



Effect of Obesity on Balance Control in Adolescent Females

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Authors' contributions

This work was carried out in collaboration between all authors. Author ASG designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors EAE and AAA managed the literature searches and make editing. All authors read and approved the final manuscript.

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ABSTRACT

Background: Obesity may affect musculoskeletal, locomotor system and quality of life in adolescent females.

Aim: The study was conducted to detect the effect of obesity on balance control in adolescent females.

Methods: Cross section study, sixty adolescent females were selected from faculty of physical therapy, Kafr elsheikh University. Their ages ranged from 15 to 19 years old. Group A, 30 subjects with normal body weight, body mass index (BMI <25 kg/m²) and group B, 30 obese subjects BMI ranged from 30-40 kg/m². Balance measured by Biodex Balance System (measuring dynamic balance parameter; overall (OA), anterior-posterior (AP) and medial-lateral (ML) stability index scores).

Results: The mean scores of OA, AP and ML in group B were significantly higher in group B (P <.05) than group A.

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Conclusion: The study proved that adolescent obese females have poor balance control compared to non-obese group. We concluded that obesity has a negative impact on balance control of young adult obese female.

Keywords: Obesity; balance; adolescent females; Biodex.

1. INTRODUCTION

Obesity in different age stages has many risks on general health condition, because of increased incidence of chronic diseases as diabetes, cardiovascular disease, musculoskeletal system deficits and impairment of psychological condition which affect the quality of life [1].

In general females have many changes in their body along their life stages. In adolescent stage, the females have high incidence of overweight which is considered as predisposing factor for obesity complication [2,3] especially with environment technology changes and low physical activity [4,5].

One of serious complication of obesity is that, the condition affects on locomotor system. Overweight increase stress on bone, soft tissue and joints, which change the mechanics of the body [6,7] and abnormal distribution of weight which leads to impairment of female's locomotor system, increase incidence of falling and loss of interest in activity when compared with females in normal weight [8].

Balance is important component in normal physical movement, maintain standing position and in complicated activities needed for manipulative skills. It is very difficult to maintain standing position if center of gravity is not adequately felt within base of support [9,10].

The increase in body weight affects kinetic and kinematic components of the human movement, and also affect the posture, change the pattern of human bipedal movement (human gait pattern) and finally increase the incidence of falling in elder people [11,12].

Many studies detect the effect of obesity on balance in older people but there are less studies on adolescent females. The aim of this study is to detect the effect of obesity on the balance and postural control in adolescent females.

2. MATERIALS AND METHODS

A cross section study with cluster allocation was adopted. A total of 88 adolescent females

volunteers from the Physical Therapy Faculty, kafr elsheikh University ,Egypt, out of which 60 were recruited for this study. Fig. 1). The participant age ranged from 15 to 19 years old. The purpose and nature of the study were explained to all participants. The females participated in the study after signing an informed consent form before data collection. Recruitment began after approval of the Faculty of Physical Therapy Ethics Committee number P.T.REC/012/001653.

There were two groups in this study, group (A): normal weight group, their body mass index (BMI) not exceed 25 kg/m², and group (B): obese group, their BMI ranged from 30 to 40 kg/m².

Any musculoskeletal or neuromuscular disease or deformities, scoliosis, contracture or visual impairments were excluded from the study.

For each participant the height and weight were measured by Basic anthropometric parameters such as body weight, body height, BMI was calculated by dividing the subject's weight by the square of her height, expressed in metric units: Metric: BMI = kg/m², where kg is the subject's weight in kilograms and m is the subject's height in meters. According to Hills & Parker (10), BMI between 18.5-24.9 is considered as normal, BMI between 25-29.9 is considered as overweight and BMI 30 and above is considered as obese.

Sample size estimation: To avoid a type II error, a preliminary power analysis [power (1- α error P) = 0.9, α = 0.05, effect size = 1.63] determined a sample size of 10 for each group in this study. This effect size was calculated after a pilot study (n=10) considering OA stability as a primary outcome.

2.1 Procedures

All females attended a single testing session and were instructed concerning the ongoing tests before data acquisition.

Balance testing by using Biodex Balance System: which is balance screening and training tool (Inc, Shirley New York, USA). Biodex Balance System consists of movable balance

