

ANTHROPOMETRIC PROFILE, BODY COMPOSITION AND VERTICAL JUMP SCORE IN BOXERS AND SWIMMERS

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Background. Vertical jump test (VJT) is used in some sport disciplines to evaluate an individual's lower extremity power. However, VJT data is unavailable in young Indian boxers and swimmers.

Objective. The given study was aimed to evaluate the VJT, anthropometric profile and body composition in young male Indian swimmers and boxers and compare the data with sedentary control group. The study also explored the relationship of VJT with anthropometric parameters and different components of body composition in the studied groups.

Methods. Male boxers (n=40), swimmers (n=40) and sedentary subjects (n=40) with similar socio-economic background with age ranging between 21 and 25 years were sampled for the study from Kolkata, India. Body composition was determined by skinfold measurements and VJT was evaluated by Sargent Jump Test.

Results. One way ANOVA shows significant ($p < 0.001$) difference in body mass, %Fat, total body fat (TF), lean body mass (LBM) and VJT score in boxers, swimmers and sedentary groups. Significant positive correlation of LBM with VJT score was associated with a greater jumping height in swimmers. On the other hand, VJT had significant negative ($p < 0.05$) correlation with sum of all the skinfolds, individual skinfold and total fat in both athlete group as well as in the sedentary group.

Conclusion. Significant intergroup difference was found in the studied parameters. VJT scores obtained in all the groups were well comparable. Higher value of body %Fat imposed the unfavourable effect towards achieving higher jumping height mainly in sedentary group.

KEY WORDS: VJT, boxers, swimmers, %Fat, LBM.

Introduction

Vertical jump test (VJT) is used to evaluate the leg power or leg strength which is an important component of fitness testing in athletes as well as in sedentary population [1, 2]. Muscular strength is also assessed by vertical jump testing procedure [3]. Plyometric exercise training improves vertical jump performance and leg strength [4]. Vertical jumping and lower extremity power are significant in achieving success in volleyball players [5]. Higher value of VJT of international male volleyball players showed a better performance of explosive strength and a better use of arms during jumping activities [6]. Low fat percentage (%Fat) appeared to coincide a better performance in VJT score also in elite male handball players [7]. To the opposite, higher %Fat and BMI values exhibited poor physical fitness and lower value of VJT score in volleyball players [8]. Swimming

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performance depends on muscular power [9], muscular endurance [10], anthropometric characteristics, as well as on body composition in relation to VJT score. Swimmers need high muscle power functioning in lower limbs to achieve a sound performance [11]. The swimming start can be seen as an explosive event (jump), which requires high force production over a short period of time. There are, however, a few citations in the literature regarding the jump performance of swimmers [12]. Previous study showed that amateur boxers had lower VJT score, compared to wrestlers [13]. There is no data concerning jump performance (VJT) in Indian boxers and swimmers. Moreover, the relationship of VJT with anthropometric parameters and body composition in swimmers and boxers has not yet been investigated in Indian context. Therefore, the purpose of the present study was to: evaluate the VJT, anthropometric profile and body composition in young male Indian swimmers and boxers; compare the VJT, anthropometric profile and body composition between the boxers, swimmers and with sedentary control group; explore the

relationship of VJT with anthropometric parameters and different components of body composition in the studied population.

Methods

Selection of Subjects

Young male swimmers (n=40) and boxers (n=40) belonging to 20–24 years age group with an average of five years training experience were sampled for the study from different sports academies in Kolkata, India. The sedentary control group (n=32) was randomly selected from the postgraduate section of the University of Calcutta, Kolkata, India. All participants had similar socio-economic background, and were disease-free, took no medication during the study period, and had no history of previous bone fracture or heavy injury. Written informed consent was obtained from each participant in accordance with the policy of the University of Calcutta Ethics Board. The study was approved by the Human Ethics Committee of the Department of Physiology, University of Calcutta.

The study was conducted at a room temperature ranging between 20–23 °C and relative humidity ranging between 40–45 %. After coming in the laboratory, subjects took rest for half an hour. Body height was measured with the subject standing barefoot with an accuracy of ± 0.50 cm whereas the body mass was measured to an accuracy of ± 0.1 kg by using the weight measuring instrument fitted with height measuring rod (Avery India Ltd., India) with the subject wearing minimum clothing.

Determination of Body Composition [14]

Body composition was determined by skinfold measurement using the following formulae:

Body density (BD; gm·cc⁻¹) was determined by means of the following equations:

$$BD = 1.10938 - 0.0008267X_1 + 0.0000016X_1^2 - 0.0002574X_2$$

(X₁ = sum of chest, abdominal, thigh skinfolds, X₂ = Age in nearest yrs)

$$\%Fat = 495/BD - 450$$

Percentage of lean body mass (%LBM), total body fat, and total LBM were calculated using the following equations:

- % Lean Body Mass (%LBM) = 100 – %Fat
- Total Fat or TF (kg) = %Fat/100 × Body Mass (kg)

- LBM (kg) = Body Mass (kg) – Total Fat (kg)

Determination of VJT Score

The VJT Score of each subject was measured according to the protocol elaborated in earlier reports [15].

