Correlation between waist circumference and dynamic balance in young male adults

Mahmoud S Aboraya[1], Doaa I Amin[1], Neveen A Abdel Raoof[1]

[1] Basic Science department, Faculty of Physical Therapy, Cairo University

Abstract

Background: A steadily increasing trend of obesity among young adults, especially college and university students, is becoming more evident. There is a relationship between the weight of individuals and their ability to balance. The fat tissue localization plays a major role in locating the center of mass (COM) hence has a great effect on postural balance. Studying the relation between waist circumference and balance would help to establish risk factors leading to decreased balance and increased risk of falling, helping physiotherapists to define the high risk population. **Methods:** 21 physical therapy students aged 18-25 years and their body mass index ranged from 30-34.99 kg/m^2 were recruited for this study. The dynamic postural balance was measured using Biodex balnce system with at stability level 4 and waist circumference was measured using stretch resistant tape. **Results:** Pearson`s correlation coefficient was calculated (at $\alpha = .05$) between waist circumference (WC) and the three stability indices. The correlation between (WC) and overall stability index (OSI) was .54 (p=.017) (significant with moderate strength), the correlation between between (WC) and anterioposterior stability index (APSI) was .52 (p=.02) (significant with moderate strength) and the correlation between between (WC) and mediolateral stability index (MLSI) was .5 (p=.03) (significant with moderate strength). **Conclusion:** It was concluded that there is a significant correlation of moderate strength between waist circumference and dynamic postural balance in young obese male adults.
Keywords: Dynamic postural balance, Waist circumference, Obesity

Introduction

Postural stability, or balance, is a general term used to describe the dynamic process through which the body is maintained in equilibrium. Equilibrium is either at rest (static equilibrium) or in steady-state motion (dynamic equilibrium)[1]

Balance is achieved when center of gravity (COG) or the body's center of mass (COM) is maintained over its base of support (BOS) [2] . whereas postural stability is achieved by the complex integration and coordination of multiple body systems including the vestibular, visual, auditory, motor, and higher level pre-motor systems[3].

According to the world health organization WHO, in 2014, more than 1.9 billion adults, 18 years and older, were overweight. Of these over 650 million were obese. Obese and overweight individuals have reduced functional abilities compared to normal weight individuals[4]. There are evidences to suggest that an increased body fat mass decreases postural stability[5].

What is important to note is that the obese population is not a homogenous one. The distribution of adipose tissue separates obesity into two types with different metabolic and health consequences; there is an android type, where the fat is localizing mostly in the upper part of the body, especially the abdomen and chest, and a gynoid type, where fat accumulates on the thighs and buttocks[6]. The purpose of this study was to investigate the correlation between waist circumference measured by measuring tape and the dynamic balance measured by Biodex stability system in young adults.

Subject and Methods

Study design

Observational, cross-sectional study.

Participants

A total of 21 physical therapy male students aged 18–25 years and their body mass index (BMI) ranged from 30:34.99 Kg/m^2 who were currently enrolled from Faculty of Physical Therapy, Cairo University, in the period from May 2018 to December 2018. Patients with history of lower extremity fractures, cerebral concussions, visual or vestibular disorders, surgery to the lower extremity were excluded from the study. The purpose and procedures of the study were fully explained to all subjects, and all subjects subsequently voluntarily agreed to enroll in the present study.

Measurements procedures

Each participant completed a practice session immediately prior to balance measurement. Following familiarization, three ten second trials, each separated by a 20 second rest period, were used to calculate the balance indices for each participant. The Biodex balance system set to a dynamic position of 4 out of 8. This level was chosen as it is in the middle of the available levels of platform restrictiveness. Testing was performed barefoot on the dominant lower extremity. All balance tests were completed with the participants' hands on their hips and with eyes open [7].

Waist circumference was measured at the midpoint between the lower margin of the least palpable rib and the top of the iliac crest, using a stretch- resistant tape. The subject stood with feet close together, arms at the side and body weight evenly distributed, wearing little clothing. The subject was asked to relax, and the measurements were taken at the end of a normal expiration [8]

Body weight was assessed in light clothing, without shoes, and recorded to the nearest 0.5 kg using a calibrated scale. Height was measured without shoes to the nearest 0.5cm using a calibrated height meter[9].

Data analysis

Measured data were analyzed and their mean values and standard deviation were calculated. Person correlation coefficient was calculated to determine relationship between waist circumference and (OSI, APSI and MLSI). All statistical significance levels were α level =0.05.

Results

Statistical analysis was conducted using Excel 2007 for windows. Descriptive statistics for the weight, height, waist circumference and BMI of the studied sample are presented in table (1).

