Association of Cardio respiratory Fitness, Body Composition and Blood Pressure in Collegiate Population of Amritsar, Punjab, India

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Citation

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Abstract

Maximal oxygen consumption (VO_2 max) is single best measure of cardiorespiratory capacity and is considered as a benchmark to quantify cardiovascular functional capacity and aerobic fitness. The present study deals with the association of cardio respiratory fitness, body composition and blood pressure in collegiate population (n =180) of Amritsar, Punjab, India, aged 19 – 26 years. Height and weight were determined by anthropometric methods, blood pressure was measured with subjects lying supine after at least 5 min rest, VO_2 max was measured by Queen's College Step test; fat mass and fat free mass were estimated by bioelectrical impedance analysis method. The results indicated that there was a close association of VO_2 max with fat mass and systolic blood pressure in boys, and only with systolic blood pressure in girls.

INTRODUCTION

Civilization and industrialization make our life pleasant, jubilant and luxuriant. Indeed, automation and other technologies have contributed greatly to lessening physical activities at work place and home. The assessment of cardio respiratory fitness in children and adolescent has been growing in importance because several data link the VO_2 max with CVD risk factors[1,2]. Aerobic fitness is a very good indicator of cardio respiratory fitness / cardiovascular and exercise tolerance for every day activities which are largely aerobic for the general population[3]. Research has indicated the importance of exercise in reducing the risk of cardiovascular diseases, through reduction of blood lipids, body fat, and blood pressure, improvement in myocardial function and as an independent risk factor[4]. Thus, the concept of fitness being defined as good condition or good health, tells us that, while we do not expect the general population to compete with athletes, an above average VO_2 max score indicates a healthy level of cardio respiratory fitness and that an individual is fit to cope with the general demands of living[3]. The evidence from longitudinal studies indicate that early identification of cardio vascular risk factors in children, particularly for body fat %, blood lipids, hypertension and cardio respiratory fitness should be addressed as preventive measure in public health perspectives[5] . So these approaches may also be helpful in the studies relating to the young adults.

The studies on relationship among cardio respiratory fitness, body composition and blood pressure in school children are scanty[6]. So, the purpose of the present study was to fulfill the lacuna of knowledge in these aspects in young adults especially in north Indian context. Therefore, the aim of the present study was to study the association of cardio respiratory fitness with body composition and blood pressure in collegiate population of Amritsar, Punjab, India.

MATERIALS AND METHODS

The sample consisted of 180 randomly selected unrelated normal healthy collegiate boys (n=110) and girls (n= 70) aged 19-26 years, taken from Guru Nanak Dev University, Amritsar, Punjab, India. The mean height and weight of boys and girls were 172.38 cm and 65.87 kg, and 157.92 cm and 53.16 kg, respectively. The consent for voluntary participation was obtained. The work was done in the department of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar, Punjab, India.

Cardio respiratory Fitness: Queen's college step test[7] was used to predict maximal aerobic capacity. It is a standard method to measure one's maximal oxygen uptake using bench stepping sub maximal exercise, suitable for both sexes of adults. Prior to the test, subjects did 5-7 minutes warm up

consisting of lower limb muscles stretching and brisk walking. A wooden stepping bench of 16¼ inch was used along with metronome and stop watch. Metronome was used to monitor the stepping cadence, which was set at 88 beats per minute (22 complete steps per minute) for females and 96 beats per minute (24 complete steps per minute) for males. The step test began after a brief demonstration and practice period. The subjects were asked to perform each stepping cycle to a four-step cadence, up-up-down-down continuously for 3 minutes. After completion of test, subjects remained standing while pulse rate was measured for 15 seconds, 5 to 20 seconds into recovery. Recovery heart rate was converted to beats per minute (15 s HR x 4).

Following equations were used for the estimation of Vo2max ($mL.kg^{-1}min^{-1}$)

Males: $VO_2max = 111.33 – [0.42 \times$ Step-test pulse rate $(b.min^{-1})]$

Females: $VO_2max = 65.81 – [0.1847 \times$ Step-test pulse rate $(b.min^{-1})]$

Anthropometric Measures: Height, weight and body mass index were assessed after Weiner and Lourie[8].

Blood Pressure: Resting blood pressure was measured using a sphygmomanometer (Mercury Type) and stethoscope. The measurements were taken after subjects were in recumbent position in calm quiet environment for at least 5-7 minutes. Systolic blood pressure and diastolic blood pressure were examined and pooled for each group and gender.

