Research Article

Effect of six-minute walk test in obesity

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ABSTRACT

Background: 6-min walk test is a very useful, reliable, safe, and easy to administer assessment tool for the functional capacity of overweight and obese individuals. **Objectives:** Aim of study to see the effect of increased body weight on 6-minute walk distance (MWD) in overweight and obese individuals and compare with normal subjects of the same age group (20–60 years). Work of walking and VO_{2max} were also calculated and compared between the groups to assess the aerobic fitness of the subjects. **Materials and Methods:** 6-min walk test was performed in 60 overweight and obese subjects in the age group of 20–60 years and 30 normal age-matched subjects taken as controls. Statistical analysis was done using SPSS Software Version 17. Data were analyzed with unpaired *t*-test and one-way analysis of variance; $P < 0.05$ was taken as significant. **Results:** The 6 MWD covered by obese Class I (543.7 ± 48.30 mts) and obese Class II (504.67 ± 42.23 mts) was significantly lower ($P < 0.001$) than control group (617.13 ± 48.28 mts). The difference in distance covered by obese Group I and Group II was also significant ($P < 0.001$). The anthropometric parameters such as weight, body mass index (BMI), and waist-hip ratio were found highest in the obese Class II, and the intergroup difference was significant. **Conclusion:** This study shows that increase in BMI reduces the functional capacity and aerobic fitness of an individual.

KEY WORDS: 6 Minute Walk Test; Obesity; Body Mass Index, Physical Fitness

INTRODUCTION

Obesity, as defined by the World Health Organisation (WHO), is a medical condition in which excess body fat accumulates to produce negative effects on health which ultimately leads to increased morbidity and reduced life expectancy.[1] Obesity predisposes an individual to various diseases such as diabetes, obstructive sleep apnea, cancers of colon, breast, endometrium, coronary artery disease at an earlier age, non-alcoholic steatohepatitis, menstrual irregularities, and infertility.[2] Once restricted to high-income countries, obesity is now also prevalent in low- and middle-income countries where its incidence is constantly increasing. Recent data from the WHO[3] show more than 1.9 billion adults, 18 years and older, are overweight. Of these over 650 million are obese. In 2016, 39% of adults 18 years and over (39% of men and 40% of women) were overweight. Overall about 13% of the world's adult population (11% of men and 15% of women) are obese. Obesity is defined by body mass index (BMI) calculated as kilograms per square meters. WHO defines BMI >30 as obese.

Overweight: BMI ≥25.00, pre-obese: BMI is 25.00–29.99, Class I obese: BMI is 30.00–34.99, Class II obese: BMI is 35.00–39.99, and Class III obese when BMI ≥40.00.[4]

As Asian populations develop negative health consequences at a lower BMI than Caucasians due to genetic predisposition, some countries have developed their own criterion of obesity. China uses a BMI of >28 kg/m^2 for obesity[5] whereas in Japan BMI >25 kg/m^2 is obese.[6] Physical fitness is a very useful health marker of functional status of our cardiovascular,

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respiratory, neuroendocrine, musculoskeletal, and circulatory system.[7] It is used to see the association between body composition and its relation to morbidity and mortality.[8] Indians are fast becoming overweight and obese in the last couple of years.[9] In this study, physical fitness in obese subjects was assessed by means of 6-min walk test according to the guidelines of the American Thoracic Society. The 6-min walk test (MWT) is safer, easier to administer, better tolerated, and better reflects activities of daily living than other walk tests.[10]

MATERIALS AND METHODS

The present study was conducted in the Department of Physiology, National Institute of Medical Sciences (NIMS), Medical College and Hospital, Jaipur, Rajasthan, from June 2015 to March 2016. Ethical clearance was taken from the Ethical Committee of NIMS Medical College and Hospital, Jaipur, Rajasthan. 60 overweight and obese cases and 30 age and BMI matched normal healthy male and female aged 20–60 years were selected. They were classified as normal, overweight and obese according to the WHO Guidelines of BMI.

Exclusion Criteria

Cases with the previous history of cardiovascular disease, diabetes mellitus, osteoarthritis, hypertension, asthma were excluded from the study.

