Original Article

Received on 26.11.2016, **Accepted on** 12.12.2016

Physiotherapy and Occupational Therapy Journal
Volume 9 Number 4, October - December 2016
DOI: http://dx.doi.org/10.21088/potj.0974.5777.9416.1

Does Body Composition Influence the Balance in Asymptomatic Individuals?: A Single Blinded Cross-Sectional Study

Ramu Khadka*, Vencita Priyanka Aranha, Vevita Priya Aranha***, Asir John Samuel****

Abstract

Aim: To establish the relationship between body composition and balance in asymptomatic individuals. *Study Design:* Cross sectional study. *Study Setting:* Tertiary care teaching hospital. *Method*: A Sample of 56 students comprising of 36 male and 20 female were recruited for the cross-sectional correctional study. All required anthropometric measures were recorded and BMI, waist-to-hip ratio (WHR) and percentage of body fat (PBF) were estimated from them. Their association with functional reach test (FRT) as balance measure was determined using Spearman's rank correlation coefficient. *Result:* There is no association of FRT with BMI (ρ=-0.13; p=0.36) and PBF (ρ=- 0.072,-0.13; p>0.05) while moderate to good degree of association with WHR (ρ=0.54; p<0.001). *Result:* Body composition does not have any influence over balance. Increasing central obesity component increases stability among asymptomatic individuals.

Keywords: Body Composition; Correlation; Cross-Sectional Study; Stability; Students.

Introduction

Balance is defined as an ability to maintain the line of gravity (vertical line from center of gravity) of a body within the base of support with minimal postural sway [1]. Sway is the horizontal movement of the center of gravity even when a person is standing still. A certain amount of sway is essential and inevitable due to small perturbations within the body (e.g., breathing, shifting body weight for one foot to the other or from forefoot to rear foot) or from external sources (e.g., air currents, floor vibration). An increase in sway is not necessarily an indicator of poorer balance so much as it is an indicator of decreased neuromuscular control [2]. In the case of an individual standing quietly upright, the limit of stability is defined as the amount of postural sway at which balance is lost and corrective action is required. Maintaining balance requires coordination of input from multiple sensory systems including the vestibular, somatosensory, and visual systems [3].

There always exists a controversy whether the body composition affects balance of the individual or not. Dutil M et al performed a study to find the impact of obesity on balance control in community dwelling older women. They showed that obesity clearly affects the postural control in older women and they concluded that obesity has a negative impact on the capacity of older women [3]. Osman et al reported that BMI has impact on postural control during both BLS and ULS [4]. Sarkar et al conducted a study to know the effects of obesity on the balance and gait parameters like step width and foor angle (degree of toe out) in young adults. Fifty subjects of both the genders were taken. 30 were taken as a control group (non-obese, BMI < 25) and 30 were taken as experimental group (obese, BMI>30). Functional reach test was used for balance testing and the footprint method was used for gait parameters measurements. They concluded that obesity has negative impact on balance of an individual [5].

Andrea et al reported that there were no differences on performance based balance measures among different weight groups [6]. Greve and Alonso concluded that high BMI requires more

Author Affiliation: *Alvas College of Physiotherapy and Research Center, Moodabidri -574227, Karnataka, India. **Department of Pediatric and Neonatal Physiotherapy, Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Maharishi Markandeshwar University, Mullana-133207, Haryana, India. ***Maharishi Markandeshwar Institute of Management, Maharishi Markandeshwar University, Mullana-133207, Haryana, India.

Reprint Request: Asir John Samuel, Assistant Professor, Department of Pediatric and Neonatal Physiotherapy, Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Maharishi Markandeshwar University, Mullana-133207, Haryana, India.
E-mail: asirjohnsamuel@mmumullana.org

displacements to maintain postural balance [7].

As far as to our knowledge, there is one literature demonstrating the relationship between balance and BMI in India. However, it was done in small sample size. Hence, we intend to do a study with proper sample estimated by sample size calculation and to explore further relationship between Body composition and balance among asymptomatic individuals.

