Original Article

Estimation of maximum oxygen uptake by evaluating cooper 12-min run test in female students of West Bengal, India

BANIBRATA DAS

Department of Physiology, South Calcutta Girl's College, University of Calcutta, Kolkata, India

ABSTRACT

Das, B. (2013). Estimation of maximum oxygen uptake by evaluating cooper 12-min run test in female students of west bengal, india. *J. Hum. Sport Exerc., 8*(4), pp.1008-1014. The main purpose of the study is 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. Thirty young female students from each of the urban as well as rural sectors (age range, 16 – 21 years) of West Bengal were recruited by simple random sampling. Indirect estimation of VO2 max was done with help of 12 min running (Cooper test) of each group of subjects. This study also try to find whether there is any correlation and coefficient between VO2 max and age, weight, stature of the female students of urban sector and rural sector. The rural female young students do have a statistical significantly higher value of predicted maximum aerobic capacity (VO2 max) than the urban female young students with a probability of P. **Key words**: COOPER TEST, INDIRECT MEASUREMENT, INDIAN FEMALES.

Corresponding author. Department of Physiology, South Calcutta Girls' College, University of Calcutta, 72 Sarat Bose Road, Kolkata – 700 025, India.
E-mail: dr.banibrata@gmail.com, dr.banibrata@yahoo.com
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INTRODUCTION

Physical activity is an integral part of everyday life. In order to evaluate physical fitness of the female students there are several methods to estimate VO_2 max. There are aconsiderable number of tests developed in many years for measuring the maximum oxygen consumption. It is well known, direct measurement of maximum oxygen uptake (VO_2 max) is recognized as the best single index of aerobic fitness (Astrand & Rodhal, 2003), but that way is not always possible due to both expensive and require sophisticated instrument and trained staffs. According to Dolgener et al. (1994); Grant et al. (1995); Chatterjee et al. (2004), direct measurement of maximum oxygen consumption is not always practical in some situations, such as fitness testing or testing in a larger population. Therefore indirect methods are suitable used for determining VO_2 max.

The indirect field tests do not require special equipment or conditions, they are very simple to perform and it is possible to do the test in a larger number of subjects at one time. Although the indirect tests are not as precise as direct measures but still they are considered as acceptable predictors of VO_2 max (Chatterjee et al., 2004; Heil et al., 1995; Kliene et al., 1987).

Cooper's 12 minute run test (Cooper, 1968) is a popular field test used for measuring aerobic fitness. This fitness test was initially used to estimate the VO_2 max. Dr. Cooper found that there is a very high correlation between the distance someone can run (or walk) in 12 minutes and their VO_2 max value, which measure the efficiency with which someone can use oxygen while exercising. This test is still one of the basic fitness tests used by the military, as well as many coaches, trainers and an individual to determine cardiovascular fitness and track fitness over time. This simple test also allows you to compare your cardiovascular endurance with others of your age and gender.

The present study emphasizes on the physical fitness of the different types of female students (urban and rural) of West Bengal, India by predict VO_2 max through Cooper 12 min run test. This study also compares the physical fitness level of the urban and rural female students.

MATERIAL AND METHODS

Selection of subjects

The study was performed on 30 urban female students and 30 rural female students. The average age of both groups of workers was 16 – 21 years. Both groups of subjects are from the same socioeconomic backgrounds and were selected for the study on the basis of random sampling from the urban sector as well as rural sector of West Bengal, India respectively.

Measurement of Physical parameters

The height and weight of the sedentary young female students of both urban sector and rural sector were measured by an anthropometer (Martin's Anthropometer) and weighing machine (Crown, Mfg. by Raymon Surgical Co.) respectively. Body surface area (BSA) and the Body Mass Index (BMI) of all the subjects were also computed by the following equation:

BSA (m^2) = (Body Height in cm) $^{0.725}$ × (Body Weight in kg) $^{0.425}$ × 0.007184 (DuBois & DuBois, 1916; Banerjee & Sen, 1955)

BMI = Weight (kg)/Height (m^2) (Poskit, 2000)

