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Comparison of Grip Strength Between Physical Education and Non-Physical Education Students and its Relationship with Body Composition and Somatotype

Sukanta Saha

Memari College, Memari, Burdwan, West Bengal India

Abstract: *Purpose:* The purpose of this present study was of two-fold, firstly, to compare the hand grip strength (both right and left) of physical education and non-physical education students and, secondly, to find out the relationship among hand grip strength, body composition variables and somatotype components. *Methods:* 500 young college levels male students (age range 18-25 years) out of which 250 physical education students and 250 non-physical education students were participated in this study. BMI, % body fat, % skeletal muscle mass, % skeletal mass, lean body mass, body surface area and somatotype components of the subject were estimated with standard procedure and equations. Hand grip strength of the subjects was measured by standard digital handgrip dynamometer. *Results:* The findings of the present study indicated that physical education students had significantly ($P \leq 0.01$) higher mean value of grip strength (right hand 49.46, left hand 46.71) than the non-physical education counterpart (right hand 46.04, left hand 43.44) in both hands. The mean value of the hand grip strength of college male student was higher in the right hand (47.76) in comparison to left hand (45.09). Hand grip strength had significantly positive correlations ($P \leq 0.01$) with all the body composition variables and somatotype components, except % skeletal mass and ectomorphy component, which were negative correlation with both hand grip strength. *Conclusion:* It may be concluded that hand grip strength had strong positive correlations with physical activity, % skeletal muscle mass, lean body mass and mesomorphy component of somatotype in Indian men college students.

Key words: BMI · % Body Fat · Lean Body Mass · Handgrip Dynamometer

INTRODUCTION

Among all muscle function tests, measurement of hand grip strength has gained attention as a simple, non-invasive marker of muscle strength of upper extremities, well suitable for clinical use. Many daily functions and sporting events require high activity levels of the flexor musculature of the forearms and hands. These are the muscles involved in gripping strength. Grip strength determines the handedness of an individual. Hand grip strength is a physiological variable that is affected by a number of factors including age, gender and body size. Strong correlations between HGS and various anthropometric measurements (weight, height, hand length etc.) were reported earlier [1-8].

Grip 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]. Hand grip strength is an easily obtainable measure of physical health and muscle function. It is often used as an indicator of overall physical strength [12], hand and forearm muscles performances [9-17] and as a functional index of nutritional status [13-17] and physical performance [18].

It is empirically known that college students have an "unhealthy" lifestyle, as they have their free time reduced due to an intense load of academic activities, with less available time to practice physical activities and to have balanced meals. On the other hand, physical education students have an academic course load and also with a syllabus that contains practical classes of sports that mandatorily represent the practice of regular physical activities. Additionally, many of them practice other activities in their free time, usually related to physical exercises. In the present study, an attempt has been made to comparison the handgrip strength between physical

Corresponding Author: Sukanta Saha, Memari College, Memari, Burdwan, West Bengal, India.

education and non-physical education students and also finds out its relationship to various body composition variables and somatotype components.

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 (19) colleges located in nine (9) different districts of West-Bengal in India irrespective of their caste, religion, dietary habits and socio-economic status.

Anthropometric Measurements: The age of the subjects were calculated from the date of birth as recorded in their institution. Height, weight, five muscle girths (upper arm, fore arm, chest, thigh and calf), four bone diameters (humerus, bistyloid, femur and bimalleolus) and eight skinfolds thickness (triceps, sub-scapular, suprailiac, pectoral, axilla, abdominal, thigh and calf) of the subjects were measured with standard equipments and procedure.

All the anthropometrics measurements of the subjects were taken right side of the body as per the direction of the Leon and The Koerner Foundation Study Group in 1973. Researcher was used the technical error of measurement (TEM) for evaluating the consistency, or precision, of the measure on a given variable. The TEM is the square root of the sum of the differences between measures one and two squared, divided by twice the number of subjects. The TEM provides an estimate of the measurement error that is in the units of measurement of the variable.

Body Composition and Somatotype: For calculating % body fat of the subjects (Jackson and Pollock – 1978, body density) Siri equation (1956) was adopted. Poortman's (2005) and Drinkwater *et al.* (1986) formula was taken up for assessing skeletal muscle mass and skeletal mass respectively. Measurement of Body Surface Area (BSA) of the subjects Mosteller's Formula (1987) was used. Somatotype components (endomorphy, mesomorphy and ectomorphy) of the subjects were calculated according to Carter and Heath anthropometric method (1990).