Methodology

The study protocol was approved by the research and institution ethics committee. The study was done in accordance with the ethical guidelines of Helsinki declaration. A pilot study of 10 samples was done prior to the study to find out procedural difficulties. The data obtained was used for sample size estimation. A total of 56 students were selected for taking data of which 36 were male participants and 20 were female participants. A detailed explanation of the aim and objective of the study, and method of the study was given. All the queries of the participants were answered and consent was taken from them prior to the measurement of the required data.

The weights of the participants were taken from the weighing machine and height was taken from wall mounted stadiometer by using standard protocol. From height and weight, BMI of each participant was calculated by using the standard formula, BMI = Weight (in Kg)/ Height^2 (in meter^2)

The hip and waist circumference were measured by using measuring tape with participant in standing position with normal base of support. The procedure followed was in accordance with the guidelines given by ACSM. The waist circumference was taken from the narrowest waist level i.e. at the mid-point between the lowest rib and the top of the hip bone (iliac crest). The hip circumference was taken from the widest part of the buttocks. The waist girth was divided by the hip girth and the waist-hip ratio (WHR) was found out.

The static balance was measured using functional reach test as described by Duncan et al [8]. The participants were instructed to stand next to, but not touching, a wall and position the arm that is closer to the wall at 90 degrees of shoulder flexion with a closed fist. The starting position at the 3rd metacarpal head was recorded on the measuring tape mounted horizontally on the wall. The participants were instructed to "Reach as far as you can forward without taking a step". The final location of the 3rd metacarpal is recorded. Scores are determined by assessing the difference between the start and end position is the reach distance, measured in centimeters. Four trials are done and the average of the last three was noted. A 15 seconds rest break was allowed between the trials.

The skin fold measurement was taken by using Syndex® skin fold caliper, Figure 1. For male participants, 3 distinct points namely triceps skinfold, chest skinfold and subscapularis skinfold thickness were measured in relaxed position. For each skinfold point, 3 measurements were taken and only average of the three was entered in the data sheet. Similarly for females three skinfold thickness points were defined, namely triceps skinfold, abdominal skinfold, and supra iliac skinfold. The measurements were taken using standard methods prescribed by American College of Sports Medicine (ACSM). As with male participants, for female participants also 3 readings were taken for each skinfold point and average of three readings were entered in the data sheet.

From the obtained skin fold thickness Body Density was calculated by using the formulae:

For Males

Body Density = 1.1125025 - 0.0013125 × (Sum of thickness of three sites) + 0.0000055 × (Sum of thickness of three sites)^2 - 0.000244 × AGE

For Females

Body Density = 1.089733 - 0.0009245 × (Sum of thickness of three sites) + 0.00000025 × (Sum of thickness of three sites)^2 - 0.0000979 × AGE.

From the Body Density, the percentage of body fat (PBF) was calculated as, PBF = (457/BD) – 414.2

Data Analysis

The data were analyzed using the software, SPSS version 20. Gaussian distribution of the collected data was established using Kolmogorov-Smirnov test. The height and weight were found to be follow normal distribution hence they were expressed in terms of (mean ± SD). Since the other collected data didn't follow the normal distribution, they were expressed in terms of median (IQR) and non-parametric test was used for the statistical comparison. Demographic characteristics of the collected data were expressed as median and interquartile range. The relation between body composition and balance was compared using Spearman's rank correlation coefficient. To minimize the type I error, $P < 0.05$ was defined as significant.

Results

The demographic characteristic of the asymptotic individuals recruited are displayed in Table 1. Table 2 shows the correlation between the body composition and FRT. According to Portney and Watkin's Criteria [9], there exists negative, little or no significant relationship between BMI and PBF with FRT while moderate correlation between WHR and FRT.