Test Procedures

A 400 meter track was marked out in a ground to conduct cooper's test and the subject were given a trial run before to familiarize them with the nature of the experiment several days before the actual day of the test. In the day of the experiment the subject were asked to standing in the start. The experimental subjects were asked to run / walk as many lap of 400 meter track as possible for the period of 12 minutes. After exact 12 minutes the subjects were asked to stop running/ walking immediately. Then total distance in meter covered after 12 minutes by the experimental subjects were recorded. VO_2 max was predicted by using the following formula:

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

Statistical Analysis

Student paired "t" test was performed among the female students of urban sector and female students of rural sector to find out whether there is any significant difference in between the physical parameters of both the groups for the chosen level of significance ($p < 0.05$).

Correlation and regression was performed to assess the significant difference between VO_2 max and age, weight, stature of the female students of urban sector and female students of rural sector.

Statistical analysis was performed using the statistical package PRIMER OF BIOSTATISTICS (Primer of Biostatistics 5.0.msi, Msi Version 1.20.1827.0, Primer for Windows, McGraw-Hill). Spearman rank order correlation and regressions were performed to explore the magnitude and direction of association between two variables.

RESULTS

The mean values of age and physical parameters (height, weight, BSA and BMI) of urban and rural young female students were shown in table 1. No significant differences were found between the physical parameters (height, weight and BSA) of urban and rural young female students. Only there is a significant change in BMI between urban and rural young female students.

Table 1. *Physical parameters of the urban and rural female students*

Parameters	Urban Students	Rural Students	t score	p value	Remarks (P < 0.05)
Age (years)	18.4 (±1.54)	18.5 (±1.45)	0.259	0.797	NS
Body Height (cm)	152.4 (±4.8)	152.9 (±4.81)	0.403	0.688	NS
Body Weight (kg)	51.0 (±5.55)	49.2 (±3.34)	1.522	0.133	NS
BSA (m^2)	1.51 (±0.09)	1.49 (±0.07)	0.961	0.341	NS
BMI (kg/ m^2)	22.0 (±2.2)	20.9 (±1.05)	2.472	0.016	S

Table 2 mainly shows the comparative study of predicted maximum aerobic capacity (VO_2 max) among the urban young female students and rural young female students. From statistical analysis (table- 2) it was observed that, the rural female young students do have a statistical significantly higher value of predicted maximum aerobic capacity (VO_2 max) than the urban female young students with a probability of $P < 0.001$. Table 3 mainly represents the correlation coefficients (r) of the predicted maximum aerobic capacity (VO_2

max) score with age, height, weight, BSA, BMI among the urban young female students and rural young female students. Table 3 shows the relationship between maximum aerobic capacity (VO_2 max) and age. From this study it shows that the maximum aerobic capacity (VO_2 max) is negatively correlated with age incase of urban female students ($r = - 0.68$; $P< 0.001$) and rural female students ($r = - 0.71$; $P< 0.001$).

Table 2. *Comparative study of predicted maximum aerobic capacity (VO_2 max) among urban and rural female students*

Category	Predicted VO_2 max by Cooper test	t value	95% CI Interval	P value
Rural Female students	50.2 (±5.75)	6.76	6.23 to 11.47	P <0.001
Urban Female Students	41.3 (±4.37)			

Table 3 also shows that relationship between maximum aerobic capacity (VO_2 max) and body height and weight of the urban young female students and rural young female students. This table shows that predicted VO_2 max has a negative association with height of urban young female students ($r = - 0.32$; $P< 0.10$) and height of rural young female students ($r = - 0.19$; $P> 0.10$). It is evident from the table 3 that there is a negative correlation ($r = - 0.09$) between predicted VO_2 max and body weight of the urban young female students, but there is a positive correlation ($r = 0.15$) found between predicted VO_2 max and body weight of the rural young female students. The predicted VO_2 max has a negative correlation with BSA of both urban ($r = - 0.18$) and rural ($r = - 0.02$) young female students respectively. But BMI of the both group of subjects has positive correlation [Urban ($r = 0.10$); rural ($r = 0.39$)] with predicted VO_2 max.

