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Leg explosive power and handgrip strength of college students

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ABSTRACT

The purpose of the present study was to compare the leg explosive power and handgrip strength of Indian college level men physical education and non-physical education students and also find out the relationship with body composition variables to leg explosive power and handgrip strength. A total of 500 (physical education- 250 & non-physical education- 250) college level male students, aged 18-25 years (mean 22.29 ± 2.21) were selected purposively selected as the samples of the study. Sargent vertical jump test and a standard adjustable digital handgrip dynamometer were used for measuring leg explosive power and handgrip strength respectively. Anthropometric measurements were taken for estimating % body fat, % skeletal muscle mass, lean body mass and body surface area of the selected subjects. The findings of the present study showing that physical education students have higher mean values in leg explosive power ($P \leq 0.01$) and handgrip strength ($P \leq 0.01$) than non-physical education students. Leg explosive power had significantly positive correlation ($P \leq 0.01$) with % skeletal muscle mass and lean body mass and significantly negative correlation ($P \leq 0.01$) with rest of the body composition variables irrespective of physical education and non-physical education students. Handgrip strength had significantly positive correlations ($P \leq 0.01$) with all the body composition variables irrespective of physical education and non-physical education students. It may be concluded that physical activity has strong positive relationship with leg explosive power and handgrip strength.

Key words: Body Composition, Vertical Jump, Physical Education

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INTRODUCTION

The most obvious benefit of strong, healthy muscles is the ability to perform everyday tasks efficiently and effectively, which contributes to a healthy lifestyle. The importance of strength and power in the majority of sports is well accepted and early identification of high strength and power levels can be a useful tool for talent identification, strength diagnosis, and development of sport specific profile [1-3]. According to Aragon-Vargas [4] vertical jump tests are common in physical education, fitness, and sports programs, as a means to assess lower limb power. Numerous researches have shown that the vertical jump strongly correlates with explosive leg power [5-8], many coaches will measure vertical jump to estimate explosive leg power.

Handgrip strength is the integrated performances of muscles that can be produced in one muscular contraction [9]. It is widely accepted that grip strength provides an objective index of the functional integrity of the upper extremity [10,11]. Handgrip strength is an easily obtainable measure of physical health and muscle function. It is often used as an indicator of overall physical strength [10], hand and forearm muscles performances [9] and as a functional index of nutritional status [12-16] and physical performance [17]. Handgrip strength is a physiological variable that is affected by a number of factors including age, gender and body size. Strong correlations between handgrip strength and various anthropometric measurements (weight, height, hand length etc.) were reported earlier [18-22].

MATERIALS AND METHODS

Sample

The present study was conducted on 500 young college levels male students (age range 18-25 years) out of which 250 physical education students who were completed one year Bachelor of physical education (B.P.Ed) course and took part in obligatory physical activities under their course of study and 250 non-physical education students who were not participated regular physical activity. The subjects were selected from nineteen colleges located in nine different districts of West-Bengal in India irrespective of their caste, religion, dietary habits and socio-economic status. Exclusion criteria were set upon my knowledge of some genetic, psychological, neurological or chronic diseases which affecting leg explosive power, hand function and anthropometric characteristics.

Anthropometric Measurements

The age of the subjects were calculated from the date of birth as recorded in their institution. Height, weight, three muscle girths (upper arm, thigh and calf), and eight skinfolds thickness (triceps, sub-scapular, suprailiac, pectoral, axilla, abdominal, thigh and calf) of the subjects were measured with standard equipments and procedure. The examinations were conducted according to the guidelines of the International Society for the Advancement of Kinanthropometry (ISAK) [23]. The Technical Error of Measurement (TEM) was lower than 5% for skinfolds and 2% for the other measurements.

Body Composition

For calculating body density of the subjects Jackson and Pollock [24] formula was adopted. The Siri Equation [25] was used to convert body density to percent body fat of each participant. Poortman's [26] and Mosteller's [27] formula was taken up for assessing skeletal muscle mass and body surface area (BSA) respectively.

Leg Explosive Power

Sargent vertical jump test was conducted for measuring leg explosive power. First, confidence of appropriate physical condition were achieved, correct process of measurement were described for them and then subjects warmed up completely to perform the test. Subject stands side on to a wall and reaches up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips is marked or recorded. This is called the standing reach height. The athlete then stands away from the wall, and jumps vertically as high as possible using both arms and legs to assist in projecting the body upwards. Attempt to touch the wall at the highest point of the jump. The difference in distance between the standing reach height and the jump height is the score. The best of three attempts was recorded in cm.

Handgrip Strength

The grip strength of both right and left hands was measured using a standard adjustable digital handgrip dynamometer (Takei Scientific Instruments Co., Ltd., Japan) at standing position with shoulder adducted and neutrally rotated and elbow in full extension. The dynamometer was held freely without support, not touching the subject's trunk. The position of the hand remained constant without the downward direction. The subjects were asked to put maximum force on the dynamometer thrice from both sides of the hands. The maximum value was recorded in kilograms. Total grip strength was calculated by adding both hand grip strength divided by two (right hand grip strength + left hand grip strength ÷ 2). Anthropometric equipments and hand grip dynamometer were calibrated before each assessment. All subjects were tested thrice and the best of three attempts was recorded. There was a one minute resting period between each hand grip strength testing in order to overcome fatigue.

