falls[13]. Some authors have suggested that poorly fitting footwear and slippers or shoes with inadequate fixation may increase the risk of trip-related falls[14-17]. Wearing inappropriate footwear may also impair balance and alter gait patterns in the elderly[18,19]. Robbins[20] found that older men performed better with thin hard-soled shoes rather than running shoes with soft soles and hypothesized that soft midsoles induce a more unstable foot position; the deformable material alters plantar feedback and may induce a greater maximum supination angle that is underestimated by the wearer which may limit postural adaptations to maintain stability[21].

Decline in physical mobility is a major concern for many older people. Even small improvements in the areas of mobility, balance, and gait may contribute valuable benefits in terms of quality of life[22]. Therefore, measures of balance and gait performance are critical in the field of aging and essential to help health care

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professionals and researchers keep their focus on the real needs of the older population[23,24].

Research on the effects of different types of footwear on balance and gait in the aging population is very limited[25]. Till now, in India, there are very few studies on the effect of footwear on balance and gait in elderly individual especially in males. So, that the present study was undertaken. The purpose of the study is to determine whether different types of footwear affect the balance and gait in elderly males.

METHODOLOGY

A Convenient sample of 50 males, aged between 60 to 80 years were taken from charitable trust named by Mannmandir charitable trust, Katargam, Surat after receiving permission from administration. Participants were selected for study based on inclusion and exclusion criteria. Inclusion criteria of subjects were 60-80 years of age, male individuals, able to stand unsupported for 30 seconds or more, able to walk independently at least 20 meter and turn 180 degrees, able to follow simple instruction, able to do at least 90 degrees of shoulder flexion with dominant hand, at least have a one pair of shoes. Exclusion criteria of subjects were Female individual, < 60 years of age, could not stand independently, any inability to follow standardized test instructions, any known neurological condition, any known cardiovascular disorder which limits physical daily activities, any known musculoskeletal disorder (i.e. fracture, joint replacement, amputation, physically limited activities).All participants were asked to give & sign consent form prior to participate in the study.

Functional reach test, Time up and go test and 10 meter walk test were taken as an outcome measure. Reliability and validity of all the 3 tests were good[26,27,28]. Information on age, level of mobility, medications, use of spectacles, falls history of last one year, different type of footwear characteristics were determined. All the Subjects were assessed for the presence of foot abnormalities including hallux valgus, hallux rigidus, hammer toes, claw toes, overlapping or under riding toes, painful corns and ulcers. All the subject were assessed for balance and gait using the functional reach test, timed up and go test and 10 meter walk test with three different type of footwear (i.e. barefoot, walking shoes, usual footwear[slippers]).

All of the assessment tests were performed in morning. Subjects performed the FRT, TUG and 10 MWT in a randomized order. The tests were performed in the sequence in which the subjects drew their names from a hat at the beginning of the testing period. The order of the footwear conditions was counterbalance among the subjects so that all possible sequences of footwear conditions were equally represented.

To avoid undue fatigue, subjects rested 3 minutes between different footwear conditions and 1 minute between different functional measurements. For the first footwear condition, one therapist had explained each test and demonstrated it in a standardized manner. For the 2 following footwear conditions, the therapist repeated the explanation but did not demonstrate the test. All subjects were received the same number of practice and test trials for all footwear conditions. Three trials were given for each test and average of three trials was noted by therapist for all footwear conditions. One way repeated measure ANOVA and post-hoc analysis were done by SPSS 20.

RESULTS

Table 1: Demographic and footwear characteristics of subjects

		No. of Subject (n=50)
Living with family	Yes	50
	No	00
History of fall in one year	Yes	05
	No	45
Diabetes	Yes	16
	No	34
Hypertension	Yes	12
	No	38
Heart Problem	Yes	4
	No	46
Cholesterol	Yes	2
	No	48
Spectacles	Yes	13
	No	37
Cataract operation	Yes	28
	No	12
Presence of foot deformity	Yes	00
	No	50
Use of mobility aids	Yes	05
	No	45
Type of walking shoes:	Lace	02
	Velcro	05
	Shoes without lace & Velcro	43
Heel height(cm)	<2.5	11
	2.5-5	39
	>5	00
Shoe sole	Treaded	40
	Non Treaded	10
Usual footwear sole	Treaded	34
	Non Treaded	16
Usual footwear (slippers) sole characteristics	Soft sole	22
	Hard sole	28
Sole flexibility	>45 degree	18
	<45 degree	32

A total number of 50 older males participated in this study. All the subjects had completed all three tests without any difficulty. The mean age of all subjects was 70.8 and

standard deviation was 6.822. All the tests were performed by subjects with 3 different type of footwear condition (barefoot, walking shoes and usual footwear [slipper]) and results were noted by therapist. Details of Demographic and footwear characteristics of subjects are described in table 1. One way repeated measure ANOVA showed that there was a significant difference between each footwear condition for all 3 tests.

