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Comparison of Physical Fitness level among normal weight and Obese Female University students

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ABSTRACT

The first aim of this study was to examine and compare the physical fitness level among normal weight and obese female university students. The second aim was to investigate the influence of exercise training on some physical fitness factors between these students. Thirty sedentary female medical students from Medical Sciences University of Tehran assigned on two separate groups of normal weight (n=15, BMI=21.58±1.13) or obese (n=15, BMI=28.22 ±5.84).Anthropometric measurements included were: height, weight, age and Body Mass Index (BMI). Physical fitness tests (One mile run for determination of cardiovascular endurance, Bench and leg press for determination of upper and lower limb muscular strength, Sit-up and push-up for determination of abdomen and shoulder muscular endurance and sit and reach test for determination of flexibility. All physical fitness tests were assessed before and after exercise training program. Resting and training heart rate and blood pressure were assessed in pre and post test. Significant differences were found between the means for the obese and normal weight groups for body physical fitness tests (p < .05).There were not significant differences between the means for the obese and normal weight groups for resting and training heart rate and blood pressure (p < .05).In this study, the obese participants had more fat mass compared to the normal weight participants. High BMI had an adverse effect on common every-day functional tasks in female students. Compared to those that are normal weight, individuals with obesity had the greatest impairments in physical function and tended to less accurately depict physical function abilities.

Key Words: VO_2max, Obisity, Sedentary, Physical Activity

INTRODUCTION

The term “Obese” and “Overweight” are often used, interchangeably. Technically “Obesity” is the upper end of the “Overweight". The World Health Organization [24] defines “overweight” as a BMI equal to or more than 25, and “obesity” as a BMI equal to or more than 30. Obesity is increasing at an alarming rate throughout the world. It has now become a problem worth attention among both developed and developing countries. Obesity in all stages of life is thought to be the result of both genetic and environmental influences. Obesity is increasingly recognized as a public health epidemic and modifiable risk factor for coronary heart disease (CHD) [1, 2]. Among adult US women and men, nearly two thirds are overweight and more than one third are obese, and these proportions are rapidly increasing[1,3].There has been a substantial increase in the prevalence of obesity globally, even in developing countries [4].In the United States (US), it is estimated that over 65% of adults are overweight, defined as a body mass index (BMI) greater than 25.0 kg/m^2, with over 30% considered obese (BMI > 30 kg/m^2). Despite increased attention to this epidemic, the prevalence of obesity continues to rise [5, 6].It is generally believed that an interaction between what has been called a thrifty genotype and changing environmental exposures has led to the increase in obesity prevalence[7].However, establishing exactly which environmental factors that have caused the global increase in obesity is difficult to determine[8].Furthermore, the observed variations in body weight change from both negative[9] and positive energy balance,[10,12] demonstrates that genes plays a substantial part in determining weight gain, and that some individuals are more genetically susceptible than others. The negative impact of obesity on health includes an increased risk of several chronic diseases such as type 2 diabetes,[13] hypertension,[14] dyslipidaemia,[15] cardiovascular disease, [16] stroke, [17]Alzheimers disease and cancer.[18]Obesity is also associated with increased total mortality.[19]Moreover, obesity is associated with an increased risk of discrimination and bias in situations concerning education, employment and health care[20]Disabilities such as back pain, mental disorders, arthritis, and learning problems are also more common in the obese compared to normal weight[21,22]The obese also have a lower social activity compared to normal weight people[23].Up to now, three subtypes of obesity were known: the “at risk” obese with metabolic syndrome (MS), the metabolically healthy but obese individuals (MHO), and the metabolically-obese normal weight subjects (MONW)[25].The increase of obesity prevalence may be correlated with nutrition and lifestyle transition over the past two decades, including more animal foods, inactivity, and a more westernized lifestyle[26].Evidence indicates that weight loss is qualitatively more effective when obtained by physical activity rather than by diet only[27].On the other hand, aerobic exercise might be used to directly oxidize fat[28]. In this respect, circuit weight training (CWT), a type of resistive exercise characterized by working different muscle groups on each using a mixed metabolism, and low-intensity aerobic exercise such as jogging (JOG) are two types of exercise that can be used as coadjuvants for the treatment of obesity. Obesity has been shown to have a negative impact on physical function [29]. In cross-sectional studies, high BMI is associated with impaired functional mobility and decreased ability to perform activities of daily living. Mobility tasks most often affected include: walking, stair climbing, rising from a chair, activities at floor level, and balancing [30]. A BMI classification of overweight or obese usually increases the risk of developing cardiovascular and other diseases [32]. Longitudinal studies support the association between mobility limitation and obesity and have shown that excess weight is predictive of future disability [30]. Recent analysis of data from national surveys suggests the prevalence of obesity-related disability is on the rise which reinforces the need for strategies to address this public health concern [30]. According to Bray (2004) [33], a curvilinear relationship exists between body mass index and mortality ratio. So, as BMI increases, mortality ratio increases in a J-shaped curve. Exercise is very important in aiding weight loss, especially in obese populations. However, some forms of exercise such as walking, cycling, etc. may not be appropriate for those who are obese. This is because extra stress is placed on the joints due to the extra body weight an obese individual must move during physical activity. Often times, this extra demand and stress may lead to dropping out of walking programs and other physical activity programs. Mattson, Larsson, and Rossner (1997)[34 found that walking may be too much for an obese individual because they fatigue too quickly, have abnormal gait patterns, and increased discomfort due to increased friction in the lower extremities because of the prevalence of gluteal fat. Also, obese subjects used 57% of their VO2 max values while the non-obese used only 37% of their VO2 max at self-selected, comfortable speeds. If these side effects are too harsh, alternative forms of exercise for this population should be sought [34].Research supports the risk of mobility disability in adults that are overweight and obese. This is necessary so that exercise physiologists, physicians, and personal trainers can prescribe exercise training as a safe and effective way to lose weight in obese individuals who cannot tolerate the stress of other weight bearing forms of exercise. However, little is known about physical fitness level among normal weight and obese female university students. Furthermore, the influence of exercise training on some physical fitness factors between these students has not been explored.Therefore; the purpose of this study was to compare the physical fitness level among normal weight and obese female university students. In addition, the impact of exercise training on some physical fitness factors between these students was explored.