They were asked to report to the department in the morning between 9:00 am and 10:00 am preferably without heavy meals and a good sleep. The following parameters were assessed at the time of entry (pre-test). Weight-recorded to nearest 0.5 kg using a standard scale. Height - measured to nearest 0.1 cm without footwear by stadiometer in Frankfurt position. BMI was calculated by Quetelet's index (weight in kilogram divided by height in metre square). Waist circumference (WC) - measured with minimal adequate clothing (light clothes) by the tailor's measuring tape in a plane perpendicular to the long axis body at the level of umbilicus without compression of skin during inspiration. Hip circumference (HC) - measured with minimal adequate clothing (light clothes) across the greater trochanter with legs and feet together by a measuring tape without compressing the skin fold. Waist-hip ratio (WHR) - it is the ratio of WC and HC in cm and is the measure of central pattern of fat distribution. 6 MWT - a measured corridor course was used for walking with subjects instructed to walk from one end to other at their own pace attempting to cover as much distance as possible in the allotted 6 min. The walk was timed, and distance travelled in 6 min recorded in meters. Location - a long, flat, straight, enclosed 30 m (100 ft) college corridor marked by cones were used. The length of the corridor was marked every 3 m by a color tape. Total distance walked was final measurement. The subject was rested for about 10 min in a chair, located near the starting position, before the test. During this time anthropometric parameters of the subject and the blood pressure were taken. As soon as the subject starts to walk, the timer is set. Number of laps was counted each time the subject returns to the starting point. Additional distance covered was also recorded. VO_{2max} was calculated as follows: Work done in 1 min = distance travelled in 6 min X mass (weight) divided by 6. Work done in Kcal/min = value obtained × 0.00024. Work done in Kcal/min converted to l/min by dividing by 5 (let it be x), then VO2 max (ml/kg/min) = {x.1000/ body weight(kg)}. Post-test 6-min walk distance (MWD) covered, walk work and VO_{2max} was calculated.

Statistical analysis was done using following tests: It was done using Statistical Package for the Social Sciences Version 17.0 (SPSS) software. Unpaired *t*-test and one-way analysis of variance were used and applied for the obtained data and $P < 0.05$ is taken as significant.

RESULTS

Table 1 summarizes mean age was 40.3 ± 9.07 years, mean weight was 59.43 ± 6.52 kg, mean height was 166.4 ± 5.56 cm, mean BMI was 21.23 ± 1.79 kg/m^2, and mean WHR was 0.826 ± 0.046 cm.

Table 2 summarizes mean age was 38.7 ± 9.15 years, mean weight was 82.73 ± 5.05 kg, mean height was 161.3 ± 4.49 cm, mean BMI was 31.75 ± 1.12 kg/m^2, and mean WHR was 0.96 ± 0.059 cm.

Table 3 summarizes mean age was 38.26 ± 8.10 years, mean weight was 92.16 ± 6.06 kg, mean height was 157.8 ± 5.45 cm, mean BMI was 36.94 ± 1.21 kg/m^2, and mean WHR was 0.958 ± 0.056 cm.

Table 4 the demographic parameters such as weight, BMI, and WHR were found highest in the obese Class II group as compared to obese Class I and control group, and this difference between the groups was statistically highly significant (<0.001).

Table 5 the distance covered by the normal (control) group was significantly higher than the obese Class I and obese Class II ($P < 0.001$). Similarly, a greater distance was covered by obese Class I compared with obese Class II, and this difference between the two groups was statistically significant ($P < 0.001$). This infers that an increase in BMI reduces the ability to cover the distance in an allotted time.

The total amount of work done in walking 6 min by the obese Class II group was significantly higher than the obese Class I and normal (control) group ($P < 0.001$). Similarly, a greater amount of work was done by obese Class II group when

Table 1: Demographic and anthropometric parameters of control Group I (*n*=30)

Parameter	Mean	Range	SD
Age (year)	40.3	23–60	9.07
Weight (kg)	59.43	48–68	6.52
Height (cm)	166 0.4	155–179	5.56
BMI (kg/m^2)	21.23	17.86–24.65	1.79
WHR	0.826	0.75–0.89	0.046

BMI: Body mass index, WHR: Waist-hip ratio, SD: Standard deviation

Table 2: Demographic and anthropometric parameters among Obese 1 Group II (*n*=30)

Parameter	Mean	Range	SD
Age (year)	38.7	20–56	9.15
Weight (kg)	82.73	74–92	5.05
Height (cm)	161.3	152–168	4.49
BMI (kg/m^2)	31.75	30.11–34.07	1.12
WHR	0.96	0.84–1.05	0.059

BMI: Body mass index, WHR: Waist-hip ratio, SD: Standard deviation

Table 3: Demographic and anthropometric parameters among Obese 2 Group III (*n*=30)