Statistical analyses

Data have been presented as mean \pm SD. One way ANOVA was conducted to determine the significance of difference in the undertaken parameters among the studied groups. Pearson's product moment correlation was conducted to calculate the relationship between physical parameters and VJT score. Regression analysis was adopted to calculate the prediction norms for predicting VJT score from different physical parameters.

Results

Values of physical and anthropometric parameters and vertical jump score in boxers and swimmers and their sedentary counterparts are shown in table 1. Table 2 represents the values of correlation coefficient of VJT scores with different anthropometric parameters and body composition in boxers, swimmers and sedentary group. Simple and multiple regression norms for the prediction of VJT score in Indian boxers and swimmers and sedentary groups are shown in table 3 and table 4, respectively.

Discussion

Mean values of age, body weight, and body height, BMI, %Fat, TF, LBM and VJT score are displayed in table 1. Among the three groups, one way ANOVA shows significant inter-group difference (P<0.05) in the parameters (body height, BMI, %Fat, TF, LBM and VJT score), except the body height (table 1). Bonferroni correction was performed in the cases when it was reasonable. According to the classification of Arkinstall VJT scores, obtained in boxers and swimmers, were below average level [16].

Table 1. Values of physical and anthropometric parameters and vertical jump score in boxers and swimmers

	Age (yrs)	Height (Cm)	Weight (Kg)	BMI (kg·m ²)	%fat (%)	Total Fat (kg)	LBM (kg)	VJT Score (cm)
Sedentary (n=32)	22.53 \pm 1.5	167.04 \pm 3.2	66.01 \pm 7.7	23.64 \pm 2.56	14.58 \pm 3.29	9.8 \pm 3.06	56.2 \pm 5.29	35.5 \pm 2.7
Boxer (n=40)	22.12 \pm 1.11	166.16 \pm 3.33NS	53.32 \pm 2.81*	19.33 \pm 1.51*	6.25 \pm 1.47*	3.37 \pm 0.95*	4.95 \pm 2.06*	37.31 \pm 4.28
Swimmer (n=40)	22.95 \pm 1.37	165.22 \pm 4.57	58.32 \pm 7.55*#	21.28 \pm 1.90*#	10.99 \pm 1.81#	6.39 \pm 1.54*#	51.92 \pm 7.08*	40.80 \pm 4.15*#

Values are mean \pm SD, *p<0.05, #p<0.05 when compared to control, # When compared to boxer and swimmer.

Table 2. Values of correlation coefficient of VJT scores with different anthropometric parameters and body composition in boxers, swimmers and sedentary group

	Age (Yrs)	Body weight (kg)	Body height (cm)	BMI (kg·m ⁻²)	Sum of Skinfoldds (mm)	%Fat (%)	TF (kg)	LBM (kg)	VJT (cm)
Age	C	0.001	-0.095	0.039	-0.106	-0.060	-0.054	0.033	-0.11
	B	-0.23	0.015	-0.22	-0.20	-0.14	-0.15	-0.25	0.20
	S	0.16	0.09	0.21	0.03	0.08	0.18	0.13	-0.15
BW	C		0.38*	0.95***	0.69***	0.70***	0.86***	0.96***	-0.62***
	B		0.19	0.76***	0.80***	0.79***	0.85***	0.97***	-0.42*
	S		0.84***	0.95***	-0.22	-0.20	0.47**	0.98***	0.31*
BH	C			0.07	0.064	0.062	0.19	0.45*	-0.18
	B			-0.49	0.11	0.11	0.13	0.20	-0.26
	S			0.63***	-0.03	-0.02	0.48*	0.82***	0.35*
BMI	C				0.72***	0.73***	0.86***	0.88***	-0.60***
	B				0.64***	0.63***	0.68***	0.73***	-0.18
	S				-0.26	-0.24	0.43*	0.94***	0.21
Sum of Skinfoldds	C					0.99***	0.95***	0.46**	-0.66***
	B					0.97***	0.99**	0.63**	-0.41*
	S					0.99***	0.74***	-0.35*	-0.43*
%Fat	C						0.96***	0.47**	-0.66***
	B						0.99***	0.62***	-0.40*
	S						0.75***	-0.34*	-0.45*
TF	C							0.68***	-0.70***
	B							0.70***	-0.42*
	S							0.34*	-0.20
LBM	C								-0.50**
	B								-0.38*
	S								0.36*
VJT	B								
	S								