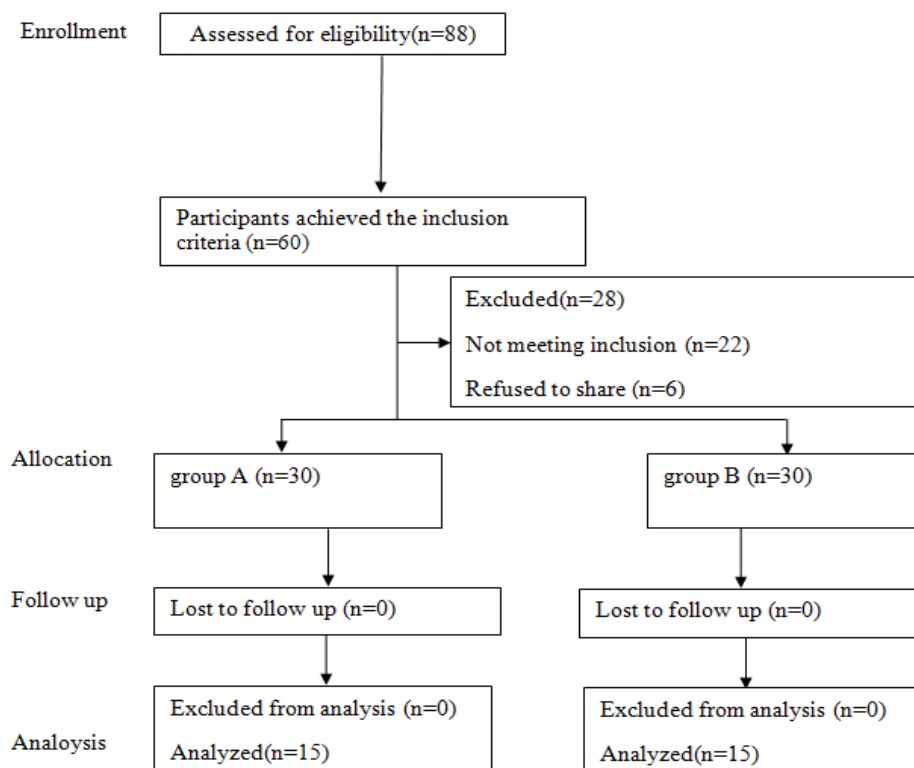


Fig. 1. Flow chart of the participants during the trial

platform, which provides up to 20 degrees of surface tilt in 360° range. Dynamic balance parameters (Anterior posterior (AP), Medio lateral (ML) and Overall (OA) stability indices) measured by the stability levels available in the system range from completely firm surface (Stability level-8) to very unstable surface (Stability level-10 [13]. Biodex proprioceptive protocol was used in standing position.

Each female was barefoot and instructed to focus on the visual feedback screen directly in front of her and attempt to maintain the cursor in the center of screen while standing on the unstable platform (stability level 6) which was chosen according to pilot study before.

2.2 Outcome Measurement

Dynamic balance parameters: anterior posterior (AP), Medio lateral (ML) and Overall (OA) stability indices.

2.3 Statistical Analysis

Unpaired t-test was applied to find out the level of significance of balance test between non-obese females and obese females.

The level of significance was set at P<0.05. BMI was correlated with balance test.

3. RESULTS

Basis characteristics of the participants are shown in Table 1. There were no statistically significant changes between the two groups at age and height (p>0.05), while there was significant difference between two group in BMI p<0.0001.

Table 1. Demographic characteristics of subjects

Items	Group A Means ± SD	Group B Means ± SD	P value
Age	18.04±1.33	17.84±1.24	0.587
Height	163.28±3.96	161.84±4.71	0.248
BMI	23.504±0.85	34.55±1.3	0,0001

As shown in Table 2, the mean values of stability indices for the normal female group (N) versus obese female group (O) at stability level six.

There were significant differences between group A and group B P<0.05 in overall stability, anteroposterior and mediolateral stability indices.

Table 2. Stability indices for the normal Female (N) group versus obese Female (O) group at stability level six

Stability index (SI) level six	$\bar{X} \pm SD$		P value
	Group A	Group B	
Overall stability index	2.57 ± 1.74	4.67±0.54	0.000
Anteroposterior stability index	1.26 ± 1.34	3.88±0.38	0.000
Mediolateral stability index	1.77 ± 1.36	3.65±0.64	0.00 0

4. DISCUSSION

Our study proved that the balance in the obese adolescent females was poorer than non- obese which indicated by elevated the mean values of stability indices measured by Biodex balance system at stability level six.

Adolescent stage is important time for skeletal growth in the spinal column, abnormal sitting and standing position in the school and prolonged time in watching television or play electronics games without physical activity may lead to changes in normal posture and increase the musculoskeletal pain [14].

The results of the study matches with Fjeldstad et al. [15], who reported that the incidence of falling , ambulatory stumbling and disturbance of balance are higher in obese than normal weight subjects. Also, Singh et al. [16], stated that abnormal body weight produce loss of postural stability and increase risk of falling, Greve et al. [17] demonstrated that increase BMI more than 30 kg/m² can lead to increase time of postural instability.

The results can be explained by Spyropoulos et al. [18] who stated that obese females are more prone to the risk of falls, the greatest effect of body weight on higher peak pressures in the obese was found under the longitudinal arch of the foot and under the metatarsal heads. The higher pressures for obese women compared to obese men during static weight bearing (standing) may be the result of reduced strength of the ligaments of the foot.

The results of our study is in line with Dutil et al. [19], who concluded that, over weight has negative effect to maintain balance as increased weight has an effect on proprioceptive information for posture control and increase risk of falling in elder females.

Fabris de Souza [20] observed that the increased width of base of support of obese individual was

due to their poor skeletal muscle performance and high metabolic expenditure.

Obesity affect the mechanics of daily functional activities due to the mass added to different body region and the changes in body geometry [21].

Increased the mass of the body in addition to increase the whole body weight will modify how the limbs and whole body create and react to forces [22]. Excess adiposity also interferes with the interaction of joints and muscles that are crucial to functional capacity and postural stability [23]. This modification is particularly consequential as an anterior displacement of the center of gravity significantly increases the magnitude of ankle moment required to stabilize the body in the erect stance. An anterior shift in whole body center of gravity also threatens stability by placing the line of gravity (LOG) closer to the body's base of support [24].

5. CONCLUSION

It can be concluded that the increase in body mass in adolescent females seems to produce disturbance in balance control.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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