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Assessment of Pulmonary Functions after Six Minutes Walk Test In Obese Young Individuals

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Abstract:
Background*: Rapidly changing diets and lifestyles are fueling the global obesity epidemic.*
Although physical activity and exercise are considered to be of paramount importance for prevention and treatment of obesity, many obese adults are not able to participate in regular physical activity due to dyspnea on exertion. The present study was planned to assess the effect of sub maximal exercise on pulmonary functions in obese young individuals.
Aim: *To assess the pulmonary functions after six minutes walk test in young obese individuals.*
Methodology: *This cross sectional study was conducted among 60 healthy volunteers (obese-30, normal -30) in the age group of 18-35 years in Chennai. Both the study groups had 15 males and 15 females each. After measuring anthropometric parameters, base line cardiovascular parameters (heart rate and blood pressure) and pulmonary functions of the subjects were recorded. Then subjects were asked to perform Six Minutes Walk Test (6MWT) according to the guidelines given by American Thoracic Society. Post test cardiovascular and pulmonary functions were recorded. The post exercise dyspnoea score and fatigue levels were calculated using Borg's scale. The analysis was done using independent 't' test. P value < 0.05 was taken as significant.*
Results: *Baseline and post exercise pulmonary functions were reduced in obese subjects compared to subjects with normal BMI. There was higher dyspnoea score and fatigue levels in obese individuals after 6MWT compared to normal subjects.*
Conclusion: *The decrease in pulmonary functions after exercise, implies that there is decreased respiratory reserve and exercise tolerance in obese individuals compared to normal subjects.*

I. Introduction

Obesity stems from a modern environment that promotes excessive food intake and discourages physical activity [(1)], both resulting as a consequence of increased urbanization and industrialization and disappearance of traditional lifestyles. The prevalence of obesity has reached epidemic proportions in south India, second highest being in Tamil Nadu (24.4%) [(2)]

Obese individuals have reduction in total respiratory system compliance due to accumulation fat in rib cage, lungs and diaphragm which gives rise to increased work of breathing during exercise. [(3)(4)(5)].Apart from the cardiopulmonary effects of obesity, reduced muscle mass, joint pain and skin friction are also important factors which decrease exercise capacity, in overweight and obese individuals [(6)].

The Six minutes walk test (6MWT) is a standardized, safe, inexpensive, and the most relevant walk test that reflects physical activity of daily living as well as cardiopulmonary fitness[(8)]. Moreover, the validity and reproducibility of the 6MWT in obese adults (23) and children(24) has been established by previous studies.

Numerous cross-sectional studies have shown an association between leisure time physical activity and obesity [(7).] The demand for clinical assessment tools to evaluate exercise capacity in people who are overweight and obese are also increasing. So, the present study was planned to evaluate the effect of sub maximal exercise on pulmonary functions in young obese individuals.

II. Materials And Methods

This cross sectional study was carried out in 60 subjects (30 obese and 30 normal) from Chennai city who were in the age group of 18 to 35 yrs. Both the study groups had 15 males and 15 females each. The study population was categorized into normal and obese based on the current lower cut-off points for BMI recommended by WHO for Asian population. (WHO 2007). The BMI of normal subjects is between 18.00-22.99 Kg/m2 and obese is >30 Kg/m2. Subjects with H/o any acute illness three weeks prior to the time of study, systemic disorders, h/o asthma, allergies, past h/o tuberculosis, wheeze, smoking, pregnancy, physically active individuals on exercise program, people on diet restriction were excluded. Ethical clearance was obtained from institutional ethical committee and informed written consent was also obtained from all the study subjects.

Initially anthropometric indices like height, weight, BMI, and Waist-hip ratio were measured. All the study subjects underwent a detailed respiratory system clinical examination. Then baseline cardiovascular parameters like heart rate and blood pressure were evaluated manually. Baseline Dyspnoea scoring and fatigue levels were measured by Borg's scale[8]. Resting pulmonary function was assessed using standard Spirometer. Then the subjects were asked to perfor m the 6 minute walk test (6MWT) following the guidelines given by American Thoracic Society (ATS). Then post 6MWT assessment of cardiovascular parameters, pulmonary functions was also done. Post test dyspnoea scoring and fatigue levels were measured by Borg's scale[8].

Statistical Analysis:

Statistical analysis was done by SPSS 11.1 software. Data is represented as Mean ±SD.. Comparison test of significance used was independent "t' test. The level of significance was taken at 5% level.

III. Result

The descriptive parameters of the study population are given in table 1. The study subjects were assigned into two groups normal (30) and obese (30) based on their BMI. Both the study groups had equal number(15) of male and female participants.

Table 1: Descriptive parameters of the study population.

