

Assessment of Cardiorespiratory Endurance in Obese College Students using Coopers 12 Min Run Test

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ABSTRACT

Background: The ability of the cardiorespiratory system to supply oxygen to active skeletal muscles during prolonged sub-maximal exercise and the ability of the skeletal muscles to perform aerobic metabolism is known as Cardiorespiratory Endurance. The highest attainable rate of aerobic metabolism during the performance of dynamic work that exhausts the subject within 5–10 min is internationally accepted as an index of one's cardiorespiratory fitness and it is defined as VO₂max. A popular test used for measuring cardiorespiratory endurance (VO₂max) is Cooper's 12 min run test. A good predictor for overall health and nutritional status is BMI. This study was conducted to assess the cardiorespiratory endurance in obese college students using coopers 12 min run test.

Methods: A total of 100 college students were included who met the inclusion criteria. The students were told to do 12 min coopers run test after a 5 min of warm up. After the test, the distance was recorded.

Result: The result shows that the cardiorespiratory endurance is reduced in obese college students. According to the data obtained, 51% of obese participants have good cardiorespiratory endurance and 30% and 19% have fair and poor respectively.

Conclusion: This study concluded that the cardiorespiratory endurance is reduced in obese college students using Coopers 12 minute run test. Lower cardiorespiratory endurance has risk to develop cardiovascular diseases, hypertension, and other chronic diseases. So, to improve the

endurance one should reduce the weight and start exercising regularly.

Keywords: [Obese college students, cardiorespiratory endurance, VO₂ max]

INTRODUCTION

A cardiovascular system and a respiratory system together make a cardiorespiratory system. Delivering oxygen and removing the waste products of metabolic pathways such as Carbon Dioxide, Lactic Acid and Urea is one of the important functions of the cardiorespiratory system. A variety of functions in the human body are performed by cardiorespiratory system including distribution of nutrients throughout the body during rest and exercise, control pH of blood, regulation of physiological and psychological functions via transporting hormones and enzymes and maintaining body temperature and fluid volume to prevent dehydration. It is well known that a lower risk of developing cardiovascular diseases, hypertension, type 2 diabetes, obesity and other chronic diseases is had by individuals with regular physical activity. An important aspect of health affecting the physical and mental activities of an individual is Cardiorespiratory Endurance also known as Cardiorespiratory fitness [1]. The ability of the cardiorespiratory system to supply oxygen to active skeletal muscles during prolonged sub-maximal exercise and the ability of the skeletal muscles to perform aerobic metabolism is known as

Cardiorespiratory Endurance^[2]. The functioning of heart, lungs and muscles in a coordinated fashion is measured by this. The health of an individual and the physical fitness is indicated with the help of Cardiorespiratory Endurance.

A sign of either: health and fitness or need for improvement is given by this ^[1]. For maintaining good health, improving cardiorespiratory endurance is an important issue. The measure of Cardiorespiratory Endurance is maximal oxygen consumption (VO₂max) which is qualified in L min⁻¹ or ml kg⁻¹ min⁻¹^[3].

The highest attainable rate of aerobic metabolism during the performance of dynamic work that exhausts the subject within 5–10 min is internationally accepted as an index of one's cardiorespiratory fitness and it is defined as VO₂max ^[4]. For measuring the maximum oxygen consumption, there are a considerable number of tests developed in many years ^[5]. Because of its laborious, complicated and difficult experimental protocol, the method of direct estimation of cardiorespiratory fitness in terms of maximum oxygen uptake (VO₂max) is restricted to application within a well-equipped laboratory. We have not yet explored the application of this test in the Indian context, although it was enumerated and standardized in a Western population^[4]. Therefore, for determining VO₂ max, indirect methods are suitable. A popular test used for measuring cardiorespiratory endurance (VO₂max) is Cooper's 12 min run test. The distance covered in 12 min was determined by Cooper's 12-minute run test (CRT), which is a popular one. A very high correlation between the distance someone can run (or walk) in 12 minutes and their

VO₂ max value was found by Dr. Cooper, which measure the efficiency with which someone can use oxygen while exercising ^[5,7].

Different age groups in India are affected by obesity as it has become an important health concern. The building up of a superfluous fat that has a negative effect on the functioning of the body and may be attributed to the energy imbalance along with an increased amount of calorie content stored in the body, may be defined as Obesity. A ratio of weight in kilograms divided by height in metres squared (Kg/m²) is Body Mass Index (BMI) or Quetelet Index ^[6]. Figure A shows WHO Asian-BMI classification^[8]. With a prevalence of 11% amongst adolescents and 20% amongst adults, India is reported to be positioned as the third amongst the countries having the highest rates of obesity ^[7,9]. At an early stage of growth and development of the individuals, an encouragement of practicing physical activity for at least 30-45 minutes per day and intake of 'good' food along with the knowledge of 'food pyramid' 20 must be inculcated. Some xenobiotic chemicals (artificial substances such as polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and trichloroethylene (TCE) that are not present in nature before their production by humans) have been reported to alter the metabolic rate of the organism and promote obesity by their lifetime exposure of non-degradation nature^[7,10].