The descriptive statistics for the FRT, TUG and 10 MWT scores under the 3 footwear conditions are documented in Table 2. Results also showed that walking shoes (8.772±2.35) were having superior score than the barefoot (8.312± 2.30) & usual footwear (8.356± 2.17) for FRT as well as for TUG (walking shoes 10.72±1.898, barefoot11.54±2.213& usual footwear11.31±1.794) and for 10 MWT (walking shoes 5.234±0.746, barefoot (5.706±0.968) & usual footwear 5.534±0.759). Post-hoc analysis was performed to determine which footwear condition resulted in significantly better scores than other two footwear conditions.

Table 2: One way repeated measure ANOVA for the FRT, TUG and 10 MWT scores under the 3 footwear conditions

	Mean (SD)	Lower 95% CI	Upper 95% CI	p value	F value
Functional reach test(cm)					
Bare foot walking	8.312 (2.298)	7.659	8.965	0.0146	4.415
Walking shoes	8.772 (2.345)	8.106	9.438		
Usual foot wear	8.356 (2.169)	7.740	8.972		
Time up and go test(sec)					
Bare foot walking	11.54 (2.213)	10.90	12.17	0.0008	7.680
Walking shoes	11.72 (1.898)	10.18	11.27		
Usual foot wear	11.31 (1.794)	10.80	11.83		
10 meter walk test(sec)					
Bare foot walking	5.706 (0.9684)	5.434	5.978	<0.0001	19.37
Walking shoes	5.234 (0.7466)	5.024	5.440		
Usual foot wear	5.534 (0.7596)	5.320	5.748		

In post hoc analysis for FRT, walking shoes (8.772±2.35) were statistically better than barefoot (8.312± 2.30) ($p<0.05$), walking shoes (8.772±2.35) were statistically better than usual footwear (slippers) (8.356± 2.17) ($p<0.05$) and no statistically significant difference was noted between barefoot and usual footwear (slippers) ($p>0.05$). For TUG and 10 MWT lesser the score of mean greater the improvement in gait. For TUG and 10 MWT same results were found in post hoc analysis. (Walking shoes vs barefoot ($p<0.05$); walking shoes vs usual foot wear ($p<0.05$) and barefoot vs usual footwear ($p>0.05$)).

DISCUSSION

The results of the present study showed that there was a significant difference between each footwear condition for all 3 tests (FRT, TUG and 10 MWT). Post-hoc analysis revealed that walking shoes were having significant superior score than the barefoot & usual footwear for all 3 tests.

Results from this study are consistent with previous studies[1,29-31]. Shoes were an important element in development of human posture[29]. An increase in stability whilst wearing shoes rather than in bare feet could be explained by three hypotheses[30]. First, the greater shoe ground contact area compared to bare feet could result in the measurement of an increase in the support base. Second, the increased sole width of shoes, compared to when barefoot could increase the base of support to avoid contact between feet. Third, shoes could act as a sensory filter by reducing proprioceptive feedback, and leading to posture modifications to improve stability[31].

The better performance in walking shoes compared with barefoot is consistent with the results from Dobbs et al[32], 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.

Results from this study are not consistent with previous studies[33-35]. Lord et al.[33] found that in a convenience sample of 30 elderly women (mainly recruited from a hostel for aged persons providing domestic care and with a mean age of 79 years), balance was best when barefoot. These studies suggest that the relationship between footwear and balance is more complex than previously suspected being affected by patient frailty, barefoot balance and type of balance tested. It is possible that patients with poorer balance have deficits in foot and ankle architecture that are compensated for by footwear, whereas more independent subjects have a reduction in balance due to reduced proprioception while wearing shoes, although this warrants further investigation.

Koepsell et al.[34] 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. While going barefoot was more common in those who had a gait abnormality and who used a gait aid, the

strong association of risk of fall persisted after controlling for these variables.

The results of this study have several implications for research and clinical practice. Authors assess individuals under three different footwear conditions that they typically encounter in their daily lives. In addition, footwear and testing surface should be described when reporting test results for research or clinical purpose.30 Results of this study also provide information about the effect of footwear on balance and gait in older males.

Limitations of study were only males individual were recruited and small sample size. All the subjects in the present study were recruited from only one charitable trust. Small sample size limits the generalizability of the results. All subjects in our study were tested in their own walking shoes and usual footwear. Walking shoes and usual footwear characteristics were not specified that could affect the results. Test performance on different floor surfaces was not examined. Future study could also be done to see the effect of different types of walking shoes on balance and gait along with different floor surface considerations.

CONCLUSION

Results from this study revealed that different footwear had a significant effect on balance and gait (FRT, TUG and 10 MWT) in male individuals. Subjects performed significantly better in the walking shoe condition as compared to the barefoot or usual footwear (slipper) conditions. Footwear intervention should be considered as a way of improving gait and balance in older male individuals.

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