DESCRIPTIVES	**Normal(n=30) (BMI 18-22.99 kg/m^2)**		**Obese(n=30) (BMI <30 kg/m^2)**	
	Males (n=15)	**Females (n=15)**	**Males (n=15)**	**Females (n=15)**
AGE(yrs)	21±3	22±3	23±5	21±3
HEIGHT(cm)	169±8.38	158±3.9	171±6.69	157±3.47
WEIGHT(kg)	63.86±7	54.53±3	98.26±16*	85.46±10*
BMI(kg/m^2)	21.89±1	21.6±1.21	33.4±4.3 *	33.8±3.1*
HR(/min)	72±9	69±9	75±12	81±10
SBP(mmHg)	115±5	115±6	122±8	118±7
DBP(mmHg)	75±5	77±4	81±5	80±5

BMI- Body mass index; HR- Heart Rate; SBP-Systolic Blood Pressure; DBP- Diastolic Blood Pressure; Data expressed as Mean ±SD; *statistically significant (P<0.05).Height was not significantly different, However, weight and BMI showed significance in difference between normal and obese groups (p < 0.05).

Table 2: Comparison of 6 Minutes walk distance between normal and obese population

Parameter		Number of subjects(n)	Normal (n=30)	OBESE (n=30)	P value
TDW(m)	Male	15	565.8±23.7	500±40.27	0.00
	Female	15	531±20.83	487±48.52	0.00

TWD- Total distance walked; Data expressed as Mean ±SD, Statistical significance (P<0.05).**Table 2:** shows comparison of total distance walked by normal and obese subjects during 6 minutes walk test (6MWT).The distance walked in six minutes was found to be significantly higher in normal population compared to obese group (P <0.05) and also males subjects covered a longer distance compared to female subjects.

Table 3: Comparison of baseline Pulmonary functions between normal and obese population.

Variales	Normal Male (n=15)	Obese Male (n=15)	Normal Female(n=15)	Obese Female(n=15)
FVC	4.01±0.45	3.98±0.66	2.83±0.31	2.72±0.25
FEV1	3.45±0.40	3.36±0.57	2.46±0.25	2.44±0.21
FEV1/FVC	0.86±0.06	0.85±0.03	0.87±0.04	0.89±0.03*
PEFR	7.94±1.71	5.54 ± 2.38	6.13±1.62	5.13±1.34

FVC-Forced vital capacity; FEV1- forced expiratory volume at the end of first second; PEFR- Peak expiratory flow rate. Data expressed as Mean ±SD, Statistical significance (P<0.05)

Table 3: shows comparison of pre exercise (Six minutes walk Test) Pulmonary functions between normal and obese population. The resting pulmonary function variables such as FVC, FEV1 and PEFR were higher in normal subjects compared to obese study subjects . Males had significantly higher pulmonary functions than females.

Table 4: Comparison of post exercise (Six minutes walk Test) Pulmonary functions between normal and obese population.

Variables	Normal Male (n=15)	Obese Male (n=15)	Normal Female(n=15)	Obese Female(n=15)
FVC	3.97±0.39	3.90±0.66	2.91±0.38	2.74±0.25
FEV1	3.46±0.37	3.31±0.57*	2.56±0.28	2.43±0.21*
FEV1/FVC	0.87±0.06	0.85±0.03	0.88±0.05	0.89±0.03
PEFR	7.92±1.44	5.50± 2.13*	6.38±1.54	5.05±1.03*

FVC-Forced vital capacity; FEV1- forced expiratory volume at the end of first second; PEFR- Peak expiratory flow rate. Data expressed as Mean ±SD, Statistical significance (P<0.05).

Table 4: shows comparison of post exercise (Six minutes walk Test) Pulmonary functions between normal and obese population. The spirometric values like FEV1, FVC, and PEFR decreased further in both normal and obese subjects after Six Minutes Walk Test (6MWT). Satistically significant reduction was observed in FEV1 and PEFR in obese male and female population compared to normal subjects. There was no much difference in post exercise heart rate, systolic and diastolic blood pressure between two groups.
Borg's scale showed slightly higher dyspnoea score(1) for obese subjects compared to their counterparts .

IV. Discussion

This cross sectional study aimed to assess the effects of sub maximal exercise on pulmonary functions in sedentary obese adults. BMI is a well known index of overall adiposity and relatively simple and reliable measure that is largely independent of height in adults. It is a global measure of body mass that includes both fat and lean mass, ventilatory function was significantly associated with relative adiposity as measured by BMI.