Therefore, the purpose of this study was assessing the cardiorespiratory endurance in obese college students using coopers 12 minute run test.

Figure A [8]:

Nutritional status	BMI (kg/m ²)
Underweight	<18.5
Normal range	18.5-22.9
Overweight	23-24.9
Obese I	25-29.9
Obese II	>30

MATERIALS & METHODS

The source of data was collected from obese students studying in Dr. A. P. J. Abdul Kalam College of Physiotherapy, Loni. Data was collected by the principal investigator. The Sample size was 100. The sample were collected by simple random sampling. Obese students with BMI more than 24.9 kg/m², both genders between the age of 18 - 29 years from Dr. A. P. J. Abdul Kalam College of Physiotherapy. The study will be conducted on the ground of Pravara Institute of Medical Sciences. With participants' consent, the test was done. Test used was Coopers 12 min run test. Pen, book, consent form, stopwatch, whistle, recording sheet were the materials used. Inclusion criteria was college students who are willing to participate, students between the age group of 18 to 29, both the genders i.e., males and females, students having BMI more than 24.9 kg/m². The students with known case of asthma, congenital heart diseases, ho have any major psychological illness, who have neurological disorders, and having lower limb fracture were excluded.

Procedure : Firstly, Consent of the participant was taken and demographic details were obtained. Height and weight were taken to calculate the BMI of the participant.

BMI was calculated with the formula : BMI = kilogram/(meter)².

The participants coming under the criteria were taken to the test. Then Coopers' 12 min run test was performed by the participant. VO₂ max was checked. After the test, the calculations were done.

The details of Coopers' 12 min run test are as follows : Demographic details, height and weight of the participant were taken to check if they come under the inclusion or exclusion criteria. BMI was calculated by above formula. The procedure of the test was explained to the participants. The participants were asked to do warm-up for 5 mins before the commencement of the test. The warm included stretching and cardio exercises. After that, the run test was performed by the participants with or without

shoes. Each participants was told to run or walk for 12 minutes on the ground. After 12 minutes participants were called or whistle was blowed to inform that the test is over. Then the distance was recorded. The participants were told to continue walking for cool-down. If the participant was dyspneic, felt fatigue or had pain in the chest area or lower extremities during test, he/she was told to stop the test immediately. The VO₂ max was calculated using the formula mentioned below. And with the help of VO₂ max cardiorespiratory endurance was checked.

Calculations :

VO₂ max : Calculated (Indirect) Maximum Oxygen Consumption capacity.

VO₂ max (ml/kg/min) = (22.351 x distance covered in kilo meters) -11.288 [1].

Normal values of VO₂ max (ml/kg/min) [9] :

CRE	POOR	FAIR	GOOD	EXCELLENT
CRE Values	25 - 30.9	31 - 35.9	36 - 40	> 40

STATISTICAL ANALYSIS AND RESULT

A total of one hundred students (100) of Dr. A. P. J. Abdul Kalam College of Physiotherapy participated in the research. Obese males and females of different age groups were involved i.e., from 18 to 29 years. The inclusion and exclusion criteria were applied. The procedure using Coopers 12 min run test is carried out. And the distance covered by the participants in the test was used to calculate cardiorespiratory endurance.

Body Mass Index:

According to the ranges of BMI category as per the Asian classification, the participants were categorised into different grades of Obesity.

The BMI was calculated by the formula : BMI = weight (kg)/ height² (m)²

The mean is 27.827 and Standard deviation ± 2.24 for Body mass index

No. of Obese students according to the grades of Obesity : **Table 1** shows the no. of

Obese students according to the grades of Obesity.

Table 3 shows, there were 82 participants which came under grade 1 and 18 were under grade 2 of obesity according to Asian classification of BMI.

Table 1: No.of students according to grades

GRADE 1	GRADE 2
82	18

Table 2 shows the mean and \pm SD of BMI as per the grading of Obesity :

The mean and standard deviation for BMI as per the grades of obesity is 27.010 ± 1.49 for grade 1 and for the grade 2, the mean is 231.544 and standard deviation is ± 0.96 .

Table 2 : BMI as per grade of obesity	MEAN \pm SD
Grade 1	27.010 ± 1.49
Grade 2	231.544 ± 0.96

Distance covered in Coopers 12 minute run test :

The participants were told to run, jog or walk for 12 minutes and after completion of 12 minutes, the distance was noted and then the mean and standard deviation was taken out. The result obtained was: The mean is 2306.14 and Standard Deviation is ± 214.20 for distance covered in Coopers 12 minute run test by the participants.