Table (1) Descriptive statistics for the weight, height, waist circumference and BMI

Variable	Mean ± standard deviation
Weight (kg)	102.2 ± 9
Height (m)	1.76 ± .064
BMI (Kg/m^{2})	32.9 ± 1.7
Waist circumference (cm)	105.6 ± 8.6

Pearson`s correlation coefficient was used to determine the correlation among waist circumference and (overall stability index (OSI) – anterioposterior stability index (APSI) – mediolateral stability index (MLSI) as presented in table (2).

Table (2) Pearson's correlation coefficient between waist circumference and stability indices

	OSI	APSI	MLSI
Waist circumference	r= .54 p= .017	r= .52 p= .02	r= .5 p= .03

All stability indices showed significant correlation (at α= .05) with moderate strength.

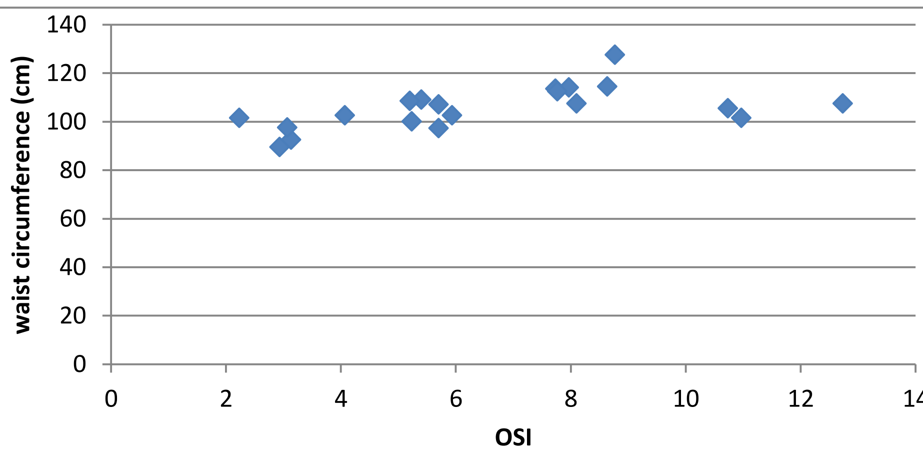

Fig 1. Scatter plot for OSI and waist circumference (cm)

The scatter plots for the correlation between WC and (OSI, APSI and MLSI) are presented in figures (1),(2) and (3) consecutively.

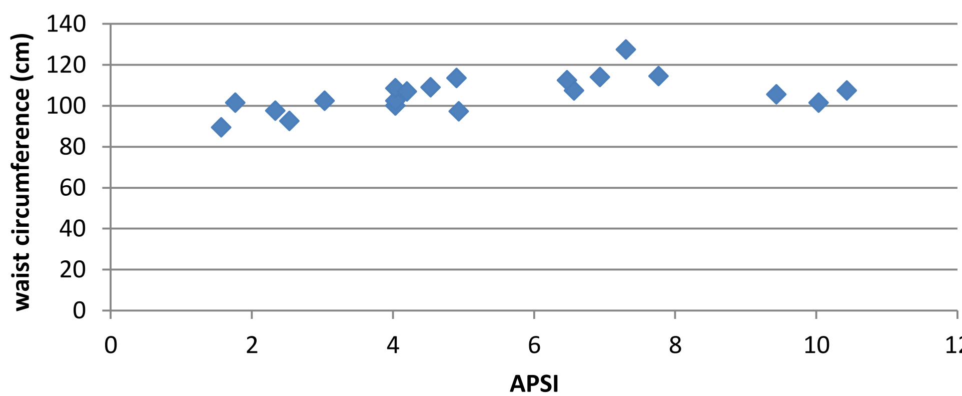

Fig 2. Scatter plot for APSI and waist circumference (cm)

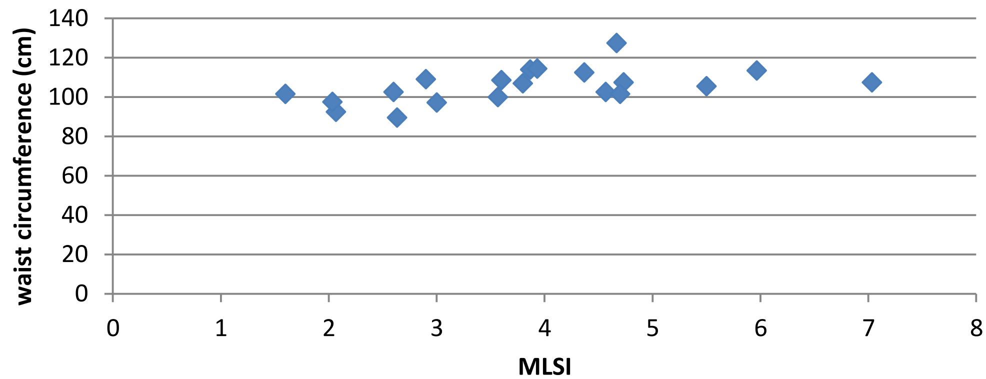

Fig 3. Scatter plot for MLSI and waist circumference (cm)

Discussion

The variables which were examined in this current study were waist circumference and dynamic postural balance indices (OSI, APSI and MLSI) measured by Biodex stability system. The results showed that there was a significant correlation of moderate strength .

