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THE STUDY OF CARDIORESPIRATORY STATUS IN OBESE AND NONOBESE INDIVIDUALS

Physiology

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ABSTRACT

Introduction: Obesity is becoming a global disease where India is affected the most. Obesity is leading to cardio respiratory diseases and to many co-morbid conditions.
Aims And Objectives: The current study was designed to evaluate cardio respiratory status in obese men and to compare with healthy non obese men of similar age.
Material And Methods: The study was conducted among 50 obese men and 50 non obese men between 30 to 50 years of age. Body mass index was measured as per Quetelets formula. Cardio respiratory functions like heart rate, systolic blood pressure, diastolic blood pressure, forced vital capacity and peak expiratory flow rate were assessed and compared between the two groups.
Results: There was a highly significant direct correlation with maximal heart rate, systolic blood pressure, diastolic blood pressure and negative correlation with decreased forced vital capacity and peak expiratory flow rate among obese men when compared to non-obese men of similar age groups.
Conclusion: The results proved that cardio respiratory diseases increase in obesity leading to increased morbidity and mortality. Body weight has to be maintained within the normal range in order to improve the cardio respiratory fitness.

KEYWORDS

Obesity, body mass index, heart rate, systolic blood pressure, diastolic blood pressure and pulmonary function tests.

INTRODUCTION:

"Obesity affects every aspect of people's lives from health to relationships" "Jane Velez –Mitchell". Obesity is a state of excess adipose tissue mass.[1] It has become a global epidemic. They are the major health issue nowadays in the developed and developing countries. Obesity in children and adults has reached an alarming proportion and is a medical condition where it leads to many health problems and decreased life span. During the last quarter of 20th century it is emerging as an epidemic.

Overweight and obesity are linked more to deaths worldwide than underweight. The causes of adolescent obesity are lack of regular exercise, sedentary life style, over consumption of high caloric foods, genetic, perinatal and early life factors. Co-morbidities of adolescent obesity encompass both short and long-term health concerns. Body mass index has been used by the WHO as a standard for recording obesity statistics since early 1980s. Others include waist circumference, anthropometry (skin fold thickness), densitometry (underwater weighing), CT or MRI, and electrical impedance.

Prevalence. [1,2]· "Overweight and obesity are the fifth leading risk of global deaths. Worldwide obesity has more than doubled since 1980. In 2008, more than 1.4 billion adults, 20 years and older were overweight. Of these over 200 million men and nearly 300 million women were obese".

In 2010, more than 40 million children under 5 years of age were overweight. it's a major problem seen in developed as well as developing countries especially in urban areas. Childhood obesity is leading to multiple problems like breathing difficulties, high risk of fractures, increased blood pressure, cardiac problems, diabetes and psychological ailments.

At least 2.8 million adults die each year as a result of being overweight or obese. As many as 68% of U.S. adults aged ≥20 years were overweight between the years of 2007 and 2008. Extreme obesity (BMI≥40) has also increased and affects 5.7% of the population. The increasing prevalence of medically significant obesity raises great concern.

India has now the third largest number of obese people after US and China. As per the survey done in India in year 2007-2008 showed high prevalence of overweight among females than in males and in urban than in rural areas.

AIMS AND OBJECTIVES:

Aim Of The Study:

To assess the differences in cardio respiratory parameters such as heart rate, blood pressure, forced vital capacity and peak expiratory flow rate in obese and healthy non-obese subjects in the age group 30-50 years.

Objective Of The Study:

1. To assess cardio respiratory parameters such as heart rate, blood pressure, forced vital capacity and peak expiratory flow rate in obese subjects.
2. To assess similar cardio respiratory parameters in non-obese subjects.
3. To compare the results between obese with non-obese groups.

MATERIALS AND METHODS:

Our study was a comparative study and it was undertaken to analyse the differences in cardiorespiratory parameters in healthy obese and healthy Non-Obese subjects in the age group 30-50 years. In our study we selected 100 subjects which includes 50 male obese subjects and also 50 male Non-Obese subjects who categorized based on WHO criteria of Body mass index. They were selected from the general population of Vijayawada City randomly. We took approval from ethical committee of our institute. The procedure was explained in detail to the patients and we took written informed consent from them.

Inclusion Criteria:

50 Healthy male Non obese subjects with BMI of 18.50 – 24.99 kg/m² in the age group of 30-50 years
50 Healthy obese males with BMI ≥ 30 kg/m² in the age group of 30-50 years were taken as controls.