Table 1: Technical error of measurements of the present study and normal value of TEM

Variables	TEM of the Present Study	Normal Value of TEM
Height & Weight	0.00%	0.5%
Breadths and Girths	0.01%	1.0%
Skinfolds	0.10%	5.0%

Hand Grip 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. 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) were determined for directly measured and derived variables. Independent t-test was used for comparisons between physical education and non-physical education students for all the measured variables. Pearson's correlation coefficients were used to establish the correlations of handgrip strength with other variables in physical education and non-physical education students. Data were analyzed using SPSS (Statistical Package for Social Science) version 17.0. A 5% level of probability was used to indicate statistical significance.

RESULTS

Descriptive statistics and t-value of body composition, somatotype and hand grip strength of physical education and non-physical education students were shown in Table 2.

Physical education students had higher mean value in almost all the variables studies, except % body fat, endomorphy and ectomorphy component than non-physical education counterpart and showing statistically highly significant differences ($p<0.001$) in all the variables except height and % skeletal mass.

Table 2: Descriptive statistics and t-value of body composition, somatotype and hand grip strength of physical education and non-physical education students

		Physical education		Non-physical education		
	Variables	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 Cmposition	BMI	21.31	1.35	20.51	2.06	5.11**
	% Body Fat	12.37	3.01	14.36	3.69	6.58**
	Body Density	1.07	0.01	1.06	0.01	12.24**
	Lean Body Mass	52.9	4.55	49.95	5.23	6.70**
	% Skeletal Mass	13.57	1.34	13.38	0.98	1.80
	% Skeletal Muscle Mass	49.79	3.22	48.35	3.32	4.90**
	Body Surface Area (m^2)	1.68	0.09	1.65	0.10	3.51**
Somatotype	Endomorphy	3.85	0.86	4.37	1.01	6.17**
	Mesomorphy	4.67	0.88	4.14	1.23	5.51**
	Ectomorphy	2.86	0.74	3.34	1.18	5.42**
Grip Strength	Right Hand	49.46	4.74	46.04	4.58	8.17**
	Left Hand	46.71	4.91	43.44	4.34	7.85**

(**) indicates p< 0.01.

Table 3: Descriptive statistics and t-value of right and left hand grip strength of physical education, non-physical education and total students

	Right Hand		Left Hand		
Variables	Mean	S.D.	Mean	S.D.	t-Value
Physical Education Students (N = 250)	49.46	4.74	46.71	4.91	6.34**
Non-physical Education Students (N = 250)	46.04	4.58	43.44	4.34	6.48**
Total Students (N = 500)	47.76	4.97	45.09	4.91	8.52**

(**) indicates p< 0.01.

Table 4: Pearson correlation of body composition and somatotype with hand grip strength of physical education and non-physical education students

	Physical Education		Non-physical Education	
	Grip Strength			
	Right Hand	Left Hand	Right Hand	Left Hand
Height (cm)	0.220**	0.234**	0.269**	0.223**
Weight (Kg)	0.123**	0.107**	0.343**	0.370**
BMI	0.404**	0.396**	0.551**	0.552**
% Body Fat	0.366**	0.327**	0.230**	0.339**
% Skeletal Muscle Mass	0.393**	0.427**	0.258**	0.257**
% Skeletal Mass	-0.016	-0.003	-0.259**	-0.318**
Lean Body Mass (Kg)	0.345**	0.341**	0.268**	0.253**
Body Surface Area (m^2)	0.034	0.017	0.261**	0.235**
Endomorphy	0.381**	0.340**	0.224**	0.338**
Mesomorphy	0.632**	0.661**	0.623**	0.523**
Ectomorphy	-0.469**	-0.465**	-0.604**	-0.586**

(**) indicates p< 0.01.

Descriptive statistics and t-value of right and left hand grip strength of physical education, non-physical education and total students were presented in Table 3.

Pearson correlation of body composition and somatotype with hand grip strength of physical education and non-physical education students was shown in Table 4.

Hand grip strength had significantly positive correlations ($p \leq 0.01$) with all the body composition variables and somatotype components, except % skeletal mass and ectomorphy component of somatotype, which were negative correlation with both hand grip strength.

Figures 1-5 presented the scatter plot of total hand grip strength (sum of right and left hand grip strength divided by two) of the subjects irrespective of physical

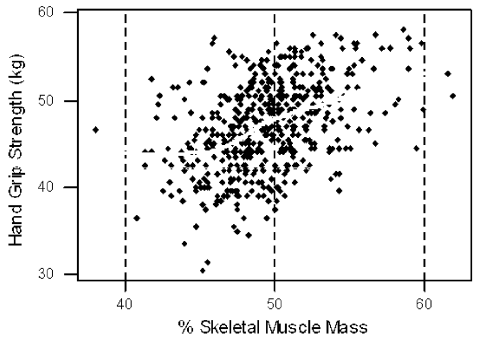

Fig. 1: Scatter plot of hand grip stregth of college student in respect to % skeletal muscle mass

