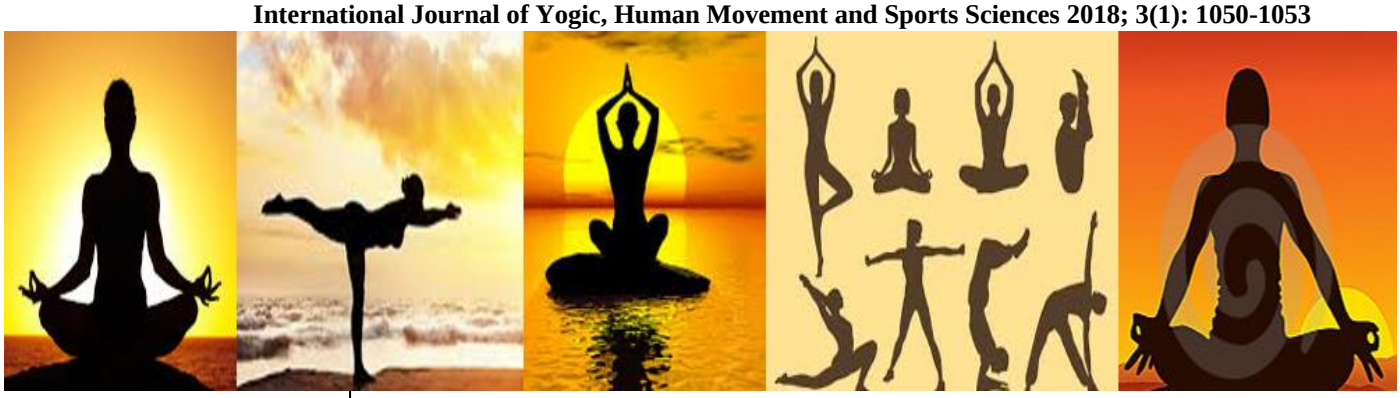
International Journal of Yogic, Human Movement and Sports Sciences 2018; 3(1): 1050-1053



ISSN: 2456-4419
Impact Factor: (RJIF): 5.18
Yoga 2018; 3(1): 1050-1053

www.theyogicjournal.com
Received: 07-11-2017
Accepted: 08-12-2017

Jyotsna Aggarwala
Human Performance Lab, Sports Authority of India, New Delhi India

Meenu Dhingra
Human Performance Lab, Sports Authority of India, New Delhi, India

Alisha Khan
Human Performance Lab, Sports Authority of India, New Delhi

Correspondence
Jyotsna Aggarwala
Human Performance Lab, Sports Authority of India, New Delhi India

Relationship between physiological and anthropometric characteristics in elite sports persons

Jyotsna Aggarwala, Meenu Dhingra and Alisha Khan

Abstract
Background/Aims: The reduction in the physical activity affects body composition factors like body fat percentage, body mass index (BMI) and body muscle mass. There are close relationships between the body composition factors and aerobic, cardiovascular fitness. The present study was conducted to analyze this trend in sports population.
Methodology: 88 male sports persons were recruited for the study from National Academies at Sports Authority of India having at least 3 years of training experience in their respective sports. BMI and total body fat percent was estimated using anthropometric method. Aerobic capacity was measured using the Astrand protocol.
Results: Significant but weak negative correlation was obtained between aerobic capacity and BMI (-0.301, $p<0.01$) and aerobic capacity and body fat percent (-0.320, $p<0.01$).
Conclusion: Anthropometric measures of body mass index and body fat percent have found to be negatively correlated with aerobic capacity. However, the level of correlation is quite less; the study therefore, needs further corroboration with different athletic groups segregating the athletic population based on the dominant sports demands like endurance, speed, agility or strength.

Keywords: Aerobic capacity, body fat percent, anthropometry, physiology, sports

Introduction
Aerobic capacity has been accepted as the major component of physical capacity in athletes. Maximal oxygen uptake ($VO_{2\ max}$) has been regarded by majority of authors as the best indicator of aerobic capacity of an organism, and at the same time, the best indicator of an athlete's physical capacity (Rankovic *et al.*, 2010) [14]. $VO_{2\ max}$ is the highest rate of oxygen consumption attainable during maximal exercise. Maximal oxygen uptake as a measure of aerobic capacity has been determined as the international standard of physical activity (Bowers, 1988). The basic unit of measuring the maximal oxygen uptake is its absolute value expressed in liters or milliliters per minutes. However, the absolute value is highly affected by body weight; so it is often expressed as milliliter/kg/minutes.
The reduction in the physical activity affects body composition factors like body fat percentage, body mass index and body muscle mass. There are close relationships between the body composition factors and aerobic or cardiovascular fitness. With decrease in body fatness, there is increase in aerobic fitness (Brooks, 2002) [4]. Recent studies suggest that even in young, physically, highly active men with an obviously optimal lifestyle; a lower BMI is associated with more risk profile for vascular disease. For young, active sportspersons all these factors are concerned for their cardiovascular risk profile (Pearson *et al.*, 2002) [13].
Amani, Somchit, Konting & Kok, 2010 [1] have shown that a moderate negative correlation exists between body fat percent and aerobic capacity. It is suggested that excessive amount of waste fat exerts an unfavourable burden on cardiac function and oxygen uptake by working muscles. Low cardio-respiratory fitness in young adults with increased body fat could be a factor for developing cardiovascular co morbidities later in middle age and old age (Sharma, Kamal & Chawla, 2016) [16]. Some other studies have shown that there is no significant relationship between the body composition and aerobic capacity of sports persons (Dhara & Chatterjee, 2015) [6]. Strong negative correlation between fat percent and different measures of aerobic capacity in both male and female distance runners (MST & 12 min walk run) demonstrated by Demirkan, Can & Arslan, 2016.