Table 3. *Correlation and coefficient and p value of tailed significance for urban and rural female students*

Subjects	Parameters	Correlation and Coefficient (r)	Standard error (SE)	t score	p value	Remarks (P<0.05)
Urban	**VO_2 max & Age**	- 0.68	0.13	5.23	P < 0.001	S
	VO_2 max & Height	- 0.32	0.17	1.88	P< 0.10	NS
	VO_2 max & Weight	-0.09	0.18	0.50	P> 0.10	NS
	VO_2 max & BSA	-0.18	0.18	1.00	P> 0.10	NS
	VO_2 max & BMI	0.10	0.18	0.55	P> 0.10	NS
Rural	**VO_2 max & Age**	- 0.71	0.13	5.46	P < 0.001	S
	VO_2 max & Height	- 0.19	0.18	1.05	P> 0.10	NS
	VO_2 max & Weight	0.15	0.18	0.83	P> 0.10	NS
	VO_2 max & BSA	- 0.02	0.18	0.11	P> 0.10	NS
	VO_2 max & BMI	0.39	0.17	2.29	P < 0.05	S
Urban & Rural	**VO_2 max**	0.40	0.17	2.35	P < 0.05	S

DISCUSSION

Maximum oxygen uptake capacity (VO_2 max) has been widely considered to be reliable and valid measure of cardio respiratory fitness (Das & Dhundasi, 2001). The result of maximum oxygen uptake capacity (VO_2 max) in the present investigation shows that the rural female students have a significantly higher VO_2 max than the urban female students. This result corroborates with the work of Das et al. (2010). According to them of the rural female student has a higher predicted VO_2 max (QCT) than the urban female students.

This study mainly shows that maximum oxygen uptake (VO_2 max) is known to be significantly correlates with age. As suggested by Astrand & Rodhal (1986) that maximum oxygen uptake increases with age up to 20 years. After that there is a gradual decline in maximum oxygen uptake. Hagen et al. (1993); Biswas et al. (2004) also suggested the same view. According to them, decrease of maximal oxygen uptake with the advancement of age.

This study shows that maximum oxygen uptake is directly related to body weight. This results was supported by Samanta & Chatterjee (1981); Biswas et al (2004). Among the physical parameters body mass index as the best predictor of VO_2 max. From this study it was observed that body mass index shows positive and significant correlation coefficient with VO_2 max especially on the rural female students (r=0.39) and with the urban female students (r = 0.10). This study also shows that highest values of correlation coefficient were obtained between VO_2 max and BMI in case of both rural and urban female students (Hattiwale et al. 2008).

In the present investigation, age was observed to have only significant relationship with the VO_2 max in both the female group of students. In a previous study Biswas et al (2004) it was also noted the same type of observation. When correlating each physical parameter with VO_2 max, it was established that body height, body weight, BSA and BMI of the urban female students does not have significant correlation with VO_2 max, but incase of the rural female students age and BMI shows significant correlation with VO_2 max. This study also shows that there is a significant correlation (r=0.40), between the predicted maximum aerobic capacity (VO_2 max) of urban young female students and rural young female students.

This study also found that there is a very high correlation between the distances someone can run (or walk) in 12 minutes and their VO_2 max value. The regression coefficient between VO_2 max and 12 min run distance in the present study was 1.00 incase of both urban and rural female students. Whereas, Cooper in 1968 observed the result of correlation – coefficient was 0.90. The age range of the Cooper was high (17 – 54 years). Whereas, in this study the age range was 16 – 21 years.

CONCLUSIONS

High level of physical fitness requires a high VO_2 max value. This study conclude that the rural female students has a higher cardio respiratory fitness due to significantly high VO_2 max value in 12 min run Cooper test.

This study also concluded that significant correlation coefficient was found between age and VO_2 max value in both groups (urban & rural) of female students. This study also concluded that body height, body weight and BSA of the urban female is significantly negative correlates with their VO_2 max value and the body height and BSA of the rural female is significantly negative correlated with their VO_2 max value. BMI is

mainly known as the best predictor of VO_2 max. The rural female students' shows a significantly higher value of correlation and coefficient with VO_2 max.

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