Exclusion Criteria:

Subjects with BMI between 25-29.99.,

Subjects suffering from Respiratory diseases such as Chronic obstructive diseases, Bronchiectasis that might affect the pulmonary functions.

Subjects with medical problems especially cardiac illnesses, hypertension, Diabetes mellitus, Smokers and Alcoholics were also excluded from the study.

Weight: Weight was measured in kilograms on a standardized digital weighing machine to the nearest of 0.1 kg. with minimal clothes and without shoes.

Body Mass Index (BMI):
BMI was calculated based on the quetelets index,
BMI = Weight (in Kg's) / Height (in meters^2)
The subjects with a BMI > 30 considered as obese.

Cardio respiratory parameters:
We recorded the resting pulse rate by palpating the radial pulse and measured blood pressure with a mercury sphygmomanometer using the appropriate sized cuff after making the subject to sit and relax for ten minutes.

Forced vital capacity (FVC) and peak expiratory flow rate (PEFR) were recorded by spirowin PC based digital spirometer. Subjects were explained about the whole procedure in detail and were motivated prior to the start of manoeuvre. The test was performed over 3 times. We selected the test with the best manoeuvre. We compared the results for each parameter between the obese and the non-obese and statistical analysis was done by student unpaired't' test.

Statistical Analysis:
Descriptive data were presented as mean, standard deviation and range values. Calculations were done by student's ' t' -test for the two group's and compared. A ' P' value of 0.05 or less was considered as statistically significant.

RESULTS:
Our study, entitled " The study of cardiorespiratory parameters in obese and Non-Obese subjects in 30-50 yrs age group was conducted in the Department of Physiology, Siddhartha Medical College, Vijayawada. In our study, fifty male obese subjects and fifty male non-obese subjects in 30 to 50years age group were analysed for the results. The results obtained were expressed as mean ± standard deviation. Out of the fifty non-obese subjects, 22 subjects were in the age group of 31-40 years, 28 subjects were in the age group of 41-50 years. In obese group around 41 people were in 41-50 years and the rest in 31-40 years. On comparison of weight, height and BMI in 50 non-obese subjects and 50 obese subjects, the mean for age (years); the mean for weight (kg); the mean for height (metres); the mean for BMI was shown in Table 1 and they were statistically significant (p<0.0001).

Table - 1

Groups	n	Age(yrs)		Weight(kg)		Height(mt)		BMI	
		Range	Mean ±SD	Range	Mean ±SD	Range	Mean ±SD	Range	Mean±SD
Non obese	50	33-50	42.1±5.09	50-82	64.2±10.8	1.50-1.85	1.67±0.103	18.7-24.7	22.8±1.66
Obese	50	38-50	44.5±3.50	68-100	80.3±7.25	1.49-1.74	1.58±7.82	30.1-36.8	32.2±1.93
Significance	t			-8.74		5.11		-26.2	
	p			<0.0001		<0.0001		<0.0001	

comparison of mean weight, mean height and mean BMI in nonobese and obese subjects
SD= Standard Deviation, BMI= body mass index

The mean for heart rate (beats/min); the mean for systolic blood pressure (mm of Hg) and the mean for diastolic blood pressure (mm of Hg) in non-obese subjects was compared with obese subjects and was shown in table 2 and they were statically significant (P<0.0001)

Table - 2

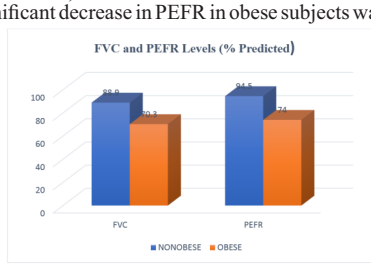
Groups	n	HR (Beats/min)		SBP (mm of Hg)		DBP (mm of Hg)		MAP (mm of Hg)	
		Range	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range	Mean±SD
Non obese	50	68-87	78.7±11.6	112-138	121±6.88	60-90	68.6±5.90	77-104	85.9±5.82
Obese	50	80-96	89.8±3.68	124-154	145±6.67	66-94	86.6±7.64	86-114	106±7.18
Mean difference		11.1		24		18		20.1	
Significance	T	6.42		17.7		13.2		15.2	
	P	<0.0001		<0.0001		<0.0001		<0.0001	

Comparison Of Cardiac Parameters Between Non-obese And Obese HR= heart rate, SBP=systolic blood pressure, DBP= diastolic blood pressure, MAP= mean arterial pressure.