Body Composition: Fat mass and fat free mass were measured by Tanita bioelectrical impedance analysis method.

Statistical Analysis: Student's t-test was used to compare the 8 variables between boys and girls. Linear regression analysis was used for VO_2 max, fat mass, fat free mass, systolic blood pressure and diastolic blood pressure with other variables in both boys and girls.

RESULTS AND DISCUSSION

The distribution of mean values of 8 variables in collegiate population of Amritsar is shown in Table1. The boys have higher mean values in height (172.38 cm) , weight (65.87 kg) , body mass index (22.16 kg/m^2), fat free mass (58.99 kg), VO_2 max (48.74 ml. kg^{-1} $min.^{-1}$), systolic blood pressure (122.27 mmHg) and diastolic blood pressure (77.51 mmHg) and lesser mean value in fat-mass (6.87 kg) than the girls (157.92 cm, 53.16 kg, 21.30 kg/m^2, 43.97 kg, 33.97 ml. kg-1 min.-1, 116.69 mmHg, 73.51 mmHg and 9.13 kg respectively). Highly significant differences ($p \leq 0.001$) were noted in height (t=15.73), weight (t=8.02), fat-mass (t=3.93), fat-free-mass (t=13.47), VO_2max (t=12.26), systolic blood pressure (t=4.82) and diastolic blood pressure (t=3.77) between boys and girls. The findings of the present study were supported by earlier reports [6,7,9,10,11].

Figure 1

Table 1: Distribution of mean values and standard deviations of 8 variables in boys and girls

S. No.	Variables	Boys(n=110) Mean	SD	Girls(n=70) Mean	SD	t-value
1.	Height(cm)	172.38	±5.08	157.92	±5.61	15.73***
2.	Weight (K.g)	65.87	±9.19	53.16	±8.17	8.20 ***
3.	Body Mass Index (kg/m^2)	22.16	±2.90	21.30	±3.14	1.64
4.	Fat Mass (K.g)	6.87	±3.23	9.13	±3.43	3.93***
5.	Fat Free Mass (K.g)	58.99	±6.82	43.97	±5.38	13.47***
6.	Vo_2 max ($mL.K.g^{-1}.min^{-1}$)	48.74	±8.25	33.97	±2.36	12.26***
7.	Systolic Blood Pressure (mmHg)	122.27	±6.33	116.69	±7.19	4.82***
8.	Diastolic Blood Pressure (mmHg)	77.51	±6.09	73.51	±6.07	3.77***

*** indicates $P \leq 0.001$

The linear regression analysis between VO_2 max and other 7 variables in boys and girls is shown in Table 2. The VO_2 max has negatively significant correlations ($p \leq 0.05$) with fat mass (r= - 0.27) in only boys and with systolic blood pressure both in boys (r= - 0.23) and girls (r= - 0.31). Here, the linear regression analysis showed that, fat mass has strong correlation with VO_2 max in boys. The lesser the fat mass in boys, greater is the VO_2 max. The earlier study[6] also showed that boys had greater VO_2 max in comparison to girls. This may also be attributed, impart, to boys higher level of hemoglobin concentration and lower level of subcutaneous fat[12].

The systolic blood pressure had a close negative correlation with VO_2 max. The boys with lower systolic blood pressure had higher VO_2 max values. This may be due to the fact that there exists certain cardiovascular adaptations with fitness training which cause lower blood pressure. The stroke volume increases with lower heart rate, there by increased capillarization of muscles and greater extraction of oxygen from the arteries[9]. These results also coincide with our findings.

Figure 2

Table 2: Linear regression analysis between VO max and other 7 variables in boys and girls

		Age Groups	
S. No.	Variables	Boys n=99	Girls n=49
1.	Height (cm)	0.02	-0.19
2.	Weight (Kg)	-0.12	-0.12
4.	Fat Mass (Kg)	-0.27*	-0.02
5.	Fat Free Mass (Kg)	-0.02	-0.18
6.	Systolic Blood Pressure (mmHg)	-0.23*	-0.31*
7.	Diastolic Blood Pressure (mmHg)	-0.08	0.07

*** indicates P≤ 0.001, * indicates P≤ 0.05

The linear regression analysis for VO_2 max and various parameters (except systolic blood pressure) did not find any correlation in the girls, may be because of the girls selected for the study were purely sedentary without any involvement in physical activity. The results do not match with the earlier report[6] who found correlation between fat%, fat mass and Vo2max. Only the systolic blood pressure among girls had a correlation with VO_2 max, may be the girls were relaxed and stable. Although there appears to be a genetic component in physical fitness[13], several studies have documented relationship between fitness and cardiovascular disease risk factors in adults and children[12,14].

