Study Of Ventilatory Lung Function Tests and Aerobic Capacity In Overweight Young Adults

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Abstracts: **Background & objectives :** The deleterious effects of obesity on cardiovascular system have been well documented but their effects on the respiratory system and aerobic capacity have been overlooked. Thus this study was planned to assess ventilatory lung function tests and aerobic capacity in overweight young adults. **Material and Methods:** A total of 60 young students (18 to 22 years) were recruited in this study. They were divided in to 2 groups. Overweight group and control group. Pulmonary function tests (static and dynamic) were recorded on a computerized portable Schiller lung function unit. Aerobic capacity (VO_2 max) was estimated by Queen's College Step test. Data was analyzed by Students 't' test. **Results :** In overweight group expiratory reserve volume , forced vital capacity, maximum ventilatory volume, forced expiratory volume at the end of first second and VO_2 max were reduced as compared to control group. **Interpretation and conclusion:** These results indicate that increase in BMI may affect ventilatory lung function tests and aerobic capacity in young adults.[Joshi A R et al NJIRM 2014; 5(2) :30-33]

Key Words: Aerobic capacity, Body mass index, Ventilatory lung function tests

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Introduction: In today's fast paced life young adults hardly catch a break, this affects their health adversely. The consequences of westernization of lifestyle have dire effects on the waist line of young adults in India.

Obesity is defined as abnormal or excessive fat accumulation in body that may impair health.[1] Body mass index (BMI) is a simple index commonly used in classifying obesity status in adult population. Though the general populace are not significantly obese (BMI in excess of 30-40 Kg/m^2), a BMI of 25 -29.9 Kg/m^2 (over weight status) in a young adult is indicative of a future of obesity.

The deleterious effects of obesity on cardiovascular system have been well documented[1] but their effects on the respiratory system have often been overlooked. This study has highlighted the impact of being overweight on the ventilatory lung functions.

Aerobic capacity is considered as the most accurate parameter of cardiorespiratory fitness. It is the maximum amount of oxygen used by the person during maximal or sub-maximal exercise. [2] Maximal oxygen uptake (VO_2 max) is widely accepted as the single best test to measure maximal aerobic power. [3]

Students pursuing professional course are constantly under tremendous amount of stress due to vast curriculum. While undergoing the studies students they hardly do any exercise. Obesity due to lack of exercise and increased stress levels due to course structure may deteriorate their health status earlier than normal adults. Thus this study was planned to study effect of increased BMI on ventilatory lung function tests and aerobic capacity in young adults.

Material and Methods : The study was approved by institutional reviewers board. It was conducted on 60 student volunteers between the age group of 18-22 years of either sex. The volunteers were physically healthy. They were evaluated as per standard proforma which included a questionnaire. Experimental protocol was explained to all volunteers and written consent was taken from them. The volunteers suffering from obstructive or restrictive lung disease, metabolic disorder and those doing regular exercise were excluded from the study.

All anthropometric measurements were taken from individuals wearing light clothing and bare-foot. Standing height was measured to the nearest of 0.1 cm. The weight was measured before lunch on an empty bladder to the nearest of 0.1 kg. BMI was estimated by Quetelet's Index. [4]

Quetelet's Index-
BMI = Weight (Kg)/Height(m)^2

The classification was done according to standard values.[3]

Category	BMI (kg/m^2)
Severely underweight	less than 16.0
Underweight	16.0 to 18.5
Normal	18.5 to 24.9
Overweight	25 to 29.9
Obese Class I	30 to 34.9
Obese Class II	from 35 to 40

The volunteers were divided into 2 groups namely the overweight group and control group depending on BMI. Subjects having BMI in the range of 18.5-24.9 kg/m^{2}were included in control group and those having BMI 25 to 29.9 kg/m^{2}were included in study group.

Ventilatory lung function tests: The tests were recorded on a computerized portable Schiller lung function unit SP-1(RS 232). The recorded parameters were compared with the inbuilt pulmonary function norms for the Indian population depending upon the age, sex, height, and weight. Static tests like Expiratory Reserve Volume (ERV),Forced vital capacity (FVC) and dynamic tests like Forced vital capacity at the end of 1st second (FEV$_1$) and Maximum Ventilatory Volume (MVV) were recorded.

The spirometer was calibrated daily using calibration syringe of 2 liters. Recording of static and dynamic pulmonary function tests were conducted on motivated young healthy volunteers in standing position. [5]

All the pulmonary function tests were recorded at noon before lunch as expiratory flow rates are highest at noon. Three satisfactory reading were taken as per guidelines of American Thoracic Society.

Aerobic power (VO_2 max**) by Queen's College Step Test**[6] : The step test was performed on a stool of 16.25 inches (41.3 cm) height for a total duration of 3 minutes at the rate of 24 cycles(steps) per minute for boys and 22 cycles(steps) per minute for girls.Metronome was used to guide the volunteers for desired rate of step cycles.