***p<0.001, **p<0.01, *p<0.05, B = boxer group, S = swimmer group, C= sedentary group.

Table 3. Simple regression norms for the prediction of VJT score in Indian boxers and swimmers

Group	Simple Regression Equation	SEE (cm)
Sedentary	VJT=44.99-0.78 %fat	2.06
Boxer	VJT=44.54-1.16 %fat	3.92
Swimmer	VJT=52.06-1.02 %fat	3.71
Sedentary	VJT=45.26-0.23 S	2.09
Boxer	VJT=46.23-0.37 S	3.90
Swimmer	VJT=52.59-0.30 S	3.75
Sedentary	VJT=50.58-0.26 LBM	2.34
Boxer	VJT=76.32-0.78 LBM	3.96
Swimmer	VJT=29.69+0.21 LBM	3.87

S = sum of skinfoldds, LBM = lean body mass

In the present study VJT score of the swimmers was significantly (P<0.001) higher than the boxers, and sedentary group. Papadopoulos et al. [12] reported lower values of vertical jumps performance in much younger (14.5±1.3 years old) swimmers, compared to an average of 22 years old swimmers in present study. Similarly, the VJT score in boxers in present study (age of an average of 22) was higher,

compared to the jumping performance of the younger subjects (male kick boxers with the age 18.5±1.85 years), reported by Ouergui [13]. The variances of the results in jumping performance can be explained by the age of subjects in different studies. It is worth mentioning that in the given study VJT score of the swimmers was lower, compared to data reported for the vertical jump performance in American football players of similar age [17]. The variances of the results in jumping performance in these two studies can be attributed possibly to the special type of movements with higher specific requirements for power performance of the American football players, compared to swimmers.

In the given investigation VJT score was significantly (P<0.001) higher in boxers and swimmers than their sedentary counterparts. This finding was similar to the earlier report in male elite volleyball players who also demonstrated significant positive correlation between height and VJT score [5]. Malaysian male taekwondo players had significantly higher VJT score than their female counterparts [18].

Table 4. Multiple regression norms for the prediction of VJT score in Indian boxers and swimmers

Group	Regression Equation	R	R ²	SEE (cm)
Sedentary	VJT=49.96-0.62 %fat-0.12 LBM	0.70 (P<0.001)	0.4901	1.97
Boxer	VJT=66.91-1.22 %fat-0.44 LBM	0.43 (P<0.02)	0.1849	3.86
Swimmer	VJT=37.90-0.87 %fat-0.24 LBM	0.51 (P<0.01)	0.2601	3.57

LBM = lean body mass

Earlier studies reported significant positive correlation of height with VJT score in male elite volleyball players [5]. In the given study significant positive correlation was found between height and VJT score in swimmers. This finding corroborated with the earlier study in Malaysian martial art players [19].

Vertical jump score of athletes could be predicted by %Fat which is related to the work performed during vertical jump [20]. Previous research suggests that a reduction of body fat by proper dietary planning would help to develop leg power [21]. In the present study the VJT score had significant (P<0.001) negative correlation with the individual skinfold, sum of skinfolds, %Fat and TF. However, LBM showed significant (P<0.05) negative correlation with VJT score in boxers only. Analogous findings were also reported in Malaysian martial art players [19]. Similarly, poor VJT score in professional rugby league players was attributed to the higher value of %Fat [22].

Generally, sedentary individuals have a larger body %Fat. Hence, athletes with lower body %Fat have advantages in vertical jumps. Body %Fat is the best predictor of vertical jump for recreational male athletes. In the present study, sum of skinfold thicknesses has significant negative correlation with VJT score [1,20]. Therefore, an individual who has lower body fat percentage would be able to make more jumping height [18,23].

Simple regression equations have been calculated to find out norms for the prediction of VJT score from %Fat, sum of skin folds and total fat (TF). Multiple regression equations were also calculated to predict VJT score in both the athlete groups from sum of skinfolds and total fat (TF). In the multiple regression equations %Fat was not considered as a predictor variable since it was calculated from the sum of skinfolds. Standard errors of estimate (SEE) of the computed multiple regression equations were smaller than the simple regression equations and the values of these SEE were substantially small enough to recommend the multiple regression norms for practical use in epidemiological studies and also in clinical settings.

Conclusion

One way ANOVA showed significant (p<0.001) difference in body mass, %Fat, total body fat (TF), lean body mass (LBM) and VJT score in boxers, swimmers and sedentary groups. The VJT scores, obtained in the athlete groups, were below average, compared to data from other studies. Higher value of body %Fat imposed the unfavourable effect on achieving higher jumping height mainly in sedentary group. Significant positive correlation of LBM with VJT score was associated with a greater jumping height in swimmers. On the other hand, VJT had significant negative (p<0.05) correlation with sum of all the skinfolds, individual skinfold and total fat in both athlete group as well as in the sedentary group.