6 Minutes Walk Test(6MWT) used in our study is a simple, self-paced and easily applied objective test to assess the sub maximal level of exercise capacity. Most patients do not achieve maximal exercise capacity during the 6MWT. Since most activities of daily living are performed at sub maximal levels of exertion, the 6MWD will reflect the functional exercise level for daily physical activities[(8)]. It is considered more as a global performance test than a mere measure of motor capacity. Previous studies have shown that the 6 minutes walk distance (6MWD) reflects the degree of disability in obese subjects. This can be correlated to the variables such as age, anthropometric data (body weight, height, BMI,) body composition (FMI, FFMI), hand grip strength and disability.

In the present study, the distance walked by normal subjects was found to be significantly higher compared to obese study population and the distance covered by male study subjects was significantly more compared to females. The lesser distance covered by obese subjects in this study could be due to reduced muscle strength and higher fat mass which puts increased load on the feet and joints, as well as from skin friction from the rubbing of obese limbs [(9)] as compared to their counterparts [(10)].

And also the 6MWD shows a significant difference depending on height, sex and age. The females present a shorter step length and consequently, distances walked is shorter at the 6MWT [(11)].The higher muscle mass in males and difference in distribution of fat mass between males and females, may influence the total distance walked[(10)].

In our study, the baseline pulmonary functions was found to be decreased in obese group compared to normal study subjects. The significant reduction was observed in FEV1 and PEFR.

Previous studies have demonstrated that increasing weight gain is associated with more rapid loss of lung function [(12)(13)(14)(15)]. Forced expiratory volume in 1s (FEV1) and forced vital capacity (FVC), tend to decrease with increasing BMI. A large French population-based study by Leone et al. demonstrated that even mild abdominal obesity, even with a normal BMI, is associated with lower VC and FEV1 in both men and women. The FEV1-to- FVC ratio is usually well preserved or increased even in morbid obesity (5), indicating that both FEV1 and FVC are affected to the same extent [(16)(17)(18)]. The most consistently reported effect of obesity on lung function is a reduction in the functional residual capacity (FRC) [(19)]. In obesity, the reduction in Expiratory Reserve Volume(ERV) may become so marked that the FRC approaches residual volume (RV).

Vital Capacity(VC) is reduced in obese subjects due to mechanical and inflammatory causes. Mechanical causes include decreased respiratory compliance and increased gas trapping from premature small airway closure. The decrease in chest wall compliance is due to deposition of fat in and around the ribs, the diaphragm and the abdomen, increased pulmonary blood volume and increased closure of dependent airways in moderate to severe obese subjects [(19)]. In addition, obesity is associated increased levels of proinflammatory adipokines (such as leptin, interleukin-6, and tumor necrosis factor-alpha 32) which may also affect inflammation of small airways, resulting in premature closure of the inflamed and edematous small airway.

After Six Minutes Walk test, the obese group showed further reduction in pulmonary functions compared to baseline levels. The dyspnoea score and fatigue levels for obese subjects were also higher when compared to subjects with normal BMI.

Obese subjects have decreased respiratory muscle strength especially in the diaphragm, because the respiratory muscles have to overcome the increased elastic load during inspiration. It may also be due to an increase in respiratory resistance (nonelastic work).

During heavy -to- peak exercise, obese subjects have to increase their FRC (or hyperinflate) to avoid significant levels of expiratory flow limitation . This dynamic hyperinflation may contribute to reduced tidal volume and increased respiratory rate and may contribute to a reduced ventilatory reserve during peak exercise [(20)]

Studies have also confirmed that obese subjects are at a greater risk for inspiratory muscle fatigue both at rest and with exercise[(21)(22)]due to decreased glycogen synthase activity in respiratory muscles [(23)(24)(25)]

Obese people do a rapid, shallow respiration both during exercise and at rest [(20)]. They feel dyspnic since they have to do more work during breathing because of decreased complaince and increased resistance. At low lung volumes, small airways collapse and increase the sensation of dyspnoea. [(26) (27)]. Respiratory muscle weakness and fatigue leads to CO2 accumulation and hydrogen ion release which stimulate chemoreceptor activity and causes dyspnoea. Even in eucapnic obese adults the oxygen cost of breathing is four fold higher at rest as well as during exercise when compared to normal subjects.. The respiratory inefficiency among obese subjects due to increased oxygen consumption and increased CO2 production leads to decreased ventilatory reserve and predisposition to dyspnoea.

V. Conclusion

In conclusion, there is a reduction in resting and post exercise pulmonary functions in obese subjects compared to subjects with normal BMI. The decrease in pulmonary functions in obese subjects after exercise implies that there is decreased ventilatory reserve. Weight loss is the best way to improve the respiratory functions in obese subjects.

In summary, this study provides new data for clinical practice and adds to the limited research on 6MWT performance in sedentary obese South Indian population. This information can be used by the physical therapists to design exercise regimes that suits the individuals interests and physical abilities to provide safe and successful participation in physical activities for overweight and obese adults.

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