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Relationship between body mass index and cardio respiratory fitness among young healthy adults

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Abstract
Obesity is an independent risk factor for cardiovascular disease. Energy dense cheap foods, labour-saving devices, motorized transport and sedentary work in the present time has led to obesity. Obesity can be assessed in several ways and BMI measures body composition on the basis of weight and height. Cardiovascular endurance involves contraction of large muscle groups for prolong periods of time during which maximum acclimatization of circulatory and respiratory systems are necessary. VO2 max is internationally accepted parameter to evaluate cardio respiratory fitness. Low cardio-respiratory fitness in young adults with increased body fat can be a potential factor for developing cardiovascular problems later in middle age. So, the data regarding the BMI and its Related Cardio-respiratory fitness in young adults are extremely critical to design the preventive programs for Cardiovascular diseases.
Methods: 100 young male adults were selected by convenient sampling method based on inclusion and Exclusion criteria. Baseline data were assessed using Body mass index (BMI) and Queen's College Step Test for Vo2 max.
Results: The results showed that there was a significant positive correlation between BMI and VO2max (ml/kg/min) Normal-weight subjects demonstrated greater cardio respiratory fitness compared to overweight and obese subjects which suggests possible effect of body fat on cardiorespiratory functions.
Conclusion: BMI is having significant impact on cardio respiratory fitness as the BMI increased the cardio respiratory fitness assessed by VO2 max decreased. This study demonstrates the importance of low cardiorespiratory fitness in young adults with increased body fat which could be a factor for developing cardiovascular comorbidities later in middle age.

Keywords: Obesity, cardiorespiratory fitness, body mass index, maximum oxygen utilisation capacity, queen's college step test

Introduction
Obesity is an independent risk factor for cardiovascular disease. Energy dense cheap foods, labour-saving devices, motorized transport and sedentary work in the present time has led to obesity. Obesity can be assessed in several ways and BMI measures body composition on the basis of weight and height.
Cardiovascular endurance involves contraction of large muscle groups for prolong periods of time during which maximum acclimatization of circulatory and respiratory systems are necessary as in brisk walking, swimming, running, hiking, aerobics, bicycling etc. Cardio-respiratory endurance (CRE) is supposed to be health related because low levels of that have been consistently linked with markedly increased hazard of deadly health related problems from all causes, especially heart disease.
Maximal oxygen uptake (VO2max) is the highest rate of oxygen consumption attained during maximal or exhaustive exercise. VO2 max is internationally accepted parameter to evaluate cardio respiratory fitness. Earlier studies have established the use of Queen's College Step Test to predict VO2max indirectly.
Low cardio-respiratory fitness in young adults with increased with body fat can be a potential factor for developing cardiovascular problems later in middle age. So, the data regarding the BMI and its Related Cardio-respiratory in young adults are extremely critical to design the preventive programs for Cardiovascular diseases.

Method and Methodology
Study design: Cross sectional study design.
Study setting: Department of physiotherapy, New Aswini Hospital, Ottapalam, Pallakad, Kerala.
Sample size: 100 Young Healthy Adults

Inclusion criteria
1. Healthy young Adults.
2. Age between 18-25 years
3. Males

Exclusion criteria
1. Male subjects below 18 and above 25 years
2. Subjects with Musculoskeletal complaints
3. History of cardiac disease
4. History of lung disease
5. Alcohol and Smoking
6. Not on regular medications affecting cardiovascular and respiratory system.
7. Not undergoing any physical conditioning programme.

Outcome measure
1. Body Mass Index (BMI)
2. Vo2 max (Maximum Oxygen Utilisation Capacity)

Procedure
100 Young healthy Adult males were included in the study as per inclusion and exclusion criteria. Body mass index was calculated using Quetlet's index: BMI=Weight (kg) / height (m2). Weight was measured using calibrated weighing machine in light clothing and bare feet and height was measured using measuring scale in centimetres which was fixed to the wall. Vo2 max was calculated using Queen's College Step Test. Step test was performed using a stool of 16.25 inches (41.30cms) height. Stepping was done for a total duration of 3 minutes at the rate of 24 cycles per minute which was set by a metronome. After completion of the exercise the subjects were asked to remain standing comfortably and the carotid pulse rate was measured from the 5th to 20th second of recovery period. This 15 second pulse rate was converted into beats per minute and the following equation was used to predict VO2max. VO2max (ml/kg/min) = 111.33 - (0.42 x pulse rate in beats per min). All experiments were performed at room temperature.

Statistical analysis
Correlation between BMI and Vo2 max Pearson correlation Correlation between BMI and Vo2 max for all 100 subjects with BMI ranging from 20 to 35.

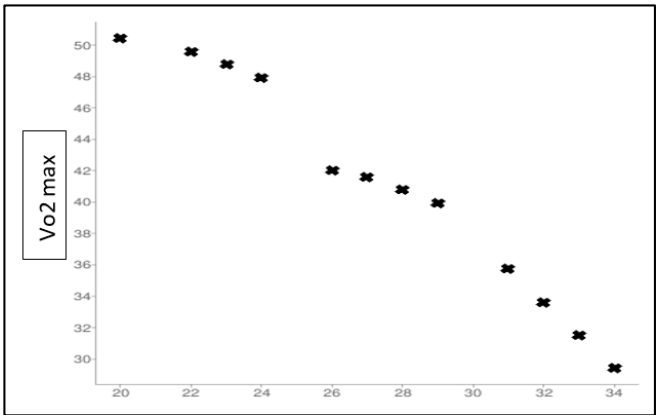

Fig 1: BMI and VO2 max Correlation for BMI range 20 to 35

Correlation between BMI and Vo2 max Pearson correlation Correlation between BMI and Vo2 max for subjects with BMI ranging from 20 to 24.