Table 1: Review of studies on relationship between aerobic capacity and body composition parameters

S. No.	Authors	Year of publication	Sample size (N)	Type of subjects	Parameters studied	Level of significance	Correlation
1	Goran *et al*.	2000	129	Pre pubertal children	$VO_{2\ max}$ & FM $VO_{2\ max}$ & BMI	0.0001	0.66 0.61
2	Bandyopadhyay *et al*.	2006	119 (males)	Sedentary	$VO_{2\ max}$ & BFP	0.001	-0.64 (Obese) -0.60 (Non obese)
3	Mclester *et al*.	2008	31 (males)	Untrained	$VO_{2\ peak}$ & BFP	0.05	-0.534
4	Wong *et al*.	2009	70 (males)	Soccer players	$VO_{2\ max}$ & BMI	0.001	-0.42
5	Amani *et al*.	2010	26 (males)	Untrained	BFP & VO_{2max}	0.05	-0.402
6	Shete *et al*.	2014	50 (females)	25 athletes; 25 non athletes	VO_{2max} & body fat %		NS
7	Maciejczyk *et al*.	2014	39 (males)	Recreationally physically active	$VO_{2\ max}$ & BMI; $VO_{2\ max}$ & BFP	0.05	-0.47 -0.40
8	Minasian *et al*.	2014	12946 (10531 females; 2415 males)	Middle school students	BFP & $VO_{2\ max}$ Boys Girls	0.01	-0.81 -0.77
9	Laxmi *et al*.	2014	100 (males)	Healthy	BMI & VO_{2max}	0.01	-0.48
10	Dhara & Chatterjee	2015	30 (males)	Physical education students	BMI & VO_{2max}		NS
11	Sharma *et al*.	2016	30 (males)	Healthy	BMI & VO_{2max} BFP & VO_{2max}	0.05	-0.868 -0.929
12	Demirkan *et al*.	2016	25 (13 males; 12 females)	Distance runners	Aerobic fitness & BFP		-0.81 for males; -0.77 for females
13	Mondal & Mishra.	2017	54 (30 males; 24 females)	Healthy medical students	$VO_{2\ max}$ & BMI BFP & $VO_{2\ max}$	0.05 0.0001	-0.32 -0.75

The previous studies have shown contradictory findings and thus there was a need to conduct a study on a larger population of sports persons from various sports disciplines to have a clear idea of the relationship between body composition and aerobic capacity.

Materials & Methods

Study design and subjects

In the present cross-sectional study, 88 male sports persons participated in the study. The subjects were taken from intermittent sports such as football, hockey, cycling, athletics and gymnastics. All the subjects had a minimum of 3 years of training in their respective sports and were part of National Academies at Sports Authority of India (SAI). Prior to participation in the study, informed written consent was taken from each of them. Ethical clearance was taken from the Institutional Ethical Committee of the Sports Authority of India.

Inclusion criteria

1. Males
2. Years of training more than 3 years
3. Age between 16-22 years

Exclusion criteria

1. Male subjects below 16 years and above 22 years of age
2. BMI below 18 kg/m^2 and above 25 kg/m^2.

Methodology: Height and weight was measured using Seca stadiometer and digital weighing scale. Aerobic capacity was analysed using the Astrand protocol on Monark LC7 Bicycle Ergometer. During the protocol, heart rate was assessed using Polar H7 heart rate monitor. Holtain skin fold caliper was used to measure skin folds at triceps, biceps, subscapular and suprailiac regions nearest to 0.2 mm. These measurements were used to calculate the body density using Durnin & Womersley's Equation and percent body fat percent using Siri's equation (Siri, 1956) [15].

Percent body fat = (4.95-4.5)/D * 100 (Siri 1956) [15]

Statistical analysis: The software used for analysis was SPSS 17.0. The data was analysed for normality. Correlation analysis of body mass index and body fat percent with aerobic capacity was done using Pearson's partial correlation coefficient statistics. The value of p below the level of 0.05 was considered significant.

