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Original Research Article

"Measurement of Cardiopulmonary efficiency of obese students between the age group of 18 to 23 years"

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Abstract:

Introduction: Obesity is generally acknowledged as a global phenomenon that increases morbidity and reduces life expectancy. Respiratory and cardiovascular systems have been reported to reflect the major adverse effects of obesity. Hence it was thought to do the cardiopulmonary efficiency tests of the subjects and to know whether any correlation exists between obesity and cardiopulmonary efficiency. **Objectives:** 1. To estimate the BMI ratio for determining obesity. 2. To compare the cardiopulmonary efficiency between obese and non-obese students. **Methodology:** The present study was conducted between two groups of subjects. Group I - Comprised of 50 obese individuals (Study Group). Group II -Comprised of 50 Non-Obese individuals (Control Group). Study conducted at Burdwan Medical College, Burdwan, West Bengal, India. Heart rate, Respiratory rate, Systolic blood pressure, Diastolic blood pressure, Vital capacity, Total lung capacity, VO2 max., Functional residual capacity was measured maintaining standard protocol and comparison done between two groups. **Results:** Cardiopulmonary efficiency of 50 obese students compared with control group of 50 non obese students. Significant variation of Heart rate, Respiratory rate, Systolic and Diastolic blood pressure, Vital capacity, Total lung capacity, VO2 max. and value of Functional residual capacity was observed between two comparative groups. In our study, cardiopulmonary efficiency is significantly lower in obese subjects than non obese groups.

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Conclusion: The study showed low cardiopulmonary efficiency in obese students in comparison with non obese students. Obesity accounts very crucial comorbidity of cardiopulmonary diseases.

Keywords: Cardiopulmonary efficiency, Obese students.

Introduction

Obesity can be defined as the generalized accumulation of excess fat in the body. The carbohydrate (glycogen) and proteins stores in the human body are limited. Increased fat intake on the other hand, does not stimulate fat oxidation, thus long standing positive fat balance result in obesity.[1]

Body mass index (BMI) is a simple index of weight for height that is commonly used in classifying overweight and obesity in adult populations and individuals. It is defined as the weight in Kilograms divided by the square of the height in meters ($kg./m^2$). BMI provides the most useful population -level measure of overweight and obesity as it is the same for both sexes and for all ages of adults. However, it should be considered as a rough guide because it may not correspond to the same degree of fatness in different individuals.[2]

The world health organization (WHO) defines, “Over weight” as a BMI equal to or more than 25. These eat off point provide a bench work for individual assessment, but there is evidence that risk of chronic disease in populations increases progressively from a BMI of 25.[3]

Levels of obesity and the risk of comorbid disease: -

Underweight – BMI <18.5 is regarded as being under weight, there is a low risk of comorbid disease. Normal Weight – BMI between 18.5 and 24.9. Over Weight – BMI between 25.0 and 29.9, the risk of disease is regarded as midly increased. Obesity– BMI of 30 and above is regarded as being obese; the risk of comorbid disease is significantly increased.[3]

The terms “Obesity” and “overweight” are often used interchangeably. However, there is a distinct difference between the two. Overweight refers to an excess body weight that includes fat, bone, muscle and body water. In contrast, obesity is defined as an excess of body weight according to body mass index.[4]

The fundamental cause of obesity and overweight is an energy imbalance between

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calories consumed on one hand and calories expended on the other hand. Global increases in overweight and obesity are attributable to a number of factors including global shift in diet towards increased intake of energy-dense foods that are high in fat and sugars but low in vitamins, minerals and other micronutrients, a trend towards decreased physical activity due to the increasingly sedentary nature of many forms of work.[5,6] Obesity is the predisposing factor of cardiovascular diseases mainly heart disease and stroke, diabetes, musculoskeletal disorders - especially osteoarthritis. Pulmonary complications like asthma and COPD have been associated with obesity.[7]

Respiratory and cardiovascular systems have been reported to reflect the major adverse effects of obesity.[8] Hence it was thought to do the cardiopulmonary efficiency tests of the subjects and to know whether any correlation exists between obesity and cardiopulmonary efficiency.

Objectives

1. To estimate the BMI ratio for determining obesity.
2. To compare the cardiopulmonary efficiency between obese and non-obese students.

Methodology

General selection criteria: -

1) Both male and female students were chosen for the study.
2) The subjects belonged to the age group 18-23 years.
3) Recording of vital data like Name, age, sex, body weight, height.
4) The subjects were selected after detailed clinical examination including pulse, blood pressure, respiratory rate, body temperature, pallor, edema, icterus etc.

The present study was conducted at Burdwan Medical College, Burdwan, West Bengal, India. At first BMI was calculated to identify the obese and non obese students. Study was conducted in two groups of subjects. (Each group comprised of 50 subjects)

Group I - Comprised of 50 obese individuals (Study Group).

Group II - Comprised of 50 Non-Obese individuals (Control Group).

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The subjects were screened for any cardio-respiratory disorders or any kind of neuronal disease. Information regarding addictions like tobacco chewing, smoking and alcohol were not included in the study. Written consent was taken from students of study and control group.

Protocol for evaluating various parameters: -

The measurements taken in a relatively quiet room. They were also asked to wear comfortable loose clothes. All parameters were measured in resting condition.

Heart Rate - The normal resting heart rate was counted with the subject in reclining position. The subject was allowed to rest for at least 15 minutes before taking the pulse count. The right radial artery was used for the count. The pulse was counted for full one minute.

Blood Pressure - The blood pressure was taken by using Mercury sphygmomanometer. The Blood Pressure was taken in both the arms and the Blood Pressure was recorded with the subject in reclining position.