MATERIALS AND METHODS

Subjects

Subjects consisted of female medical students from Medical Sciences University of Tehran assigned from different states, during the spring semester (February–June) involvement in general physical fitness course. To ensure representation across the span of BMI levels, 15 normal weight (BMI between 20 and 24.9 kg/m^2) and 15 obese (between 25 and 29.9 kg/m^2) individuals were recruited. Since Physical fitness course was part of mandatory curricula for all physical activity classes, informed consent forms were not collected. The protocol was approved by the Ethics and Research Committee of university. Individuals were excluded from the study if they were on any medications used to control pregnant or breastfeeding, diabetes, and/or dyslipidemia, orthopedic condition that would significantly compromise physical function independent of obesity including the following conditions: acute musculoskeletal injury such as sprain or strain, rheumatoid arthritis, Paget’s disease, bone diseases, previous trauma/surgery leading to disability (i.e. fused joints, amputation) and acute low back pain. Smokers were also excluded from the study.

Anthropometric Measurements

We measured anthropometric parameters for all participants according to standard methods [35]. Subjects were instructed to take off their clothes and shoes before performing all the measurements. Body weight (kg) was measured to the nearest 0.1 kg, using a balance scale (Invernizzi, Rome, Italy). Height (m) was measured using stadiometer to the nearest 0.1 cm (Invernizzi, Rome, Italy). Two circumferences were measured (waist and hip) with a flexible steel metric tape to the nearest 0.5 cm. Body mass index (BMI) was calculated using the formula: BMI = (kg)/height (m2).

Physical fitness test protocols

The subjects were submitted to five physical fitness tests in order to determine their general physical fitness:

Sit and reach test
Flexibility was assessed using the MicroFit FAS-2 flexometer to measure lower back and hamstring flexibility. The participants sat on the floor, with their shoes off, their legs straight, and feet against the flexometer foot stop. Before the test the technician asked the participant: "Do you have a back injury or is there any other reason you should not try to touch your toes?" If the participant's answer was positive, the flexibility test was skipped. When participant reached forward and touched the flexometer for 3 seconds, a measurement was recorded in centimeters.

Upper and lower limb muscular Strength
One-repetition maximum (1-RM) is the maximum load one can lift once in a given exercise and was assessed according to a previously described protocol [36].1-RM bench press (triceps, shoulders and chest). 1-RM leg press (thighs and glutei).