Forced vital capacity (FVC):
The mean for forced vital capacity (% predicted) in non-obese subjects was 88.9 ±4.36. The mean for FVC in obese subjects was 70.3 ± 6.26 (Graph 1). There was significant decrease in forced vital capacity in obese subjects compared to non-obese subjects (P < 0.0001) with a mean difference of 18.6. The mean for forced vital capacity (litres) in non-obese is 2.96 ± 0.582 and in obese is 1.94 ± 0.257. Statistically significant decrease in FVC was found in obese compared to non-obese subjects (P<0.0001) with a mean difference of 1.02.

Peak Expiratory Flow Rate (PEFR):
The mean for PEFR (% predicted) in non-obese subjects was 94.5 ± 3.95. The mean for PEFR in obese subjects was 74 ± 6.75 (Graph 1). There was statistically significant decrease in PEFR in obese subjects when compared to non-obese subjects (P < 0.0001). The mean for PEFR (litres / second) in non-obese is 8.17 ± 0.886 and in obese is 5.74 ± 0.463. Significant decrease in PEFR in obese subjects was found.

Graph 1



Graph 1: FVC and PEFR levels (% predicted) in nonobese and obese individuals

Comparison of age-related changes in heart rate (beats/min) between non-obese and obese:
The heart rate between two groups and two ages were compared. The mean for heart rate in non-obese subjects of age 31-40 years was 77.8 ± 5.97; and it was 87.9 ± 5.21 in obese subjects of age 31-40 years. There was statistical significance (p<0.0001) between the two groups regarding age31-40years.The mean for heart rate in non-obese subjects of age 41-50 years was 81.8 ± 4.26; and it was 90.2 ± 3.2; in obese subjects of age 41-50years. There was statistical significance (P<0.0001) between the two groups regarding age 41-50years.

Comparison of age-related changes in systolic blood pressure between non-obese and obese:
The mean of systolic blood pressure in non-obese subjects of age 31-40 years was117 ± 5.32; and it was 142 ± 9.58 in obese subjects of age 31-40 years. There was statistical significance (P<0.0001) between the two groups regarding age31- 40years. The mean of systolic blood pressure for non-obese subjects of age 41-50 years was 124 ± 6.36; and it was 145 ± 5.81; in obese subjects of age 41-50years. There was statistical significance (P value < 0.0001) between the two groups regarding age 41-50 years.

Comparison of age-related changes in diastolic blood pressure between non obese and obese:
The mean of diastolic blood pressure in non-obese subjects of age 31-40 years was 66.1 ±5.61; and it was 83.8 ± 11.6 in obese subjects of age 31-40 years. There was statistical significance (P<0.0001) between the two groups regarding age 31-40 years. The mean of diastolic blood

pressure for non-obese subjects of age 41-50 years was 70.6±5.42 and it was 87.3 ± 6.49 in obese subjects of age 41-50years. There was statistical significance (P value < 0.0001) between the two groups regarding age 41-50 years.

Comparison of age-related changes in forced vital capacity between non-obese and obese:

The forced vital capacity between two groups and two ages were compared. The mean of forced vital capacity in non-obese subjects of age 31-40 years was 2.88 ±0.537; and it was 1.87 ± 0.155 in obese subjects of age 31-40 years. There was statistical significance (P<0.0001) between the two groups regarding age 31-40years. The mean of forced vital capacity for non-obese subjects of age 41-50 years was 3.03 ± 0.6; and it was 1.95 ± 0.27 in obese subjects of age 41-50years. There was statistical significance (P value < 0.0001) between the two groups regarding age 41-50years.

Comparison of age-related changes is peak expiratory flow rate (PEFR)

between non-obese and obese:

The mean of PEFR in non-obese subjects of age 31-40 years was 8.05 ± 0.83; and it was 5.54±0.5 in obese subjects of age 31-40 years. There was statistical significance (P<0.0001) between the two groups regarding age 31-40 years. The mean of PEFR for non-obese subjects of age 41-50 years was 8.27 ± 0.92; and it was 5.78 ± 0.5 in obese subjects of age 41-50 years. There was statistical significance (P value < 0.0001) between the two groups regarding age 41-50years.