Results

Table 2: Mean and standard deviation of different parameters of sports persons.

	Age (years)	Years into training (years)	VO_{2max} (ml/min/kg)	BMI (kg/m^2)	Body fat percent (%)
Mean	17.58	5.02	49.37	21.7	11.32
StandarDeviation	1.26	2.07	9.13	1.89	2.79

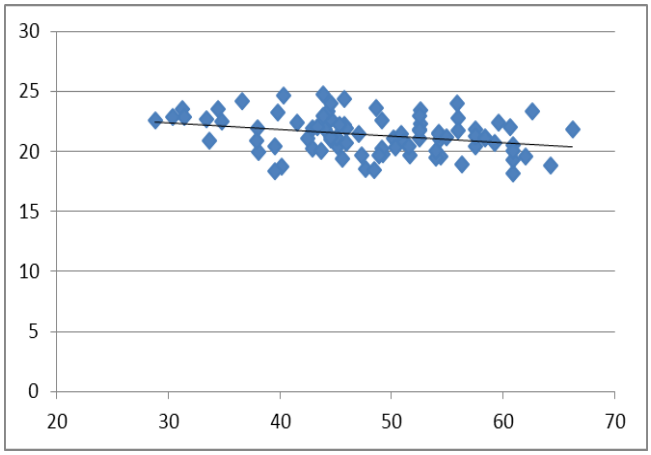


Fig 1: Correlation between BMI and aerobic capacity (-0.301**)

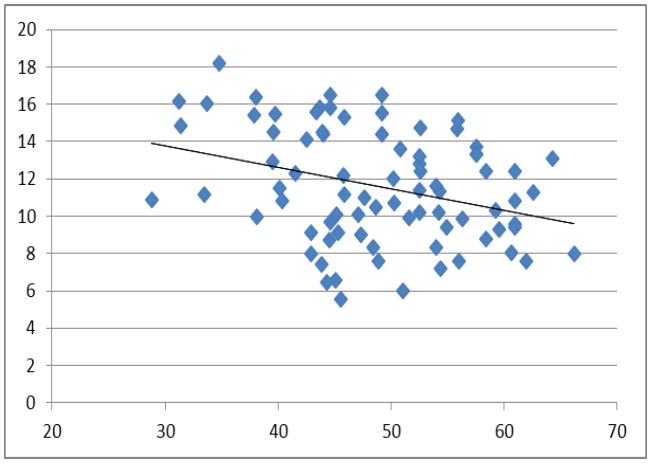


Fig 2: Correlation between body fat percent and aerobic capacity (-0.320**)

Discussion

The sports that were included in the present study were intermittent sports, that is, requiring both aerobic as well as anaerobic components, however, the level of physiological requirements or aerobic capacity varies in these sports. We obtained a significant but weak negative correlation between both VO_{2max} and BMI, and VO_{2max} and body fat percent in sports persons. In sports persons, it would not be wise to predict aerobic capacity on the basis of their body composition.

Our study was in accordance with Wong *et al* (2009) [18] who reported similar findings in male soccer players with a correlation value of -0.42 (p<0.001) between VO_{2max} and BMI. The author stated that scientific rationale of selecting players according to their anthropometry provides short term benefits and does not justify such practice in the long term process of player's development. Maciejczyk *et al* in 2014 [9] obtained similar results in recreationally physically active males between VO_{2max} and BMI; and VO_{2max} and body fat percentage. On the other hand, no significant relationship was obtained in male physical education students between aerobic capacity and BMI (Dhara & Chatterjee, 2015) [6]. Demirkan, Can & Arslan (2016) [5] reported a moderately high correlation between aerobic fitness and body fat percentage (-0.81 in males and -0.77 in females). In females, no significant correlation reported between aerobic capacity and body composition (body fat percent) both in athletes and non-athletes. (Shete, Bute & Deshmukh, 2014) [17].

In healthy and untrained individuals, a greater relationship between physiology and anthropometry has been reported. A probable reason for this could be the fact that untrained individuals and sedentary individuals may have BMI above 25 kg/m^2. In obese males correlation between VO_{2max} and body fat percent was found to be -0.64 and in non-obese sedentary males -0.60 (p<0.001) (Bandhopadhyay, Chatterjee, Chatterjee, Papadopoulou & Hassapidou, 2006) [6]. Sharma, Kamal & Chawla, 2016 [16] found a high negative correlation between VO_{2max} and body fat percent in healthy males. Many studies that were conducted emphasise on the similar findings indicating a moderate negative correlation between aerobic capacity and body composition (Mclester, Green, Wickwire & Crews, 2008; Amani, Somchit, Konting & Kok, 2010 [1]; Minasian, Marandi, Kelishadi & Abolhassani, 2014; [] Laxmi, Udaya & Vinutha, 2014; & Mondal & Mishra, 2017) [], with an exception where a positive significant correlation was obtained (Goran, Fields, Hunter, Herd & Weinsier, 2000)[].