Sit-up Test
The abdominal muscular strength and endurance of the abdominals and hip-flexors was assessed using sit-up test. To assure the starting position, the participant's lies on his/her back with knees flexed, feet on floor with the hands on the opposite shoulders. The feet were held by partners to keep them in touch with the testing surface. The student, by tightening his/her abdominal muscles, curls to the sitting position. Arm contact with the chest must be maintained. The chin should remain tucked on the chest. The sit-ups were completed when the elbows touch the thighs. To complete the sit-up the participants returns to the down position until the midback makes contact with the testing surface. When the timer gives the signal "ready go", the sit-up performance were started and the performance was stopped on the command "stop". The number of correctly executed sit-ups performed in 60 seconds was the score.

One-Mile Run Test
Subjects were begun on the signal "Ready, Start." As they cross the finish line, elapsed time was called to the participants (or their partners). It is possible to test 15 to 20 students at one time by dividing the group. Have each subjects select a partner; one is the runner and one is the scorer. While one group runs, partners count laps and record the finish time.The one-mile run was scored in minutes and seconds. A score of 99 minutes and 99 seconds indicates that the subjects could not finish the distance. Even with practice, it is difficult to ensure that young subjects were paced themselves appropriately and give a maximal effort. The object of the test for these students was simply to complete the 1-mile distance at a comfortable pace and to practice pacing.

Push-up Test
Resistance test was performed with the subjects lying in ventral decubitus and the hands resting on the floor at a width slightly greater (5 cm) than the shoulder width. The subjects were instructed to place the knees at an angle of more than 90o, thus avoiding ante- or retroversion of the hip and increasing lordosis, and consequently keeping the spine aligned. The breast had to touch the ground during each movement and the arms were supposed to be fully extended. In both resistance tests, the subject had to perform the largest number of repetitions possible over a period of one minute or until the occurrence of muscle fatigue.

Resting blood pressure
Resting blood pressure was measured using a mercury manometer. Each subject was asked to sit in a chair with both feet on the floor for approximately five minutes of rest. A blood pressure cuff was

attached to the upper arm at the level of the heart aligned at the brachial artery. An appropriate cuff size was used to ensure accurate measurement. The stethoscope bell was placed in the antecubital space over the brachial artery. The pressure was slowly released at 2 to 5 mm Hg per second. Systolic blood pressure is the point at which the first of two or more Korotkoff sounds is heard and diastolic blood pressure is the point before the disappearance of Korotkoff sounds (ACSM, 2010, p. 46). Blood pressure was measured prior to the start of the exercise test and after the exercise test during passive recovery.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS; version 17.0) was used for the data analysis. Two-tailed, independent t-tests were used to compare differences for the anthropometric measures (e.g. height, weight, BMI Independent variables) between the obese and normal weight (independent variables) groups. Two-tailed, independent t-tests were used to compare differences in physical fitness in pre and post tests between the obese and normal weight groups. Statistical significance was accepted at the $p < 0.05$ level of confidence.

RESULTS

There were significant increase between the means for the obese and normal weight groups for body physical fitness tests ($p < .05$).There were significant intergroup differences for the normal weight group for aerobic power, resting and training heart rate but, there were not significant intergroup differences for the normal weight group for resting and training blood pressure in this group ($p < .05$).There were also significantly increase for abdominal muscular strength and endurance,upper and lower limb muscular Strength and flexibility for both groups ($p < .05$).Significant differences were found between the means for the obese group for aerobic power, resting and training heart rate and resting blood pressure but, there were not found significant differences for training blood pressure ($p < .05$).Significant differences were not found between the means for the obese and normal weight group**s** for BMI and weight after training program ($p < .05$).The normal weight group means for all of these dependent variables were significantly greater than the obese group.

DISCUSSION

The purpose of this study was to compare the physical fitness level among normal weight and obese female university students. The second aim was to investigate the influence of exercise training on some physical fitness factors between these students. It was hypothesized (null) that there would be no differences in physical fitness tests in obese versus normal weight group. Second, it was hypothesized that selected physical fitness tests would be greater in normal weight group compared to obese student after exercise training program.

In this investigation, the obese and normal weight groups were significantly different ($p<.05$) for physical fitness and physiological characteristics specifically, the two groups differed in body weight and BMI. The obese students had a significantly greater body weight compared to the normal weight, but the obese individuals did not have a greater aerobic power ($ml.kg^{-1}.min^{-1}$) compared to the normal weight. The obese subjects also had a significantly greater FFM compared to the normal weight. These results contradict the findings of Balady et al. [37] who compared both men and women (20 to 29 years) during an arm ergometry test and found that men had a greater mean body weight, achieved a greater peak oxygen consumption (20.7±3.9 versus 15.5±3.1 ml.kg-1.min-1) and had a greater power output (103±34 versus 58±18 W) compared to the women.