DISCUSSION:

Obesity has major adverse effects on health. Obesity was associated with an increase in morbidity and mortality, with a 50 to100% increased risk of death from all causes compared to normal-weight individuals, mostly due to cardiovascular causes. BMI>25kg/m^2 mortality was approximately 30% higher for every 5kg/m^2 and with BMI >30 at 40 years life expectancy shortened by 6-7yrs. [3] Meta-analysis of 97 studies demonstrated that all grades of obesity were associated with higher all-cause mortality.[4]

The mean BMI of obese in our study was 32.2 and the mean BMI of nonobese was 22.8. In our study, there was a statistically significant increase in heart rate P<0.0001in obese subjects when compared to non-obese when each age subgroup was compared which was in accordance with the study by others.[5,6,7,8] In 2012 Afreen Itagi et al.[9] "studied resting heart rate, body composition and obesity among young adults in India and showed that resting heart rate had higher values and significantly positive correlation with obesity indices among obese group compared to non-obese individuals (P<0.05)".

In our study, there was a statistically significant increase in systolic blood pressure in obese subjects when compared to non-obese subjects with a mean increase of SBP by 24 mm Hg P value <0.0001 similar results were obtained by other studies .[5,6,7,8,10,11] Obesity, especially abdominal obesity is associated with an aetherogenic lipid profile; with increase low-density lipoprotein cholesterol, very low density lipoprotein and triglyceride; and with decreased high density lipoprotein cholesterol and decreased levels of the vascular protective adipokine, adiponectin. "Obesity induced hypertension was associated with increased peripheral resistance and cardiac output, increased sympathetic nervous system tone, increased salt sensitivity, and insulin-mediated salt retention; it is often responsive to modest weight loss".

In our study, there was a statistically significant increase in diastolic blood pressure in obese subjects when compared to non-obese subjects with a mean increase of DBP by 18 mm Hg P value <0.0001.Paradis.G etal had revealed that there was a statistically significant increase in diastolic blood pressure in obese subjects when compared to non-obese in all age group which is in correlation with our study. [6,7,12]

In our study we observed a significant decrease in forced vital capacity and PEFR in obese subjects when compared to non-obese subjects. There was a similar change observed when each age subgroup category was compared.[8,13,14,15,16,17,18] In 2013 comparative study of dynamic lung function tests in obese and non-obese individuals done by Srinivas C.H etal [19]found that the "parameters FVC, FEV1 and PEFR were significantly lower (P<0.001) in the obese group when compared to the non-obese group in both males and females". But the percentage of reduction in the values was more obvious in males than in the females and the study showed that increase in the BMI has negative effect on the lung functions and that effect is more apparent in males when compared to females.

In 2012 correlation between BMI, body fat percentage and pulmonary functions in underweight, overweight and normal weight adolescents done by Umesh Pralhadrao Lad et al.[20] " concluded that BMI and body fat percentage were negatively correlated with FVC and FEV1 in males and females of the overweight group". In 2014 effect of body weight on PEFR in the first year medical college male students study conducted by Laxmikant J Borse and their colleagues [21] they observed a negative relationship between body weight, as rated by the BMI, and PEFR. These studies were in correlation with our study.

Severe obesity is associated with obstructive sleep apnea and is associated with hypertension. Weight loss (10-20 kg) can bring substantial improvement, as can major weight loss following gastric bypass or restrictive surgery. Continuous positive airway pressure had been used with some success[1] Steele et al.[22] conducted a similar study and summarized that there was negative correlation between obesity and lung function in adults and these were independent of the confounding effects of physical activity and aerobic fitness. Our study correlated with the cardiorespiratory status observed by Ravikeerthy et al and Dimple arora et al. [23,24]

CONCLUSION:

The heart rate was significantly increased in obese when compared to non-obese. The systolic and the diastolic blood pressure significantly increased in obese when compared to non-obese. The forced vital capacity was significantly reduced in obese when compared to non-obese. The PEFR was significantly decreased in obese when compared to non-obese. Further research is recommended to understand how genes and gene environment interaction leads to obesity.

SUMMARY:

Prevalence and severity of obesity in young adults is dramatically increasing worldwide. Our study was done to determine the effect of increase in BMI on cardiac and pulmonary function in young adults. Hence obesity has to be controlled by preliminary steps like dietary regulation and regular exercising or to be controlled by drugs and surgical procedures.

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