VO2 max. - This was done by using Harvard's step test and Astrand – Rhyming nomogram. The subject's weight (in Kg.) was noted down. The subject was familiarized with steeping technique and was asked to demonstrate the same for a few seconds. The subject was allowed to change the leg in between. The test was performed on 20 inch high step. The subject was made to step up and down at the rate of 30 per minute for a period of 5 minutes. The subject maintained the rate and rhythm of the steeping with the help of a metronome. In case, the subjects could not perform the test for full five minutes then the duration of stepping was noted down.

In any case, as soon as the subject furnished the test, he was asked to sit down and pulse was counted for one minute (0-1 minute). The pulse and weight of the subject was plotted on Astrands nomogram to calculate the Vo2 max. A careful watch was kept on development of dyspnea, chest pains.

Functional residual capacity (FRC) was measured by the nitrogen washout technique. The residual volume was obtained by FRC minus the Expiratory reserve volume.

The Total lung capacity (TLC) was calculated as residual volume plus Vital capacity.

The standard procedure is followed for measurement of various lung function test.[4, 8]

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Results

Table 1:-

BMI (kg./m^2)	Obese subjects	Non Obese subjects
	32.6 ± 1.8	21.2 ± 1.5

Table 2:-

Parameters	Obese subjects (n=50)	Non Obese subjects (n=50)	P values
Heart rate (per min.)	79.15± 1.23	72.7 ± 1.01	<0.05
Respiratory rate (per min.)	19.23 ± 0.22	17.25 ± 0.21	<0.05
Systolic Blood pressure (mm of Hg)	122.0 ± 2.27	119.1 ± 1.83	<0.05
Diastolic Blood pressure (mm of Hg)	84.9 ± 1.1	80.6 ± 1.0	<0.05
Vital capacity (L)	2.81 ± 0.42	3.15 ± 0.35	<0.05
Total Lung capacity (L)	4.51 ± 0.71	5.16 ± 0. 73	<0.01
VO2 max. (ml/kg/min)	35.98 ± 0.26	39.68 ± 0.28	<0.01
Functional residual capacity (L)	2.44 ± 0.50	2.98 ± 0.42	<0.01

Table 1 showed, Body mass index of obese and non obese subjects, which are included in our study.

Table 2 showed, significant variation of Heart rate, Respiratory rate, Systolic and Diastolic blood pressure, Vital capacity, Total lung capacity, VO2 max., Functional residual capacity value was observed between two comparative groups. In our study, cardiopulmonary efficiency is significantly lower in obese subjects than non obese groups.

Discussion

Obesity is caused by an excess of calorie intake and also by insufficient energy expenditure.[7] In children and adolescents there is no universally agreed criterion of obesity. Obesity is defined as

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BMI > 30.0 kg/m^2. BMI varies from birth to adulthood.[8] International Association for study of Obesity (IASO) and World Health Organization (WHO) had estimated, more than 1.9 billion adults worldwide (39%) were overweight and over 650 million (13%) were obese. This new estimate by WHO with the finding that the obesity related risk are in increase. Ambulation in obese children will promote a more rapid heart rate. Obesity is commonly studied as a risk factor for cardiovascular morbidities.[9] 18 to 23 years age group is very important, due to early detection of obesity may save life from its complications. In our study, Heart rate 79.15± 1.23per min. , Respiratory rate 19.23 ± 0.22 per min., Systolic Blood pressure 122.0 ± 2.27mm of Hg, Diastolic Blood pressure 84.9 ± 1.1mm of Hg in obese subjects, where Heart rate 72.7 ± 1.01per min., Respiratory rate 17.25 ± 0.21per min., Systolic Blood pressure 119.1 ± 1.83mm of Hg, Diastolic Blood pressure 80.6 ± 1.0 mm of Hg in control group. Study showed, Heart rate, Respiratory rate, Systolic and Diastolic blood pressure is relatively higher in obese subjects in comparison with non obese. It correlates well with other studies.[10,11,12]

Maffeis et. al. suggested that mechanical factors such as the forward lean of the upper body and displacement of the center of gravity play an important role in the differences observed between obese and non obese youth during walking and running.[13] Pulmonary function is also impaired in obese individuals. This dysfunction impacts the performance of weight bearing activities.[14, 15]

In our study, Vital capacity 2.81 ± 0.42L, Total Lung capacity 4.51 ± 0.71L, VO2 max. 35.98 ± 0.26 ml/kg/min and Functional residual capacity 2.44 ± 0.50 L in obese subjects, where Vital capacity 3.15 ± 0.35 L, Total Lung capacity 5.16 ± 0. 73 L, VO2 max. 39.68 ± 0.28ml/kg/min and Functional residual capacity 2.98 ± 0.42 L in control group. Study showed, Vital capacity, Total lung capacity, VO2 max., Functional residual capacity is significantly lower in obese subjects, in comparison with non obese. Our observation correlates with other studies. [16, 17,1819,20] In 1983, Ray C. S., Sui D. Y. et. al. found that obese patients usually exhibit lung function abnormalities related to the increase in body weight. These include a decrease in the functional residual capacity (FRC) due mainly to a decrease in the expiratory reserve volume (ERV).[21] In 1996, P. Marckmann found that vital capacity, total lung capacity and functional residual volume are reduced by up to 30 percent in morbidity obese patients. The work of breathing is increased due to higher chest wall and airway resistance and functionally flattened diaphragm.[22] Carroll D & Sieker H also showed same observation in their study.[23, 24]

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Conclusion

The study showed low cardiopulmonary efficiency in obese students in comparison with non obese students. Obesity accounts very crucial comorbidity of cardiopulmonary diseases. The effects of obesity on mortality in heart failure, chronic obstructive pulmonary disease have been definitively resolved. Early treatment of obesity is required to overcome the complications of obesity.

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