After completion of the exercise, the subjects were asked to remain standing and the carotid pulse rate was measured from 5th–20nd seconds of the recovery period. This 15 second pulse rate was converted into beats per minute and the following equation was used to predict the maximum oxygen uptake capacity:
For male volunteers:- VO_2max (ml/kg/min)
= 111.33 – [0.42 x heart rate (bpm)]
For female volunteers:- VO_2max (ml/kg/min) =65.81 –[0.1847 x heart rate (bpm)]

All readings of anthropometric measurements, lung function tests and aerobic capacity were taken on same day at one sitting. The analysis of data was done by using Students 't' test. P value of <0.05 was considered as significant.

Results: Table 1 shows mean age and body mass index in control group and overweight group .

Table 1 :Demographic Data

Parameter	Control group (n = 30)	overweight group (n=30)
Age(yrs) (Mean ± SD)	18.8 ± 0.96	19.44 ± 1.47
BMI(Kg/m^2) (Mean ± SD)	20.7 ± 2.61	29.7 ± 6.3

Table 2: Comparison of ventilatory lung function tests in control and overweight group

Parameter	Control group (n = 30)	overweight group (n=30)	p value
ERV(L) (Mean ± SD)	0.76 ± 0.35	0.70 ± 0.26	> 0.05
FEV$_1$(L) (Mean ± SD)	2.47 ± 0.6	2.37 ± 0.754	> 0.05
FVC(L) (Mean ± SD)	2.61 ± 0.65	2.5 ± 0.71	> 0.05
MVV (L/min) (Mean ± SD)	106.74 ± 21.78	99.11 ± 25.45	> 0.05

p < 0.05 significant

Table 2 shows comparison of ventilatory lung function tests in control and overweight group. Ventilatory lung function tests (ERV, FVC, FEV1 and MVV) are reduced in overweight group as compared to control group, but difference is statistically not significant.

Table 3 : Comparison of aerobic capacity in control and overweight group

Parameter	Control group (n = 30)	overweight group (n=30)	p value
VO_2 max (ml/kg/min) (Mean± SD)	40.86 ± 8.6	38.34 ± 12.92	>0.05

$p < 0.05$ significant

Table 3 shows VO_2max levels obtained in control group and overweight group. Although aerobic capacity (VO_2 max) was reduced in overweight group as compared to control group it is statistically not significant.

Discussion : The present study was an attempt to study effect of increase body mass index on ventilatory lung function tests and aerobic capacity in young adults.

Present study showed that expiratory reserve volume although not significant statistically is reduced in overweight group as compared to control group.(Table2) These results agree with those observed by Ray et al[7]. In obese healthy men, pulmonary function test abnormality, most commonly associated with mild obesity was, reduction is expiratory reserve volume. Sahebjami et al[8] observed reduced ERV & FRC in obese individuals. This was due to alteration in chest mechanics.

In the present study as observed in Table 2, decreased value of FVC was recorded in overweight group as compared to control group. Similar results were observed by Rochester et al[9] for the values of FVC in patients with upper body fat distribution.

Various studies have documented that ERV contributes to amount of residual volume (RV), FRC, VC and total lung capacity.[9,10] The observed values of decreased FVC suggest displacement of air by fat within the thorax and abdomen. The results of our study show decreased FEV_1 in overweight group as compared to control group. This agrees with the findings of Goya Wannamethee et al[10] who observed reduction in FEV_1 in overweight individuals.

It was observed that the difference in the MVV in the control group and overweight group was not significant statistically. These results agree with the results of Joshi et al[11] who observed that reduction in MVV occurred in proportion to increase in weight and % body fat. It is an established fact that the ability to reach high MVV depends upon the muscular forces and on the compliance of the chest wall.

In case of VO_2 max (Table3) the response was lower in the overweight group than the control group. Our findings are similar to findings of study done by Patkar KU[12] in which they observed decreased VO_2 max in obese group. They found that ability to do exhausting work (VO_2 max ml/kg/min) was less in obese group as compared to non obese group.

However Thakur et al[13] observed that VO_2 max has no significant correlation with BMI, instead is related more closely to lean body Mass. The probable reason of this observation is that obesity or adipose tissue by no way connected with aerobic potentiality of an individual. In fact lungs and O_2 extraction power of muscles finally contribute to aerobic capacity of an individual and the single important measure of such potentiality is VO_2 max. Thus increased % body fat and VO_2 max should be considered as independent factors.

A larger sample size and a longitudinal study will definitely help in affirming many of the suspicions and doubts brought forth by this study.

Limitations

1. Male to female ratio should be maintained in overweight and control group.
2. For VO_2 max, parameters like lean body mass should also be taken into consideration and tests like skin fold thickness will help in getting more accurate results.

Conclusions : The results were indicative of impaired ventilatory lung function tests and aerobic capacity in overweight group as compared to the control group.

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