The linear regression analysis between fat mass and other 6 variables in boys and girls is given in Table 3. The fat mass has positively significant correlations (p≤0.05) both in boys and girls with weight (r=0.81and 0.88 respectively), body mass index (r=0.86 and 0.87 respectively), and fat free mass (r=0.61 and 0.69 respectively).

The systolic blood pressure and diastolic blood pressure did not show any correlation with fat mass in both boys and girls. This is in contrary to the results of the earlier study[11] which showed evidence of sex differences in relationship between measures of adiposity and blood pressure.

Figure 3

Table 3: Linear regression analysis between fat mass and other 6 variables in boys and girls

		Age Groups	
S. No.	Variables	Boys n=99	Girls n=49
1.	Height (cm)	-0.01	0.13
2.	Weight (Kg)	0.81*	0.88*
3.	Body Mass Index (kg/m^2)	0.86*	0.87*
4.	Fat free Mass (Kg)	0.61*	0.69*
5.	Systolic Blood Pressure (mmHg)	0.04	0.11
6.	Diastolic Blood Pressure (mmHg)	0.07	0.11

*indicates P≤0.05

Table 4 gives the linear regression analysis between fat free mass and other 5 variables in boys and girls. Both in boys and girls, the fat free mass has positively significant correlations (p≤0.05) with height (r=0.47in both cases), weight (r=0.96 and 0.94 respectively) and body mass index (r=0.80 and 0.78 respectively). Lohman[15] also stated that the density of fat free mass was greater in adult males in comparison with females and children. The coefficient of regression was also having a higher value for fat percent in the girls.

Figure 4

Table 4: Linear regression analysis between fat free mass and other 5 variables in boys and girls

		Age Groups	
S. No.	Variables	Boys	Girls
1.	Height (cm)	0.47*	0.47*
2.	Weight (Kg)	0.96*	0.94*
3.	Body Mass Index (kg/m^2)	0.80*	0.78*
4.	Systolic Blood Pressure (mmHg)	0.17	0.12
5.	Diastolic Blood Pressure (mmHg)	0.14	0.07

* indicates P≤ 0.05

The linear regression analysis between systolic blood pressure and 4 other variables in boys and girls is shown in Table 5. The systolic blood pressure has positively significant correlations (p≤0.05) with diastolic blood pressure in boys (r=0.30) and in girls (r=0.54) respectively. The variation in systolic blood pressure and diastolic blood pressure may be due to interference of other variables like genetics[16], socio-economic status[17] and other metabolic risk factors[18]. Bachmann et al.[19] found body mass is the most important determinant of systolic and diastolic blood pressures which is not confirmed by our findings.

Figure 5

Table 5: Linear regression analysis between systolic blood pressure and other 4 variables in boys and girls.

		Age Groups	
S. No.	Variables	Boys	Girls
1.	Height (cm)	0.12	0.01
2.	Weight (Kg)	0.14	0.11
3.	Body Mass Index (kg/m^2)	0.09	0.13
4.	Diastolic Blood Pressure (mmHg)	0.30*	0.54*

* indicates P≤ 0.05

Table 6 shows the linear regression analysis between diastolic blood pressure and other 3 variables in boys and girls where no significant correlations differences were noted in any case either in the boys or in the girls. Reddy et al[20] have found that body mass index and triceps skin fold thickness were positively correlated with systolic blood pressure and diastolic blood pressure. Balogun et al[21] have revealed that strong determinants of blood pressure levels were body mass, body mass index and triceps skin fold thickness but our results did not confirm this.

Figure 6

Table 6: Linear regression analysis between diastolic blood pressure and other 3 variables in boys and girls

		Age Groups	
S. No.	Variables	Boys	Girls
1.	Height (cm)	0.09	-0.04
2.	Weight (Kg)	0.13	0.09
3.	Body Mass Index (kg/m^2)	0.09	0.12

Thus from above discussion, it may be concluded that a correlation exists for various variables between cardio respiratory fitness, body composition and blood pressure. In order to have higher fitness profile and to avoid cardiovascular complications, young adults should take care of their food habits and physical activity to maintain a fat free body composition.

