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### Correlation of Balance and Foot Posture Index in Elderly

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#### ABSTRACT

**Introduction:** It is seen that in every individual's age there is definite reduction in musculoskeletal, cardiovascular and neurological system. As individual walks weight of the body falls on the feet which is essential part for shock absorption while standing and stability. Therefore it is seen that foot posture and morphology of muscle can affect the balance of individual, while doing activities like walking, working, climbing stairs etc.

**Aim:** To find out the correlation between balance and foot posture index in elderly.

**Materials and Methods:** The permission was taken from institutional ethical committee. Correlation study design was used. Samples were collected from old age home. Total 50 samples were participated in the study. Outcome measure for Foot Posture –Foot Posture Index was used and for balance Berg Balance Scale were used.

**Results:** Total 50 samples were collected from which 46% (n=27) were males and 54% (n=23) were females participated in the study. Samples were also categorized by BMI. Distribution of samples according to foot posture index of pronated foot in relation with berg balance scale was FPI (mean±SD) (80.4±2.59) and BSS (mean±SD) (36.36±9.2) and its correlation coefficient was 0.229. As well as samples of supinated foot in relation with balance was FPI (mean±SD) (8.07±2.5) BSS (39.88±7.04) and coefficient was 0.3109 (p<0.3109).

**Conclusion:** Balance will affect in older people having pronated and supinated foot among which pronated foot will cause more imbalance as compared to supinated foot.

**Keywords:** Pronated foot, Supinated foot, Balance, Age, Elderly population.

#### INTRODUCTION

Ankle joint refers as talocrural joint i.e. which is the articulation between distal tibia and fibula proximally

and the body of the talus distally, it is an synovial hinge joint with a joint capsule and associated ligaments which provides about one degree of freedom around which the motion of dorsiflexion/ plantar flexion

occurs. Normal range of motion is 20degree for dorsiflexion and 50 degree for plantar flexion. Centre of pressure (CoP) is the single point on the foot at which the resultant surface pressure may be considered to be acting. In the bear foot walking CoP starts at the posterolateral edge of the heel at the beginning of the stance phase and moves in a nearly linear manner through the midfoot area remaining laterally to the midline and moves medially across the ball of the foot with the large concentration along the metatarsal break. The CoP then move to the second and first toes during the late stance. There are several features of normal aging such as musculoskeletal system, respiratory system, nervous system cardiovascular system, peripheral nervous system, special senses, and vestibular system. Elderly which means being above 65 years of age which lead to frequent presence of multiple pathologies and illness can present with confusion, falls and loss of mobility and day to day functioning. In musculoskeletal system muscle strength, muscle mass, muscle endurance and muscle power is reduce.<sup>[1]</sup>Prevalence of falls in elderly are common for sustainable morbidity and mortality. Steady-state motion means in dynamic equilibrium and equilibrium means the body is at rest. Balance is greatest when the center of gravity or center of mass is maintained over its base of support. Limits of stability means sway boundaries in which an individual can maintain equilibrium without changing their boundaries.<sup>[2]</sup> Motor strategies for balance control are ankle, hip and stepping strategies. Balance control requires the interaction of nervous and musculoskeletal systems and contextual effects. Sensory processing for perception of body orientation in space provided mainly by the vestibular, visual and somatosensory systems. Intrinsic factors and extrinsic factors are the major risk factors for fall. <sup>[1]</sup>Extrinsic factors like slippery floor, stable surface type of footwear. Intrinsic factors include multiple tasks of individual forces on the body.<sup>[3]</sup>Foot is in direct contact with ground which contributes individual stability in two ways: by providing mechanical support via osteoligamentous architecture of the arch and the coordinated function of lower limb and muscles; and also by provision of sensory information regarding body position from plantar tactile bearing can affect postural sway due to decreased base of support or because of mechanoreceptors. Which deficits foot posture flexibility, foot posture, its strength and sensation impair this support function and predispose to loss of balance, weight of foot instabilities.<sup>[4]</sup>Age related with

significant changes in foot structure and posture which can affect the balance, which alternately affect the gait pattern.<sup>[4]</sup> Maximum pressure and peak forces in most of the foot regions are associated with foot structure and gait patterns of individual.