The results of this study are consistent with prior research showing lower levels of physical function in individuals approaching a BMI of 30 kg/m^2 [38]. Coakley et al[38] found a significant dose-response relationship between increasing levels of BMI and lower levels of self-reported physical function. In women 45-71 years of age, function decreased by approximately 5.5% among the moderately overweight (BMI 28 - 29.9 kg/m^2) compared to those of normal weight. Similar to findings of the current study, significantly lower levels of function were noted in women at higher levels of obesity. For example, those with a BMI > 30 kg/m^2 experienced a 10% decrease in function and those with a BMI > 35 kg/m^2 had 14-16% lower functioning compared to the normal weight reference group. These findings are supported by Marsh et al.[40] who reported that physical self-concept and ideal body image were somewhat higher in obese and non-obese teenagers. Similarly, the study by Sabia [41] supported the present findings that no significant difference could be found in the proportions of the obese and non-obese teenagers for various levels of self-concept with reference to educational dimension of self concept. It is also reporting higher paternal concern about child overweight was associated with lower perceived physical ability among girls, higher maternal concern about child overweight was associated with lower perceived physical and cognitive ability among girls. Since in the present study weight status was not found to influence the self-concept negatively, it could be assumed that there is no discrimination against on the basis of weight in the setting of the present study and hence the associated stigmatization is non-existent [42].

In our study, we were unable to find significant differences between the means for the obese and normal weight group**s** for BMI and weight after exercise training program ($p < .05$).In contrary of results of our study, Mattson, Larsson, and Rossner [43] found that walking may be too much for an obese individual because they fatigue too quickly, have abnormal gait patterns, and increased discomfort due to increased friction in the lower extremities because of the prevalence of gluteal fat. Also, obese subjects used 57% of their VO2 max values while the non-obese used only 37% of their VO2 max at self-selected, comfortable speeds. If these side effects are too harsh, alternative forms of exercise for this population should be sought [43].

The finding that individuals with obesity less accurately perceived their functional ability may be reflective of an increased effort to perform functional tasks in obese compared to those of normal weight. Individuals with obesity have been shown to expend more energy during walking than non-obese [44]. Hills and colleagues observed that obese individuals' heart rates averaged 70% of predicted maximal levels for self-selected walking speeds compared to 58% in those that were normal weight [45]. In addition, previous researchers have reported that obesity increases perceived exertion during walking [46]. In this study, obese subjects may have reported lower levels of physical fitness than they were capable due to increased effort and perceived exertion required to complete the task. Researchers have found that individuals with special conditions such as cardiovascular diseases, paraplegia, and spinal cord injuries can perform exercise on an arm ergometer to help improve their cardiovascular function and overall health. However, there is a lack of research comparing the physiological differences in an obese and non-obese population. It is important to understand the responses in this population so that appropriate exercise prescriptions can be developed. There are many differences in obese and non-obese individuals during leg cycling exercises as well as reported by Lafortuna, Proietti, Agosi, and Sartorio [47].They compared the differences in obese versus non-obese females during submaximal leg cycling exercise. For the study, there were nine obese females (23.2 years±1.6, BMI=40.4±1.2kg.min^2, fat mass=50.9±1.4%) and nine females of healthy weight (25.6 years ± 1.8, BMI 21.7 ±0.6kg.min^2, fat mass=26.5±1.8%). The protocol for this study consisted of a graded cycle ergometer test working at 40, 60, 80, 100, and 120 W with each stage lasting for four minutes and at a rate of 65 RPM.This study presents strong findings for the association of obesity and physical fitness and inactivity. However, this study is limited by its small sample size and is not representative of female students as a whole. Important directions for future research include measures of energy expenditure and attention to familial patterns of diet and physical activity. This study did not take into account other lifestyle factors that may have influenced physical function such as current or former smoking, unhealthy diet, and alcohol use, all of which may have confounded the results. Future studies should consider controlling for lifestyle factors which have been shown to influence risk of functional limitation. These findings reinforce the need for a comprehensive set of measures to accurately describe physical function in this population.Inconclusion, Compared to those that are normal weight, individuals with obesity had the greatest impairments in physical function and tended to less accurately depict physical function abilities.

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