Table 3 shows distance covered in 12 minutes in Coopers run test, according to the Grades of Obesity i.e., Grade 1 and Grade 2: Table 5 shows, the mean and standard deviation of distance covered in Coopers 12 minute run test by the participants according to the grades of obesity. For grade 1, the mean is 2380.17 and standard deviation is ± 150.50 . The mean and standard deviation for grade 2 is 1968.88 and ± 111.402 respectively.

Table 3 : Distance covered in 12 mins acc to grades	Mean \pm SD
GRADE 1	2380.17 ± 150.50
GRADE 2	1968.88 ± 111.402

VO2 max Value:

The value of VO2 max is taken out with help of the formula :

$VO_2 \text{ max (ml/kg/min)} = (22.351 \times \text{distance covered in kilo meters}) - 11.288$

The distance covered by participants was recorded and then they were used to put in the formula to gain the VO2 max values. So now, Table 4 shows the Mean and Standard deviation for VO2 max values which was 34.47 and ± 4.07 respectively.

Table 4 : VO2 max values	Mean and SD
VO2 max values (ml/kg/min)	34.47 ± 4.07

Cardiorespiratory Endurance (CRE):

Table 5 and Fig. 3 shows no. of participants having poor, fair or good cardiorespiratory endurance out of 100.

In the table and the figure below are the number of participants having poor, fair and good cardiorespiratory endurance out of 100. So, according to the data obtained, most of the participants had good cardiorespiratory endurance i.e., 51 (51%) participants had good endurance, 30 (30%) of participants had fair and only 19 (19%) of the participants out of 100 had poor cardiorespiratory endurance.

Table 5: No. Of Participants

CRE	No. Of participants	Percentage of participants
POOR	19	19%
FAIR	30	30%
GOOD	51	51%

Table 6 shows Cardiorespiratory endurance according to the grades of obesity.

Table 6 tells us about the cardiorespiratory endurance of the participants as per the grades of obesity. The classification was done according to poor, fair, good and using the grades of obesity. So, now the table shows the no. of participants coming under grade 1 and 2 having poor, fair, good endurance. Out of 100 participants, For grade 1 : only 1 participant had poor endurance, 30 had fair and most of them had good cardiorespiratory endurance i.e., 51 had good endurance. For grade 2 : No participants had fair or good endurance, all of them had poor cardiorespiratory endurance. 18 participants had poor cardiorespiratory endurance out of 100.

Table 6: Cardiorespiratory endurance according to grades of obesity

GRADES	POOR	FAIR	GOOD
GRADE 1	1	30	51
GRADE 2	18	0	0

DISCUSSION

The primary purpose of this study was to assess the cardiorespiratory endurance in Obese college students using Coopers 12 min run test. The data was collected to measure the Cardiorespiratory endurance as expressed in VO₂ max and stratify according to gender, BMI, and grade of obesity.

Result shows that 51% of obese participants have good cardiorespiratory endurance and 30% and 19% have fair and poor respectively. The cardiorespiratory endurance is reduced in obese college students using coopers 12 min run test.

In this study, there were 100 subjects (male and female) and then the inclusion and exclusion criteria were applied. After that, the participants were told to do warm-up and then coopers 12 min run test was performed. After the test, the distance was recorded and VO₂max was calculated. At last, the cardiorespiratory endurance was noted as poor, fair and good.

Probable reason behind this was related to the skeletal muscle performance and functioning of heart and lung. The ability of the cardiorespiratory system to supply oxygen to active skeletal muscles during prolonged sub-maximal exercise and the ability of the skeletal muscles to perform aerobic metabolism is known as Cardiorespiratory Endurance^[2]. The highest attainable rate of aerobic metabolism during the performance of dynamic work that exhausts the subject within 5–10 min is internationally accepted as an index of one's cardiorespiratory fitness and it is defined as VO₂max^[4]. A popular test used for measuring cardiorespiratory endurance (VO₂max) is Cooper's 12 min run test. The building up of a superfluous fat that has a negative effect on the functioning of the body and may be attributed to the energy imbalance along with an increased amount of calorie content stored in the body, may be defined as Obesity^[6].

A study was done by Banibrata Das et al on estimation of maximum oxygen uptake by evaluating Cooper 12 min run test in female students of West Bengal India. Its main

purpose was to assess and compare the fitness in terms of maximum aerobic capacity (VO₂ max) by cooper 12 min run among the urban female students and rural female students of West Bengal. 30 young female students from each of urban as well as rural sectors of West Bengal were recruited. The age was between 16 to 21 years. Estimation of VO₂ max was done with help of Coopers 12 min running test of each group of subjects. This study also tried to find the whether there is any correlation and coefficient between VO₂ max and age, weight, stature, of female students of rural and urban sector. The rural female young students do have a statistical significantly higher value of maximum oxygen uptake (VO₂ max) than the urban female young students with a probability of P^[5].