## MATERIALS AND METHODS

Ethical clearance was taken from institutional research committee. The aims and objectives of the research was explained to the participants and those who are willing to participate were included in the study and their written consent was obtained.

Correlation study design was used. Samples were collected from old age home. Total 50 samples were included in the study. Foot Posture Index and Berg Balance Scale were used as an outcome measure. Inclusion criteria included individuals above 60 years of age, both the genders were included and those who were willing to participate. The individuals who were using assistive walking devices and having any recent surgeries were excluded.

Pain was assessed by using numerical pain rating scale. For foot posture index, individuals were asked to stand in stance position, with double limb support. Individual was then instructed to stand still in stance position, with head looking in front and arms by their side. Before standing in stance position individual was asked to march on the spot, take several steps prior to setting in the stance position. It was important to assess that individual did not swirl in stance position as it will affect the posture. Individual were asked to stand for approximately two minutes in order for the assessment to be conducted. For berg balance scale individual was asked to maintain position for specific time. Test takes 15-20 minutes and comprises a set of 14 simple balance related tasks, ranging from standing on one foot to etc. The degree of achieving each task is given a score, i.e. zero unable to, four independent and then final score is taken. Data was collected and statistically analyzed to see if there is any correlation between balance in relation with foot posture.

## STATISTICS

Total 50 samples were collected from which 46% (n=27) were males and 54% (n=23) were females participated in the study. Samples were also categorized by BMI. In fig subjects are categorized in which 60% individual has normal BMI were as 16% individual has underweight and obese BMI and 10%

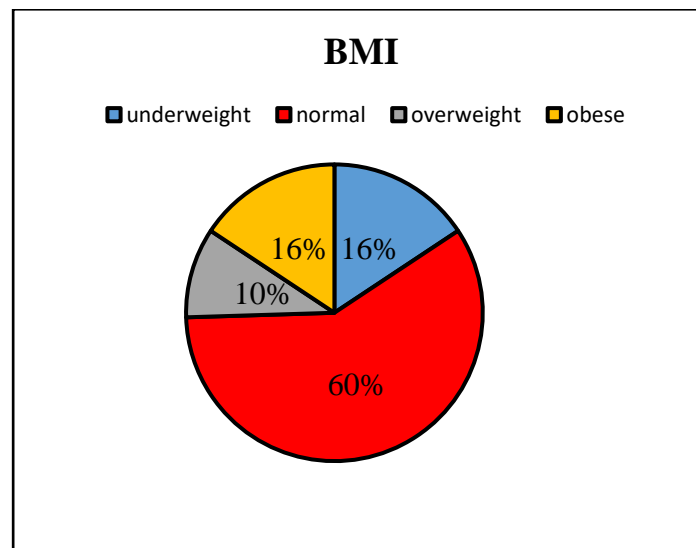
individual are in overweight BMI. Distribution of samples according to foot posture index of pronated foot in relation with berg balance scale was FPI (mean $\pm$ SD) (80.4 $\pm$ 2.59) and BSS (mean $\pm$ SD) (36.36 $\pm$ 9.2) and its correlation coefficient was 0.229. Correlation between foot posture index of pronated foot and berg balance scale are inversely proportional (-0.22). Balance will be reduced in the subjects with more

pronated foot. As well as samples of supinated foot in relation with balance was FPI (mean $\pm$ SD) (8.07 $\pm$ 2.5) BSS (39.88 $\pm$ 7.04) and coefficient was 0.3109 ( $p < 0.3109$ ). Correlation between foot posture index of supinated foot and berg balance scale are inversely proportional (-0.31). Balance will be decrease in the subjects with more supinated foot.