Parameter	Mean	Range	SD
Age (year)	38.26	27–56	8.10
Weight (kg)	92.16	75–101	6.06
Height (cm)	157.8	141–167	5.45
BMI (kg/m^2)	36.94	35.15–39	1.21
WHR	0.958	0.84–1.04	0.056

BMI: Body mass index, WHR: Waist-hip ratio, SD: Standard deviation

Table 4: Comparative demographic and anthropometric parameters among control, Obese 1 and Obese 2

Parameter	Group I (control)	Group II (Obese 1)	Group III (Obese 2)	*P* value
Age (year)	40.3±9.07	38.7±9.15	38.26±8.10	0.64
Weight (kg)	59.43±6.52	82.73±5.05	92.16±6.06	<0.001
Height (cm)	166.4±5.56	161.3±4.49	157.8±5.45	<0.001
BMI (kg/m^2)	21.23±1.79	31.75±1.12	36.94±1.21	<0.001
WHR	0.826±0.046	0.96±0.059	0.958±0.056	<0.001

Data presented as mean±SD. BMI: Body mass index, WHR: Waist-hip ratio, SD: Standard deviation

compared with control group, and this difference between the two groups was statistically significant ($P < 0.001$). This shows that amount of work done increases with increase in BMI.

Mean peak VO_2 consumption during the test was significantly higher in normal (control) group than the obese Class I and obese Class II group ($P < 0.001$). A similar statistically significant reduction in obese Class II group was observed when mean peak VO_2 consumption was compared between obese Class II and obese Class I group ($P < 0.001$). This result shows that ability to utilize oxygen by the cell reduces with the rise in BMI.

Table 5: Comparative exercise capacity parameters among control, Obese 1 and Obese 2

Parameter	Group I (control)	Group II (Obese 1)	Group III (Obese 2)	*P* value
Mean 6 MWT distance (m)	617.13±48.28	543.7±48.30	504.67±42.23	<0.0001
Work done (Kcal/min)	13.96±1.65	17.27±2.04	17.84±1.78	<0.0001
Mean peak VO_2 (ml/kg/min)	47.31±3.70	41.68±3.70	38.69±3.23	<0.0001

Data presented as mean±SD. MWT: Minute walk test, SD: Standard deviation

DISCUSSION

6 MWT and lipid profile are frequently used to assess the severity of obesity and level of physical fitness, which are less expensive and easy to perform. In this study, we evaluated the exercise capacity in different groups of obesity and compared it with healthy controls. In the present study, there was a decrease in 6 MWD in obese compared to controls, and this decrease in walk distance was statistically significant. Furthermore, obesity leads to increase in walk work while decreasing the maximal aerobic capacity as measured by VO_{2max}.

Similar results as ours were seen in study conducted by Ramanathan and Chandrasekaran[11] where the 6 MWD correlated significantly ($P < 0.05$) with age, height, and BMI. The negative influence of advancing age on the 6 MWD might be explained by the gradual reduction in muscle mass, muscle strength, and maximal oxygen uptake that typically occurs with aging. Similar findings were observed in another study conducted by Enright, and at levels of significance, the correlation was moderately weak one.[12] On the other hand, the results were not similar to ours in a study conducted by Vinchhi *et al*[13] where the positive and non-significant correlation of BMI was seen with 6 MWD. In another study conducted in children, the 6 MWD and body weight were related in a linear fashion only up to 30 kg of weight after which it became horizontal.[14] In this study, a significant decrease in VO_{2max} was also observed in obese compared to controls. Similar results were found in other studies done by Shah et al,[15] Chatterjee et al[16] and Patkar et al.[17] In another study, it was concluded that VO_{2max} by 6 MWT helps in guiding therapeutic interventions in seriously ill patients through the values might not be very accurate.[10] In another study conducted in North Karnataka on young adolescents, the results were different from ours where the correlation between VO_{2max} and BMI was not significant.[18]

The greatest advantage with our study was the simple set up for 6 MWT which was very convenient for the subjects. Limitations of the study are small sample size, and further exploration on the studied parameters is warranted in future. Furthermore, the influence of gender was not taken into account which should be included in future studies.

CONCLUSION

Our study shows that increase in BMI leads to decrease in 6 MWD covered or there occurs less exercise performing capability with increasing body weight. This decrease is due to increase in work of breathing and decreased respiratory compliance leading to further complications. Physiological cost of walking is directly associated with weight, BMI, 6 MWD in overweight individuals.

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