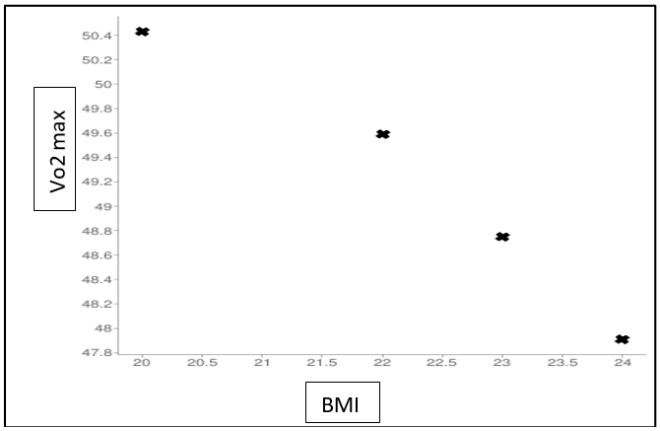

Fig 2: BMI and VO2 max Correlation for BMI range 20 to 24

Correlation between BMI and Vo2 max Pearson correlation Correlation between BMI and Vo2 max for subjects with BMI ranging from 26 to 30.

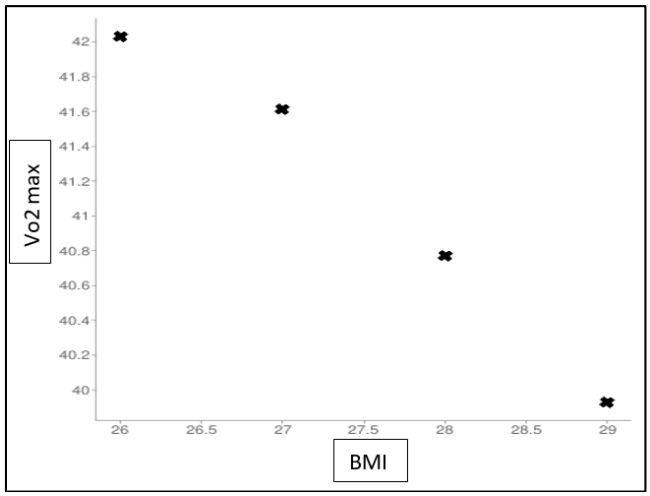

Fig 3: BMI and VO2 max Correlation for BMI range 26 to 30

Correlation between BMI and Vo2 max Pearson correlation Correlation between BMI and Vo2 max for subjects with BMI ranging from 31 to 35.

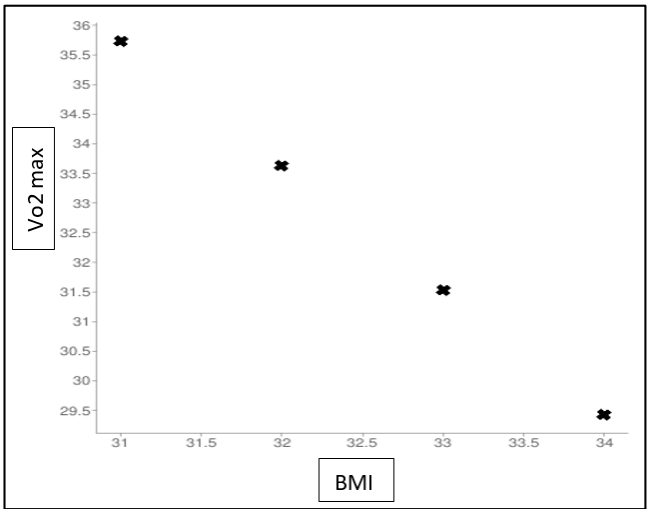

Fig 4: BMI and VO2 max Correlation for BMI range 31 to 35

Results and Discussion

The results showed that there was a significant positive correlation between BMI and VO2max (ml/kg/min) as the BMI increased the cardio respiratory fitness assessed by VO2 max decreased. Maximum oxygen utilization per unit of a muscle decreases with gain in BMI. VO2 max per kg of body weight was relatively less in obese subjects compared to normal weight individuals which indicates reduced aerobic capacity and the reasons may that the excessive hyperactive body musculature fails to uptake sufficient amount of oxygen due to deposition of proportionately high amount of fat mass, increased sympathetic nerve firing rate in obese and increased type II and decreased type I muscle fibers in obese and overweight individuals may have played a role on reduced oxygen uptake. Excessive body fat contributes no power and limits endurance, speed and movement through space. Excessive amount of body fat put an unfavorable burden and hinder the action of cardiac function thus greater likelihood of cardiac problems.

Conclusion

BMI is having significant impact on cardio respiratory fitness as the BMI increased the cardio respiratory fitness assessed by VO2 max decreased. This study demonstrates the importance of low cardiorespiratory fitness in young adults with increased body fat which could be a factor for developing cardiovascular comorbidities later in middle age. The results of this study regarding BMI and its Related Cardio-respiratory fitness in young adults are extremely critical to design the preventive programs for Cardiovascular diseases.

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