

Cardiorespiratory Fitness in College Students of Uttar Pradesh, India

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Abstract

Present study was undertaken to (i) evaluate $VO_2\max$ among college students of Uttar Pradesh, (ii) compare the data with other reports and (iii) compute prediction norms for $VO_2\max$. Seventy five Male and seventy five female college students of 19 – 24 years having middle class socioeconomic background were recruited by random sampling from Institute of Dental Sciences, Bareilly, Uttar Pradesh, India. $VO_2\max$ was determined by Queen's College step test (QCT). Physical parameters were significantly correlated ($P < 0.001$) with $VO_2\max$ in both the sexes and they were (except age) significantly higher among males. Followings are the prediction norms for $VO_2\max$ from body height which showed maximum value of correlation coefficients.

Males : $VO_2\max$ (L/min) = $0.17 \times$ body height (cm) – 26.439 [$r = 0.91$, SEE = 0.028]

Females: $VO_2\max$ (L/min) = $0.14 \times$ body height (cm) – 20.549 [$r = 0.86$, SEE = 0.051]

The results indicated better cardiorespiratory fitness among males than female college students of Uttar Pradesh, India, because of higher values of all the physical parameters in males.

Key Words: $VO_2\max$, QCT, Sedentary, Indians, Norms

Introduction

Maximum oxygen uptake or $VO_2\max$ has been internationally accepted as the best parameter to evaluate cardiorespiratory fitness. Direct measurement of cardiorespiratory fitness in terms of $VO_2\max$ is restricted within the well equipped laboratory because of its exhausting and difficult experimental protocol (Fox, 1973). Among various indirect protocols (Fox, 1973; Das and Bhattacharya, 1995; Kline et al., 1987; Siconolfi et al., 1982; Mcardle et al., 1972) the Queen's College step test or QCT is the simplest one and has already been established as the best indirect method to evaluate cardiorespiratory fitness in young Indian individuals (Chatterjee et al., 2006).

There is dearth of data on $VO_2\max$ among sedentary college students of Uttar Pradesh, India. The present study was therefore conducted to:

- (i) Evaluate $VO_2\max$ in college students of Uttar Pradesh, India.
- (ii) Compare the data with reports from India and abroad, and
- (iii) Compute prediction norms for $VO_2\max$ in the studied population.

Materials and Methods

Selection of Participants

Male (N=75) and female (N=75) healthy sedentary students from the middle class socioeconomic background, having age range of 19 to 24 years were recruited for the study on the basis of random sampling from the Institute of Dental Sciences, Bareilly, Uttar Pradesh, India. The experimental protocol was fully explained to participants to allay their apprehension and ensure maximum co-operation. They had a light breakfast 2–3 hours before the test and refrained from any energetic physical activity for that period. The participants had no history of any major disease and did not follow any

physical conditioning program, apart from some recreational sports. All the participants were non-smokers. Necessary permission was taken from the ethical committee to conduct the study.

Age of each participant was calculated from the date of birth as recorded in their school certificate. Body height and body mass were measured with standard instrument with an accuracy of ± 0.5 cm in case of body height and ± 0.25 kg in case of body mass. The body surface area was calculated from the equation of *DuBois and DuBois (1916)* which is as follows:

$$BSA (m^2) = (\text{Body Height})^{0.725} \times (\text{Body Mass})^{0.425} \times 0.007184$$

Evaluation of VO₂max by QCT

The step test was performed on a stool of 16.25 inches (41.3 cm) height 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 subject was asked to remain standing and the carotid pulse rate was measured from 5–20 seconds of the recovery period. This 15 second pulse rate was converted into beats per minute and the following equations were used to predict the maximum oxygen uptake capacity (*Chatterjee et al., 2004; Chatterjee et al., 2005*):

In Males:

$$VO_2\text{max (ml/kg/min)} = 55.23 - (0.09 \times \text{pulse rate in beats/min})$$

In Females:

$$VO_2\text{max (ml/kg/min)} = 54.12 - (0.13 \times \text{pulse rate in beats/min})$$

The whole experiment was performed at a laboratory temperature varying from 27–29°C and with the relative humidity ranging between 75% and 83%.

Statistical Analysis

Student’s t test, Pearson’s product moment correlation and linear regression

statistics were used for statistical treatment of the data.

Results

Means and standard errors of age, body height, body mass, BSA and VO₂max of the male and female participants are presented in table 1. Though age did not show any inter-group variation, but the values of all other parameters are significantly higher among males than the female students.