References

1. Roschel H, Batista M, Monteiro R, Bertuzzi RC, Barroso R, Loturco I. Association between neuromuscular tests and kumite performance on the Brazilian karate national team. *J Sports Sci Med* 2008; 8: 20-24.
2. Sargent D. The physical test of a man. *Am Phys Edu Rev* 1921; 26: 188-194.
3. Ostojic SM, Stojanovic M, Ahmetovic Z. Vertical jump as a tool in assessment of muscular power and anaerobic performance. *Med Pregl* 2010; 63(5-6): 371-375.
4. Ioannis G, Athanasios Z, Leontsini D, Kyriakos N, Kostopoulos N, Buckenmeyer P. Evaluation of plyometric exercise training, weight training, and their combination on vertical jumping performance and leg strength. *J Strength Cond Res* 2000; 14(4): 470-476.
5. Stec M, Smulsky V. The estimation criteria of jump actions of high performance female volleyball players. *Research Yearbook* 2007; 13: 77-81.
6. Borrás X, Balias X, Drobnic F, Galilea, P. Vertical jump assessment on volleyball: a follow-up of three seasons of a high-level volleyball team. *J Strength Cond Res* 2011; 25: 1686-94.
7. Nikolaidis PT, Ingebrigtsen J. Physical and physiological characteristics of elite male handball players from teams with a different ranking. *J Hum Kinet* 2013; 8 (38): 115-124.
8. Nikolaidis PT. Body mass index and body fat percentage are associated with decreased physical fitness in adolescent and adult female volleyball players. *J Res Med Sci* 2013 ; 18(1): 22-26.

9. Hawley JA, Williams MM, Vickovic MM, Handcock PJ. Muscle power predicts freestyle swimming performance. *Br J Sports Med* 1992; 26: 151–155.
10. Wakayoshi K, LJ D'Acquisto, Cappaert JM, Troup JP. Relationship between oxygen uptake, stroke rate and swimming velocity in competitive swimming. *Int J Sports Med* 1995; 16: 19–23.
11. Mameletzi D, Siatras T. Sex differences in isokinetic strength and power of knee muscles in 10–12 year old swimmers. *Isokinet Exerc Sci* 2003; 11: 231–237.
12. Papadopoulos C, Sambanis M, Gisis I, Noussios G, Gandiraga E, Manolopoulos E, Papadimitriou ID. Evaluation of force and vertical jump performance in young swimmers with different force-time curve characteristics. *Biol Sport* 2009; 26: 301–307.
13. Ouergui I, Hammouda O, Chtourou H, Gmada N, Franchini E. Effects of recovery type after a kickboxing match on blood lactate and performance in anaerobic tests. *Asian J Sports Med* 2014; 4 (2): [in press].
14. Jackson AS, Pollock ML. Generalized equations for predicting body density of men. *Br J Nutr* 1978; 40: 497–504.
15. Chatterjee S, Chatterjee P, Mukharjee PS, Bandyopadhyay A. Vertical jump test on school going boys and girls. *Ind J Physiol & Allied Sci* 2004; 2: 58.
16. Arkinstall M. *VCE Physical Education* 2nd. Malaysia: Macmillian; 2010: 248.
17. Vural F, Nalcasan GR, Ozkol MZ. Physical and physiological status in American football players in Turkey. *Serb J Sports Sci* 2009; 3 (1–4): 9–17.
18. Noorul HR, Pieter W, Erie ZZ. Physical fitness of recreational adolescent taekwondo athletes. *Braz J Biomotricity* 2008; 2(4): 230–240.
19. Nahdiya A. Prediction of vertical jump height from anthropometric factors in male and female martial arts athletes. *Malays J Med Sci* 2013; 20: 39–45.
20. Davis DS, Briscope DA, Markowski CT, Saville SE, Taylor CJ. Physical characteristics that predict vertical jump performance in recreational male athletes. *Phys Ther Sport* 2003; 4: 167–174.
21. Shin N, Hyun W, Lee H, Ro M, Song K. A study on dietary habits, health related lifestyle, blood cadmium and lead levels of college students. *Nutr Res Pract* 2012; 6(4): 340–348.
22. Gabbett TJ. Physiological and anthropometric characteristics of amateur rugby league players. *Br J Sports Med* 2000; 34: 303–307.
23. Dizon JMR, Somers KG. Making Filipino taekwondo athletes internationally competitive: an international comparison of anthropometric and physiologic characteristics. *J Sport Med Doping Studies* 2012; 2: 1–7.

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