The relationship between different patterns of fat tissue localization and postural balance was studied in post menopausal women and it was concluded that women with android fat distribution showed lower postural stability, whereas subjects with uniform fat distribution showed higher postural stability [10]. Also, the effect of different fat distribution was studied and it was found that there is difference in the stabilometric values between males and females and it was suggested that the discrepancy in the findings could be related to the adipose tissue mass distribution of gender, as the android type normally occurs in males and gynoid type in females [11].

The previously mentioned two studies are consistent with the findings of this study and the results could be explained as the fat tissue localization plays a major role in locating the center of mass (COM) hence has a great effect on postural balance. In order to demonstrate this concept the body is modeled as an inverted pendulum where the (COM) plays the weight at the end of the pendulum or (EOB) and the ankle plays the pivoting point where the (COM) swinging around. So when the (COM) is located higher as in abdominal obesity, it has a greater lever arm and it`s more challenging to be balanced over the ankle and the opposite occurs when the (COM) is brought lower to the ground as in gynoid obesity [12].

Another study that provides an explanation to our findings was done by [13] where a model of postural control was used to examine the impact of an abnormal distribution of body fat in the abdominal area upon postural stability. There was an increased torque needed to stabilize the simulation humanoid in obese models, especially when anterior position of the center of mass was included in the simulations. This suggests that, when submitted to daily postural stresses and perturbations, obese persons (particularly those with an abnormal distribution of body fat in the abdominal area) may be at higher risk of falling.

Conclusion

It was concluded that there is a significant correlation of moderate strength between waist circumference and dynamic postural balance in young obese male adults.

References

1. Azzeh FS, Kensara OA, Helal OF, El-Kafy EMA, Abd El-Kafy EM. Association of the body mass index with the overall stability index in young adult Saudi males. J Taibah Univ Med Sci. 2017;12(2):157–63.

2. Kisner C, Colby LA, Borstad J. Therapeutic exercise: foundations and techniques. 7th ed. Vasa. Fa Davis; 2017. 30-31 p.

3. Mancini M, Horak FB. The relevance of clinical balance assessment tools to differentiate

balance deficits. Eur J Phys Rehabil Med. 2010;46(2):239–48.

4. Vincent HK, Vincent KR, Lamb KM. Obesity and mobility disability in the older adult. Obes Rev. 2010;11(8):568–79.

5. Greve J, Alonso A, Bordini ACPG, Camanho GL. Correlation between body mass index and postural balance. Clinics (Sao Paulo). 2007;62(6):717–20.

6. Cieślińska-Świder J, Furmanek MP, Błaszczyk JW. The influence of adipose tissue location on postural control. J Biomech. 2017;60(October):162–9.

7. Douglas M, Bivens S, Pesterfield J, Clemson N, Castle W, Sole G, et al. Immediate effects of cryotherapy on static and dynamic balance. Int J Sports Phys Ther. 2013;8(1):9–14.

8. WHO. Waist Circumference and Waist-Hip Ratio: Report of a WHO Expert Consultation. World Heal Organ. 2008;(December):8–11.

9. Mciza Z, Goedecke JH, Steyn NP, Charlton K, Puoane T, Meltzer S, et al. Development and validation of instruments measuring body image and body weight dissatisfaction in South African mothers and their daughters. Public Health Nutr. 2005;8(5):509–19.

10. Hita-Contreras F, Martínez-Amat A, Lomas-Vega R, Álvarez P, Mendoza N, Romero-Franco N, et al. Relationship of body mass index and body fat distribution with postural balance and risk of falls in Spanish postmenopausal women. Menopause J North Am Menopause Soc. 2012;20(2):202–8.

11. 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):1638–42.

12. Loram ID, Kelly SM, Lakie M. Human balancing of an inverted pendulum: Is sway size controlled by ankle impedance? J Physiol. 2001;532(3):879–91.

13. Corbeil P, Simoneau M, Rancourt D, Tremblay A, Teasdale N. Increased risk for falling associated with obesity: mathematical modeling of postural control. IEEE Trans Neural Syst Rehabil Eng. 2001;9(2):126–36.