Table 1. Physical parameters and cardiorespiratory fitness (VO₂max) of male and female sedentary university students.

Category	Age (Years)	Body Height (cm)	Body Mass (kg)	VO ₂ max	
				ml/kg/min	L/min
Male (N = 75)	21.6 ± 0.2	169.5 ± 0.5	56.7 ± 0.2	41.9 ± 1.6	2.376 ± 0.09
Female (N = 75)	22.9 ± 0.6	160.3 ± 0.6*	52.9 ± 0.8*	35.8 ± 1.2*	1.893 ± 0.10*

NS = Not significant, * = P < 0.001

Table 2. Correlation coefficients (r) of VO₂max with different physical parameters in male and female college students of Uttar Pradesh, India.

	Category	Age (Yrs)	Body Height (cm)	Body Mass (kg)	BSA (m ²)
VO ₂ max (L/min)	Males	0.62	0.91	0.82	0.85
	Females	0.58	0.86	0.72	0.76

In all the cases P < 0.001

Table 2 shows the correlation coefficients of VO₂max with different physical parameters. All the physical parameters are significantly (P<0.001) correlated with VO₂max in both the sexes. VO₂max exhibited maximum correlation with body height in both the sexes and therefore it was considered as the best independent parameter among all the physical parameters to compute the regression equation for VO₂max. These regression norms are shown in figure 1.

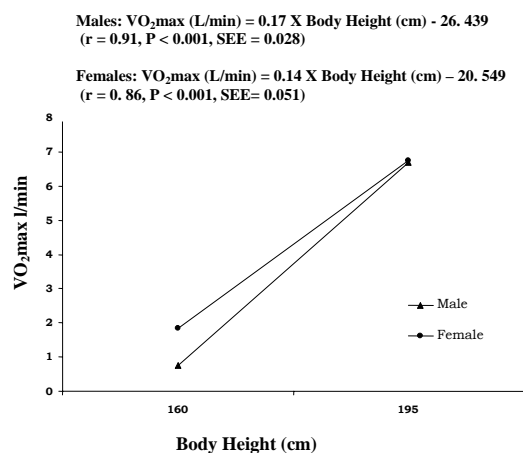


Figure 1. Relationship between VO_{2max} and body height in male & female college students

Discussion

The males have higher value of VO_{2max} than their female counterparts as also reported in previous studies from the country and abroad (Fox, 1973; Das and Bhattacharya, 1995; Kline et al., 1987; Mcardle et al., 1972). But the values of VO_{2max} obtained in both sexes is comparatively low indicating that the studied population have lower aerobic capacity and poor physical fitness in respect to Caucasians, Kurds, Yemenites, Europeans, Africans, Japanese, young population of Denmark and Americans (Wyndham et al. 1963; Davies et al. 1972; Kitagawa et al. 1977; Okura and Tanaka 2001; Wassmer and Mookerjee 2002; Uth et al. 2004). The VO_{2max} of active subjects reported by Sengupta et al. (1974), Das (1968), Banerjee et al. (1974), Walter and Nancy (1983) was much higher than that of the present study. On the other hand the cardiorespiratory fitness obtained in the present population is comparatively higher than male smokers and non-smokers of Kolkata (Chatterjee et al., 1987), female non-smokers of Kolkata (Chatterjee and Chakraborty 1986) and university boys and

girls of Kolkata (Chatterjee et al., 2004; Chatterjee et al., 2005).

The physical parameters showed significant correlation with VO_{2max} as also reported in previous studies (Kitagawa et al., 1977; Banerjee et al., 1974; Chatterjee et al., 1987; Chatterjee and Chakraborty 1986; Watanabe et al., 1994). This might be the probable cause for having significantly greater VO_{2max} among males as they in turn showed significantly higher values of physical parameters (except age) than their female counterparts. In the present population, maximum correlation of VO_{2max} was obtained with body height in both the sexes and therefore body height was considered as the best parameter to compute the prediction norm for VO_{2max} among the young college students of Uttar Pradesh, India (Fig 1).

Conclusions

The present investigation depicted that the young college students of Uttar Pradesh, India have normal cardiorespiratory fitness which is well correlated with physical parameters with males having superiority than their female counterparts. Prediction norm for VO_{2max} computed in both the sexes from body height will help for diagnosis, follow up and treatment of any kind of cardiorespiratory trouble in the studied population.

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