References

1. Sallis JF, Patterson TL, Buonom MJ, and Nader PR (1988) Relations of cardiovascular fitness and physical activity to cardiovascular disease risk factors in children and adults. Am J Epidemiol
127: 933-941.
2. Anderson GS (1992) The 1600m run and multistage 20m shuttle run as predictive tests of aerobic capacity in children. Pediatr Exerc Sci, 4: 312 - 318.
3. Zuluaga M, Briggs C, Carsile J (1995) Sports Physiotherapy applied Science and
Practice. 1st ed., Churchill Living Stone, London.
4. National Institute of Health, National Heart, Lung and Blood Institute (1998) Clinical guidelines on the identification, evaluation and treatment of overweight and obesity in adults. Evidence report NIH publication no. 98-4083.
5. Kemper HCG, Verschuur R, and de Mey L (1989) Longitudinal change of aerobic fitness in youth ages 12 to 23. Pediatr Exerc Sci
1: 257-270.
6. Guerra S, Ribero JC, Costa R, Duarto J and Mota J (2002) Relationship between cardiorespiratory fitness, body composition and blood pressure in school children. J Sports Med Phys Fitness,
42: 207-213.
7. McArdle WD, Katch IF and Katch LV (2001) Exercise physiology; Energy, Nutrition and human performance, 5th ed. Lippincot Williams and Wilkins.
8. Weiner JS and Lourie JA (1969) Human Biology: A guide to field methods. Oxford: Blackwell Scientific Publications.
9. Wilmore JH and Costill DL (1999) Physiology of sport and exercise, 2nd ed., Human Kinetics.
10. Armstrong N and Welsman J (1997) Physical activity and aerobic fitness in young people. Oxford Medical Publications, Oxford, pp.123-136.
11. Gerber LM, Schwartz JE, Schnall PL and Pickering TG (1995) Body fat and fat distribution in relation to sex differences in blood pressure. Am J Hum Biol, 7: 173-182.
12. Armstrong N, Balding J, Gentle P and Kirby B (1992) Serum lipids and blood pressure in relation to age and sexual maturity. Ann Hum Biol, 19: 447 - 487.
13. Malina RM (1994) Growth and maturation: normal variation and effect of training. In: Gisolfi CV, Lamb DR, editors. Perspectives in exercise science and sports medicine: youth, exercise and sport. Indianpolis, IN: Benchmark press; 223-265.
14. Leon AS, Jacobs DR, DeBacker G and Taylor HL (1981) Relationship of physical characteristics and life habits to treadmill exercise capacity. Am J Epidemiol, 113: 653-660.
15. Lohman TG (1986) Applicability of body composition techniques and constants for children and youths. Exerc Sports Sci Rev, 14: 325-357.
16. Malina RM and Bouchard C (1991) Genetic regulation of growth, maturation and performance. In: Growth, maturation and physical activity. Eds. Malina RM, Bouchard C and Ored Bar-Or, Champaign, Illinois: Human Kinetics Publishers, Inc; pp.303-327.
17. Reddy BN (1998) Blood pressure and Adiposty : a comparative study of socio economically diverse groups of Andhra Pradesh, India. Am J Hum Biol, 10: 5 - 21.
18. Blair SN, Ludwig DA, and Goodyear NN (1998) A canonical analysis of central and peripheral subcutaneous fat distribution and coronary heart disease risk factors in men and women aged 18-65 years. Hum Biol, 60: 111-122.
19. Bachmann H, Horacek U, Leowsky M and Hirche H (1987) Blood pressure in children and adeloscents aged 4 to 18. Correlation of blood pressure values with age, sex, height, body weight and skinfold thickness. Monatsschr Kinderheilkd, 135: 128-134.
20. Reddy RV, UdayaLakshmi P and Reddy NS (1995) Blood pressure and anthropometric variation in rural south eastern Andhra Pradesh. J Hum Ecol, 6: 126-130.
21. Balogun JA, Obajuluwa VA, Aberreoje OK, Olaogun MO, Oyeyemi AY and Balogun MO (1990) Anthropometric determinants of resting blood pressure and heart rate of Nigerian school children. Ann Trop Paediatr,
10: 425-431.

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