Conclusion

From the present study it is concluded that aerobic capacity shows weak negative correlation with BMI, and Body fat percentage in sports population. It may also be well understandable that while anthropometric measurements could be used to predict aerobic fitness in large population but that should be only for short term assessments. For carrying out long term assessments of physical fitness or aerobic fitness in athletes, standard procedures for aerobic capacity should be included i.e. indirect or direct gas exchange method using metabolic gas analyzer. As body fat shows weak negative correlation, it may be elucidated that the study needs further corroboration with different athletic groups segregating the athletic population based on the dominant sports demands like endurance, speed, agility or strength.

Limitations

The measurements of aerobic capacity using the direct method of metabolic gas analyzer could have provided more reliable results. The sample of the study was segregated between various sports. A larger sample size form a particular sport will provide correct insight for every sport and not of the sporting population as a whole.

References

1. Amani AR, Somchit MN, Konting MB, Kok LY. Relationship between body fat percent and maximal oxygen uptake among young adults. Journal of American Science. 2010; 6(4):1-4.
2. Bandyopadhyay A, Chatterjee S, Chatterjee P, Papadopoulou SK, Hassapidou M. VO_{2max} of boys according to obesity status. Journal of Human Movement Studies. 2006; 51:167-180.
3. Bowers RW, Fox EL. Sports Physiology. Boston: Graw Hill, 1988.
4. Brooks LL. The effect of after school physical activity and adult encouragement on adolescent. University of Wisconsin, 2002.
5. Demirkan E, Can S, Arslan E. The relationship between body composition and aerobic fitness in boys and girls distance runners. International Journal of Sports Science. 2016; 6(2):62-65.
6. Dhara S, Chatterjee K. A study of VO_{2max} in relation with body mass index of physical education students. Research Journal of Physical Education Sciences. 2015; 3(6):9-12.
7. Goran M, Fields DA, Hunter GR, Herd SL, Weinsier RL. Total body fat does not influence maximal aerobic

capacity. International Journal of Obesity. 2000; 24:841-848.
8. Laxmi CC, Udaya IB, Vinutha SS. Effect of body mass index on cardiorespiratory fitness in young healthy males. International Journal of Scientific & Research Publications. 2014; 4(2):1-4.
9. Maciejczyk M, Wiecek M, Szymurz J, Szygula Z, Wiecha S, Cempla J. Effect of body composition on aerobic performance. PLoS One, 2014; 9(4):95797.
10. Mclester JR, Green JM, Wickwire PJ, Crews TR. Relationship of VO_2 peak, body fat percentage and power output measured during repeated bouts of a wingate protocol. International Journal of Exercise Science. 2008; 1(2):79-90.
11. Minasian V, Mohammad S, Kelishadi R, Abolhassani H. Correlation between aerobic fitness and body composition in middle school students. International Journal of Preventive Medicine. 2014; 5(2):102-107.
12. Mondal H, Mishra SP. Effect of BMI, body fat percentage and fat free mass on maximal oxygen consumption in healthy young adults. Journal of Clinical & Diagnostic Research. 2017; 11(6):17-20.
13. Pearson TA, Blair SN, Daniels SR, Eckel RH, Fair JM, Fortmann SP. Guidelines for primary prevention of cardiovascular disease and stroke consensus panel guide to comprehensive risk education for adult patients without coronary or other atherosclerotic vascular diseases.; American heart association science advisory and co-ordinating committee. Circulation. 2002; 106:388-391.
14. Rankovic G, Mutavdzic V, Toskic D, Preljevic A, Kocic M, Nedin RG, Damjanovic N. Aerobic capacity as an indicator in different kinds of sports. Bosnian Journal of Basic Medical Sciences. 2010; 10(1):44-48.
15. Siri WE. In Advances in Biological and Medical Physics. [Lawrence J. H. and Tobias C. A. editors.] London and New York: Academic Press Inc, 1956.
16. Sharma M, Kamal RB, Chawla K. Correlation of body composition to aerobic capacity; A cross sectional study. International Journal of Applied Research. 2016; 2(1):38-42.
17. Shete AN, Bute SS, Deshmukh PR. A sudy of VO_{2max} and body fat percentage in female athletes. Journal of Clinical & Diagnostic Research. 2014; 8(12):BC01-BC03.
18. Wong P, Chamari K, Dellal A, Wisloff U. Relationship between anthropometric and physiological characteristics in youth soccer players. The Journal of Strength & Conditioning Research, 2009; 23(4):1204-1210.