## RESULTS

**Table 1: Distribution of subjects according to Body Mass Index**

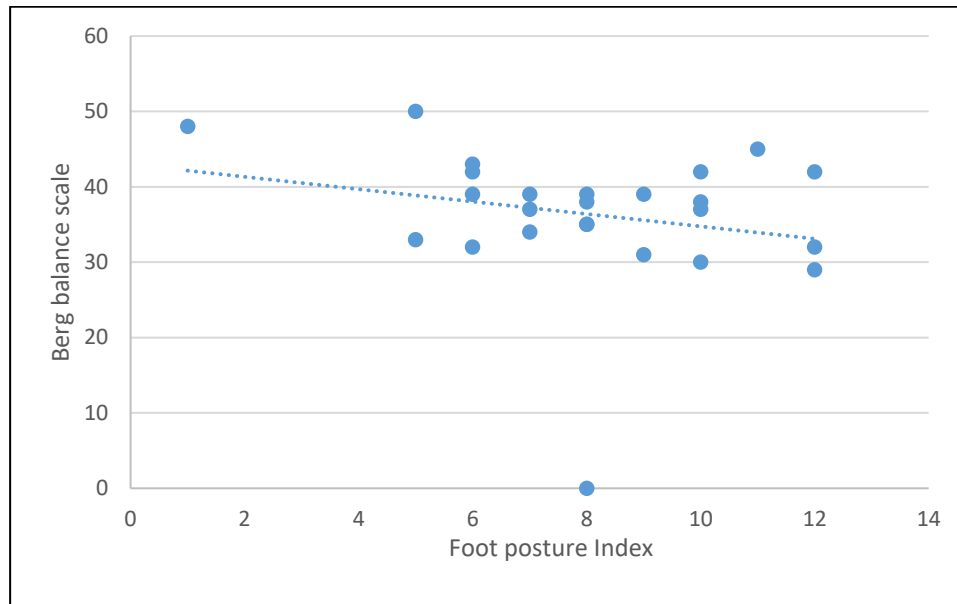
BMI	No. of participants	Percentage
Underweight	8	16%
Normal	30	60%
Overweight	5	10%
Obese	8	16%



**Figure 1: Distribution of subjects according to Body Mass Index**

**Table 2: Distribution of individuals according to foot posture index of pronated foot in relation with berg balance scale**

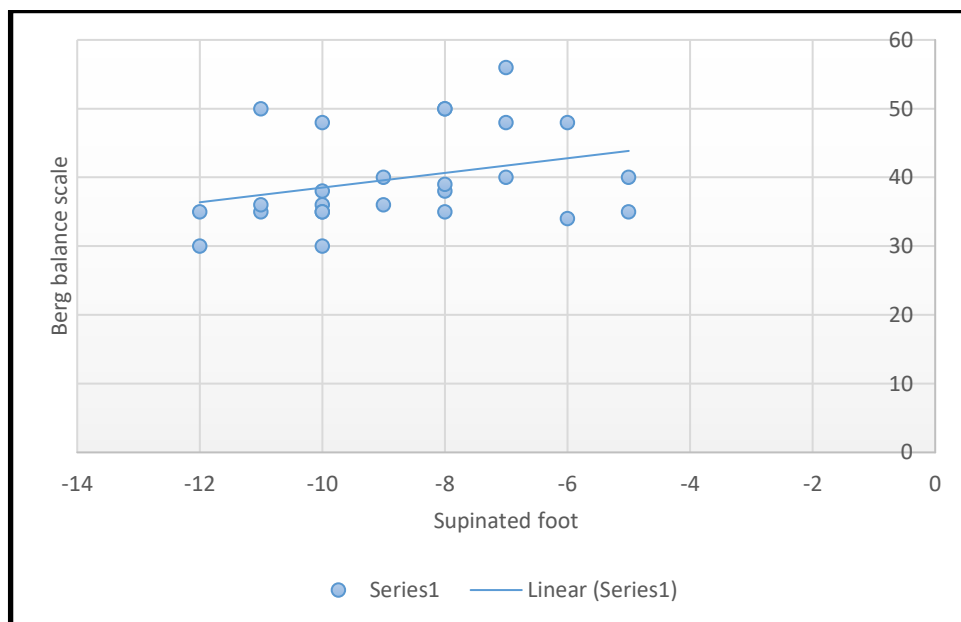
Parameters	Mean $\pm$ SD	Correlation coefficient
Foot posture index of pronated foot	8.04 $\pm$ 2.59	-0.229
Berg Balance Scale	36.36 $\pm$ 9.2	



**Figure 2:** Distribution of individuals according to foot posture index of pronated foot in relation with berg balance scale