Table 1: Demographic characteristics of the asymptotic individuals recruited

Demographic parameter	Mean/median N=56
Age (years)	22 (21,23)
Height (cm)	164.8 ± 9
Weight (kg)	60.9 ± 9
BMI (Kg/m^2)	22.3 (20.3, 23.9)
WHR	0.86 (0.78, 0.87)
PBF (%) male	10.1 (8.5, 12.7)
PBF (%) female	28.6 (23.8, 31.3)
FRT (cm)	29.2 (23.5, 33.0)

Abbreviations: BMI – Body Mass Index; WHR – Waist Hip Ratio; PBF – Percentage of body fat

Table 2: Correlation of functional reach test (FRT), balance test with the anthropometric parameters

Anthropometric Parameters	FRT (ρ)	p value
BMI	- 0.13	0.36
WHR	0.54	<0.001
PBF (male)	- 0.072	0.56
PBF (female)	- 0.13	0.31

Abbreviations: BMI – Body Mass Index; WHR – Waist Hip Ratio; PBF – Percentage of body fat

Discussion

The study revealed that body composition does not affect the balance of asymptomatic individual. In this study, it has been attempted to find out what is the exact influence of body composition on balance. This study hypothesized that balanced would be different among the individuals of different body composition.

The subjects taken in this study were within the normal BMI range except for 7 female subjects who were obese. When establishing the relationship between BMI and FRT, it was found that there is little negative or no correlation between BMI and FRT. The reason for this might be because that the maximum subjects in the study were within the normal BMI range.

PBF of both males and females were within normal range except for 8 female subjects in which they had just average or risk level of fat percentage. When the relationship between body fat percentage and the balance was established, there existed no relation between them (Portney and Watkin's Criteria) [9]. Hence the fact that body fat percentage doesn't have any influence over the balance is evident.

The comparison of the WHR (which represents the Central Obesity) with FRT showed moderate to good degree of relationship between them (according to Portney & Watkin's Criteria) [9].

The chief reason for this might be that when the central obesity increases, the center of gravity (COG) of the body tends to lower down thus giving more stability to the subjects and hence more positive influence over the balance.

Conclusion

Body composition does not have any influence over balance among the asymptomatic individuals.

Acknowledgment

The study was performed as part of an intern (Bachelor of Physiotherapy) project during December, 2012 to May, 2013 in Alvas college of Physiotherapy and Research Centre, Moodabidri - 574227, Dakshina Kannada District, Karnataka. Special thanks to, Dr. Joseph Oliver Raj, MPT, Principal, Alvas college of Physiotherapy and Research Centre, Moodabidri, for providing an opportunity in executing the study.

References

1. Shumway-Cook A, Anson D, Haller S. Postural sway biofeedback: its effect on reestablishing stance stability in hemiplegic patients. Arch Phys Med Rehabil. 1988; 69(6):395-400.
2. Davidson BS, Madigan ML, Nussbaum MA. Effects of lumbar extensor fatigue and fatigue rate on postural sway. Eur J Appl Physiol. 2004; 93(1-2):183-189. doi:10.1007/s00421-004-1195-1.
3. Dutil M, Handrigan GA, Corbeil P, et al. The impact of obesity on balance control in community-dwelling older women. Age (Dordr). 2013; 35(3):883-890. doi:10.1007/s11357-012-9386-x.
4. Ku PX, Abu Osman NA, Yusof A, Wan Abas WAB. Biomechanical evaluation of the relationship between postural control and body mass index. J Biomech. 2012; 45(9):1638-1642. doi:10.1016/j.jbiomech.2012.03.029.
5. Sarkar A, Singh M, Bansal N, Kapoor S. Effects of obesity on balance and gait alterations in young adults. Indian J Physiol Pharmacol. 2011; 55(3):227-233.
6. Hergenroeder AL, Wert DM, Hile ES, Studenski SA, Brach JS. Association of body mass index with self-report and performance-based measures of balance and mobility. Phys Ther. 2011; 91(8):1223-1234. doi:10.2522/ptj.20100214.
7. Greve J, Alonso A, Bordini ACPG, Camanho GL. Correlation between body mass index and postural balance. Clinics (Sao Paulo). 2007; 62(6):717-720.
8. Duncan PW, Weiner DK, Chandler J, Studenski S. Functional reach: a new clinical measure of balance. J Gerontol. 1990; 45(6):M192-7.
9. Portney LG, Watkins MP. Validity of measurements. In: Foundations of Clinical Research: Applications to Practice. 3rd ed. Philadelphia: FA Davis Company; 2015.p.97-115.