Statistical Analysis

Descriptive statistics (mean, ± standard deviation) and Student t-test for independent samples were used for compared between the physical education and non-physical education students. Pearson's correlation of coefficients was used to establish the correlations of vertical jump and hand grip strength with other variables in physical education and non-physical education of college level students. Data were analyzed using SPSS (Statistical Package for Social Science) version 17.0. A 1% level of probability was used to indicate statistical significance.

RESULTS

Table 1 shows the distribution of mean, standard deviations and t-value of height, weight, % body fat, % skeletal muscle mass, lean body mass, body surface area, vertical jump and grip strength of physical education and non-physical education college level men students. Statistically significant differences were found in weight (t = 3.71), % body fat (t= 6.58), % skeletal muscle mass (t = 4.90), lean body mass (t =6.70), body surface area (t = 3.51),

vertical jump (t = 11.24) and in handgrip strength (t = 14.75) between physical education and non-physical education students.

Table 1. Descriptive statistics and t-value of body composition, vertical jump and grip strength of physical education and non-physical education students

Variables	Physical Education		Non-physical Education		
	Mean	S.D.	Mean	S.D.	t-Value
Height (cm)	168.82	5.63	168.33	5.59	0.97
Weight (kg)	60.44	5.53	58.43	6.48	3.71**
% Body Fat	12.37	3.01	14.36	3.69	6.58**
% Skeletal Muscle Mass	49.79	3.22	40.35	3.32	4.90**
Lean Body Mass	52.90	4.55	49.95	5.23	6.70**
Body Surface Area (m^2)	1.68	0.09	1.65	0.10	3.51**
Vertical Jump (cm)	49.13	6.87	42.41	6.43	11.24**
Grip Strength (kg)	49.46	4.74	43.44	4.34	14.75**

(**) indicates p< 0.01.

Table 2. Pearson correlation of body composition with vertical jump and hand grip strength of physical education and non-physical education students

Variables	Vertical Jump		Grip Strength	
	Physical Education	Non-physical Education	Physical Education	Non-physical Education
Height (cm)	-0.432**	-0.291**	0.269**	0.234**
Weight (Kg)	-0.279**	-0.175**	0.343**	0.107**
% Body Fat	-0.454**	-0.531**	0.230**	0.327**
% Skeletal Muscle Mass	0.285**	0.312**	0.258**	0.427**
Lean Body Mass (Kg)	0.527**	0.412**	0.268**	0.341**
Body Surface Area (m^2)	-0.339**	-0.226**	0.261**	0.117**

(**) indicates p< 0.01.

Pearson correlations of the body composition variables with vertical jump and handgrip strength were examined in physical education and non-physical education Indian college level men students and presented in Table 2. Vertical jump had significantly positive correlation ($P \leq 0.01$) with % skeletal muscle mass and lean body mass. For the rest of the body composition variables, it was observed that almost all the variables were significantly negative correlation ($P \leq 0.01$) with vertical jump irrespective of physical education and non-physical education students. Handgrip strength had significantly positive correlations ($P \leq 0.01$) with all the variables irrespective of physical education and non-physical education students.

DISCUSSION

The main finding of present study was that assessment of leg explosive power and hand grip strength in physical education and non-physical education students and find out its relationship with body composition variables. The finding of the present study is similar to the work done by Ostojic et al [28], demonstrated the height and weight of a player had significantly negative correlation with vertical jump height. This result is disagreed by Aslan et al. [29] and Davis et al. [30] where they reported that there is no significant relationship between vertical jump and body height and weight. % Body fat is the amount of body fat stored in the body and does not take into account the lean body mass and muscle mass. Table 2 shows that % body fat and vertical jump have a negative association. An individual with lower % body fat definitely has a higher vertical jump [31,32]. This is because the athletes with lower % body fat and greater power are more likely to generate greater velocity of kicking [33]. The study done by Davis et al. (30) has reported that % body fat is the best predictor of vertical jump for recreational male athletes aged between 20 to 37 years old. This result corresponds to that of Roschel et al. [33], who stated that the sum of skinfold thickness has significant negative association with vertical jump height. % Body fat is related to the work performed during vertical jump. Since work is the product of average force acting on the subject and the displacement of the jump, heavier athletes need more work to move the body to the same displacement achieved by lighter athletes [33,34].

Height, weight and lean body mass were closely correlated with grip strength. The literature describes a positive association between Right and left hand grip strength with weight, height, BMI, lean body mass and body surface area [35-41]. Luna-Heredia et al. [42] described that body height is directly correlated with hand grip strength, possibly because this factor is more closely related to the lean body mass. The current results were also consistent with others researches that report positive associations of body fat with handgrip strength, as evidenced by studies undertaken by Deforche et al., Casajus et al. and Artero et al. [43-45]. The results of this study indicate that mean

value of the leg explosive power and hand grip strength of physical education students was significantly higher than the non-physical education students. Explanation of this finding may arrange the physical education students were regularly participated in physical activity and they also possessed higher amount of % skeletal muscle mass and lean body mass.

CONCLUSION

It may be concluded that physical activity has strong positive relationship with leg explosive power and handgrip strength. As the present study is examine relationships between leg explosive power and handgrip strength with various body composition variables in men physical education and non-physical education college aged students of few districts in India, so more research on larger area and other sex is needed to confirm or refute this finding.

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