**Table 3:** Distribution of individual according to foot posture index of supinated foot in relation with berg balance scale

Parameters	Mean±SD	Correlation coefficient
Foot posture index of supinated foot	8.07±2.5	-0.3109
Berg Balance Scale	39.88±7.04	



**Figure: 3** Distribution of individual according to foot posture index of supinated foot in relation with berg balance scale

## DISCUSSION

Elderly individuals are the people who are 65 years of age and above.<sup>[1]</sup> Health problems in elderly sometimes occur in early fifties or only in forties to understand complexity of problems in the elderly. It is seen that as individuals age there is definite reduction in musculoskeletal, cardiovascular, neuropsychiatry and immune.<sup>[2]</sup> Changes in neuromuscular system of a human being causes affection in balance. Loss of balance seen due to inadequate flexibility, strength and sensation impair in foot. A Mohd Said,<sup>1</sup> HManaf (2015) underwent the study of Mobility and Balance and Their Correlation with Physiological Factors in Elderly with Different Foot Postures muscle properties such as strength and endurance of the lower limb may be the main factors that can affect mobility performance in elderly, regardless of their types of foot postures and thus may be an important feature to make movement possible in older persons. Thus, activities with the element of strength training should be encouraged among older persons; with this method, these individuals can preserve their basic functions for a prolonged period.<sup>[5]</sup>

Body weight is associated with plantar loading and gait patterns. Balance is greatest when the center of gravity or center of mass is maintained over its base of support.

To quantify the posture of the foot i.e. in which foot is pronated, neutral or supinated Foot Posture index (ICC=0.88) is used. Falls of older subjects are associated with foot posture and age related different foot structure and Berg Balance Scale (ICC=0.92) which is objectively used to determine the patient's ability to balance safely during a series of task. The total number of participants were 50 were (n=27) 54% were females which is more in number than (n=23) 46% of males. Dufour AB, at el.(2017) underwent a study on Obesity, foot pain and foot disorders in older men and women. Obesity research & clinical practice and concluded that both men and women were at increased odds of foot pain as BMI increased.<sup>[4]</sup> Data suggested foot posture and dynamic foot function had no effect, thus are unlikely mechanisms<sup>[4]</sup> comparison of BMI in which 60% had normal BMI and 16% were underweight 10% were overweight. The study was

based according to American Heart Association Society Scale, Classification of Body Mass Index Table and figure 1.1 shows, the mean $\pm$ SD of foot posture index for pronated foot was 8.04 $\pm$ 2.59 in relation with berg balance scale 36.36 $\pm$ 9.2. Hylton B. Menz, at el (2013) underwent a study of Planus foot posture and pronated foot function are associated with foot symptoms. Interventions that modify abnormal foot posture and function may therefore have a role in the prevention and treatment of foot pain.<sup>[8]</sup>

Table and figure 1.3 shows, the mean $\pm$ SD of foot posture index for supinated foot was 8.07 $\pm$ 2.5 in relation with berg balance scale 39.88 $\pm$ 7.04. Karen P. Cote, Micheal Brunet at el (2005) underwent the study Our results suggest that postural stability is affected by foot type under both static and dynamic conditions. These differences appear to be related to structural differences as opposed to differences in peripheral input. These effects should be considered when clinicians use such balance measures to assess injury deficits and recovery.<sup>[6]</sup> Martin J. Spinke B. Pod (2015) underwent the study of Foot and Ankle Strength, Range of Motion, Posture, and Deformity Are Associated With Balance and Functional Ability in Older Adults Foot and ankle characteristics, particularly plantar flexor strength of the hallux and ankle inversion-eversion range of motion, are important determinants of balance and functional ability in older people.<sup>[7]</sup>

The balance will decrease if there is change in foot structure either pronated or supinated. Foot in pronated structure have more impairment in balance as compared to supinate.

Hence, the study shows positive correlation (r=0.229) between foot posture and balance in older people, for pronated foot. There is negative correlation (r=-0.3109) between foot posture and balance for supinated foot, which is inversely proportional to each other.

## CONCLUSION

The study shows that balance is affected in older people having pronated foot as compared to supinated foot.

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