According to Hemavahthy Mani et. al, Cardiorespiratory Endurance among End Year Student of Faculty of Pharmacy in Jatinangor, Bandung. The inclusion criteria were all end year students who had no health-related problems and the students had to agree to participate in the study. After obtaining written informed consent from the participants, Astrand Rhyming Step Test was performed to measure the level of VO₂max. In total, 32 students were included out of which 14 (43.7%) students had an average level of VO₂ max and 9 (28.2%) had just below average level. Chi-square test results showed that there was significant relationship ($p < 0.05$) between VO₂ max level and with exercising habit, but showed a significant relationship ($p > 0.05$) with gender, BMI level, and smoking habit [3].

One study was done by A Bandyopadhyay that was Validity of Cooper's 12-minute run test for estimation of maximum oxygen uptake in male university students. The study was conducted to bypass the exhaustive and complicated protocol of direct estimation of VO₂max and to validate the applicability of Cooper's 12-minute run test (CRT) for predicting VO₂max in male university students of Kolkata, India. 88 sedentary male university students were recruited and were randomly assigned to study group (N= 58)

and the confirmatory group (N=30). The mean value of predicted VO₂ max showed a significant difference with VO₂ max in the study group. The prediction norm [$Y = 21.01X - 11.04$ (SEE = 0.193 ml · kg⁻¹ · min⁻¹)] was computed from the significant correlation ($r = 0.93$, $P < 0.001$) between distance covered in CRT and VO₂ max. Application of this norm in the confirmatory group revealed an insignificant difference between PVO₂max and VO₂max. For application of CRT as a valid method to evaluate the cardiorespiratory fitness in terms of VO₂max in sedentary male Indian youth, the modified equation is recommended^[4].

CONCLUSION

This study concluded that the cardiorespiratory endurance is reduced in obese college students using Coopers 12 minute run test. Higher BMI has negative effect on musculoskeletal fitness. Lower cardiorespiratory endurance is associated with lower energy expenditure, higher body mass index and increased waist circumference. Hence, person with higher BMI has lower cardiorespiratory endurance. So, to improve the cardiorespiratory endurance one should reduce the weight and start exercising regularly.

Declaration by Authors

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REFERENCES

1. Doua Kamyam , Lena Labania, Alaa Kamyam et al. Assessment of Cardiorespiratory Endurance in Terms of Physical Fitness Index and VO₂max among Young adult population of United Arab Emirates. *International Medical Journal*. April 2020 ; 2(04) : 1927-1940.
2. David Thivel, Julien Aucouturier. *Cardiorespiratory Fitness Evaluation In Obese Youth*. ebook.ecog-obesity.eu chapter energy expenditure physical activity. 2015.

3. Hemavahthy Mani, Tri Damiati Pandji, Putri Teesa. *Cardiorespiratory Endurance among End Year Student of Faculty of Pharmacy in Jatinangor, Bandung*. *Althea Medical Journal*. 2019 ; 6(01) : 24-29.
4. A Bandyopadhyay. Validity of Cooper's 12-minute run test for estimation of maximum oxygen uptake in male university students. *Biology of Sports*. March 2015; 32(01) : 59-63.
5. BANIBRATA DAS. Estimation of maximum oxygen uptake by evaluating cooper 12-min run test in female students of West Bengal, India. *JOURNAL OF HUMAN SPORTS & EXERCISE* ISSN 1988-5202. 2013 ; 08(01) :1008-1014.
6. Richa Mukhra, Tej Kaur, Kewal Krishana et al. Overweight and Obesity: A major concern for health in India. *Clinical Therapeutica*. 2018 ; 169(05) :199-201.
7. HEYWARD, V. *The Physical Fitness Specialist Certification Manual*, The Cooper Institute for Aerobics Research, Dallas TX, revised 1997. In: HEYWOOD, V (1998) *Advance Fitness Assessment & Exercise Prescription*, 3rd Ed. Leeds: Human Kinetics. p. 48.
8. Sangeeta Girdhar, Sarit Sharma, Anurag Chaudhary et al. An epidemiological study of overweight and obesity among women in urban area of North India. *Indian journal of community medicine*. April 2016 ; 41(2) : 154-157.
9. Rajeev Ahirwar, Prakash Ranjan Mondal. Prevalence of obesity in India: A systematic review. *Diabetes and Metabolic Syndrome: Clinical Research and Reviews*. August 2018 : 318- 321.
10. Onagbiye S. Olawale, Mulubwa Mwila, Young M.E. Marie et al. Relationship between Cardiorespiratory Fitness and Anthropometric Variables among school-going adolescents in Nigeria. *University of the Western Cape Research Repository*. 2017 ; 29(1) : 65-72.

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