

## Research Report

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### Correlation of Balance Scores and Foot Anthropometric Measurements using Bruininks-Oseretsky Score in Healthy Children aged between 6-10 Years.

Grover Pranjali A.(M.P.Th), Assistant Professor, Dave Jui P. (M.Sc. P.T), Professor, Medha Deo V (M.Sc.P.T), Professor & Head, Institutional Affiliation: Terna Physiotherapy College

Address for Correspondence: drpranjali.grover@gmail.com

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**Abstract: Purpose:** Human Balance is an intricate blend of body mass with the neural regulatory mechanisms. As bipedal posture evolved, the complex interplay between the physical dimensions and the neural regulations of balance became more defined. Humans are bipeds and locomote over the ground with one foot in contact (walking), no feet in contact (running), or both feet in contact (standing) creates a major challenge to our balance control system. The common denominator in the assessment of human balance and posture is the inverted pendulum model where foot and ankle play a key role in maintenance of antero- posterior balance. As the end organ, foot keeps the body upright and balanced. It supports body weight and is the first one to participate in the automatic balance reactions. As the evidence suggests, increased foot length is associated with greater balance ability in children and there is a positive correlation between foot width and balance. Hence this study was designed to establish a co-relation between foot length and foot width with balance abilities in children. **Relevance:** while assessing the balance, foot measurements are often neglected. As clinicians, when we design the balance protocol as a part of rehabilitation, we need to consider the anthropometric measurements of the foot. **Methods:** Cross sectional study **Participants:** 64 normal children were randomly selected from a semi-urban population aged between 6- 10 years. Analysis: Spearman's co-relation analysis. **Results:** There is weak co- relation between foot length and the balance scores using Bruininks-Oseretsky scale. There is poor co- relation between foot width and the balance scores using Bruininks-Oseretsky scale. **Conclusion:** There is a weak co-relation between the anthropometric data of the foot and balance scores using 'Bruininks-Oseretsky test for motor proficiency' in healthy children aged between 6-10 years. **Implications:** Inclusion of anthropometric measurements in the balance assessment of children.

**Keywords:** Balance, Children, foot length and foot width

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#### Introduction:

Balance is one of the important domains of functional assessments in all age groups. It is defined as the process of maintaining the center of gravity within the base of support<sup>1</sup> Maintaining posture is a constant challenge for the human body, as it requires rapid and accurate responses to unforeseen disturbances, particularly in unstable situations, which are needed to prevent falls and maintain balance. Awareness of the body's position in space is determined by the integration of the visual, vestibular and somatosensory systems<sup>1,2</sup>. One of the tasks related to postural control is the ability to maintain an upright, erect position (i.e. to maintain the projection of the center of gravity within a support base defined by the position of the feet)<sup>3,4</sup>. Body characteristics including foot anthropometry are said to influence boundaries of individual stability. Anthropometric foot data could therefore be an important consideration in evaluating balance and balance training protocols<sup>5</sup>.

The foot plays an essential role in human movement, as it is the only part of the body that provides contact with the supporting surface during weight bearing activities such as standing, walking, hopping, jumping, and running. It is responsible for absorbing shock, adapting to irregular surfaces, and generating momentum for forward propulsion during gait. Unfortunately, any changes to the foot posture may eventually impair its function and make it prone to injury during physical activities.<sup>6,7</sup> Bigger sized foot generally encloses larger Base of Support area and thus provides more flexibility for movements of Centre of Gravity and improves the balance performance.

Habib and Wescott, 2005, stated that increased foot length is associated with greater balance ability in children. There was a weak relationship of heel breadth with static balance. Menz et al. found that foot and ankle characteristics are independent individual predictors of balance and functional ability in older people.<sup>8,9</sup>

#### Methodology:

64 normal children aged between 6-10 years were

selected from a semi-urban population via random sampling. Written parent /guardian consent was taken. Demographic data was collected. The 'Bruininks-Oseretsky test for motor proficiency' was administered. BOTMP2 is a reliable and validated tool for assessment of motor proficiency in children. The balance subtest was administered as a part of the study. The point scores and the total scores were calculated.

**Materials:**

- \* Bruininks-Oseretsky test for motor proficiency
- \* Measuring tape
- \* Balance beam
- \* Stopwatch

**Statistical Analysis:** Statistical analysis was done using SPSS version 10. Spearman's rank correlation was used to evaluate correlation between foot length and foot width with balance abilities in children

**Results:**

There is no correlation of either foot length or foot width with balance scores using Bruininks-Oseretsky scale. The Spearman's rank correlation values and corresponding statistical significance between Foot anthropometry and Balance are summarised in Table 1.

**Table 1: Correlation between Foot Anthropometry and Balance**

Variable	r	P-value
Balance Vs Foot Length	-0.097	0.454
Balance Vs Foot Width	0.004	0.977

**Discussion:**

The underlying assumption of this study was that the anthropometric measurements of the foot have a positive relationship with the balance performance. However after the analysis of data it was revealed that there is no correlation between both the foot length and width with the balance scores on BOTS 2. The reasons for no correlation of balance could be as follows:

The factors effective in sustaining balance include sensory information gained by somato- sensory system, vestibular system, visual systems and motor responses that affect coordination, joint range of motion and strength. Other factors, such as age, sex, sport history, and different

neurophysiologic, mechanic and anthropometric factors, are also mentioned to be effective on balance. It is not possible to analyze and predict balance based on one single factor alone because maintaining balance involves a complex interaction of multiple intrinsic and extrinsic factors and several factors such as the muscles that are activated, the rate of muscular activity, activated muscles synergies, the types of strategies for keeping balance, vision, and proprioception are among the factors which are to be considered.<sup>1</sup>

The test items may not be culturally specific for the target population. As the Bruininks-Oseretsky test for motor proficiency is primarily designed for a Caucasian population depending on their activity and fitness levels. It does not take into account the fitness and activity levels of the Indian population. Age group excluded children in their puberty or pre- puberty. These age groups may see a rapid growth spurt which may influence the anthropometric measurements of the foot and balance at large.

A study 'Relationship between some anthropometric indices with dynamic and static balance in sedentary female college student' by Elahe Moein , Farzaneh movaseghi, 2016, suggests that there was no significant relationships were found between anthropometric features with static and dynamic balance, either with eyes open or with eyes closed apart from leg length and body mass index.

A study 'Relationship between anthropometric factors and body-balancing movements in postural balance' Pirjo Kejonen, Msc, PT, Kari Kauranen, Phd, PT, Heikki Vanharanta, MD, 2003, suggested body anthropometric characteristics have slight effects on the variations of body-balancing movements in a person standing on 2 legs with the eyes open.

A study 'The relationship of balance, foot posture and foot size in school of physical education and sports students, by Gonul Babyigit Irez, 2014, suggests a weak negative co-relation between foot posture variables and static balance and small negative co-relation between dynamic balance and foot length.

A study 'The influence of foot sizes on human balance' by Hai Qiu and Suping Xiong, 2013, suggests that most foot

size measures have significant correlations on mean sway velocity and balance strategy score, but no relationship with central equilibrium score.

**Conclusion:**

There is no significant correlation between the anthropometric data of the foot and balance scores using 'Bruininks-Oseretsky test for motor proficiency' in healthy children aged between 6-10 years

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