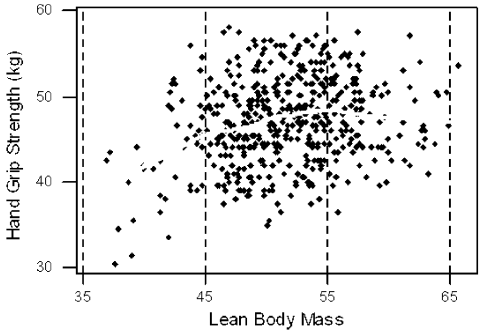

Fig. 2: Scatter plot of hand grip stregth of college student in respect to lean body mass

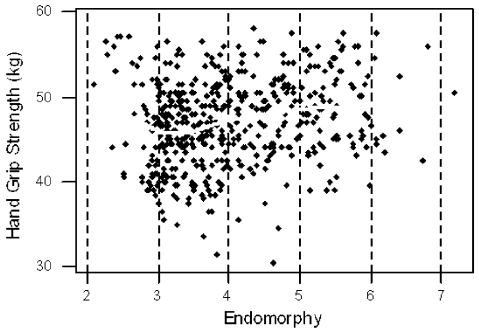

Fig. 3: Scatter plot of hand grip stregth of college student in respect to endomorphy component

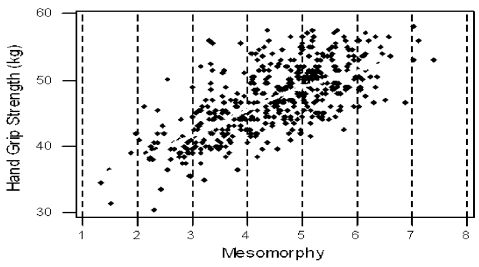

Fig. 4: Scatter plot of hand grip stregth of college student in respect to mesomorphy component

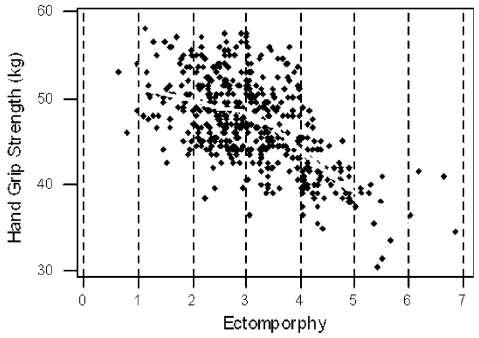

Fig. 5: Scatter plot of hand grip stregth of college student in respect toectomorphy component

education and non-physical education students in respect to % skeletal muscle mass, lean body mass, endomorphy, mesomorphy and ectomorphy respectively.

DISCUSSION

The main finding of this study was that assessment of hand grip strength in physical education and non-physical education students and find out its relationship with body composition parameters and somatotype components. In this study there is no significant difference in height of the physical education and non-physical education students; however they are significantly differ in weight. Physical education students are heavier than the non-physical education students, though they possess less amount of % body fat than the non-physical education students. As physical education students are regular participate in physical activities, that's why they contain more lean body mass and skeletal muscle mass than the non-physical education students. The inferior values of fat content in body composition demonstrate the superiority of lean body mass in youth, especially males who chose to study physical education. It is usually assume that, based on the share of lean body mass in body composition, the muscle mass can be estimated. It was then concluded that when the body weight of physical education students is greater than the general population, the cause is the development of the skeletal muscle and not presence of fat mass [19-21]. As for body composition, physical education students shows higher amounts of skeletal muscle mass and lean body mass and lower amounts of body fat compared to non-physical education students of the same gender, possibly a reflection of the higher physical activity. 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 (Fig.-2) and body surface area [22-28]. Luna-Heredia *et al.* described that body height is directly correlated with hand grip strength, possibly because this factor is more closely related to the lean body mass [29]. 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.* [30-32].

The results of this study indicate that mean value of the hand grip strength of physical education students was significantly higher in both hands than the non-physical education students. Explanation of this finding may lie the physical education students were regularly participated in physical activity and they also possessed higher amount of % skeletal muscle mass, lean body mass.

In essence, present study affirms that the mean value of the hand grip strength of college male student was higher in the right hand (47.76) in comparison to left hand (45.09). As the right hand of the subjects was the dominant hand, the subjects showed greater grip strength in that hand than the non-dominant hand, which might be because of difference in muscle strength between two hands. Incel *et al.* [33] also reported that the hand grip strength is to be higher in dominant hand with right handed subjects, but no such significant differences between sides could be documented for left handed people. However, Bagi *et al.* [34] noted greater grip strength in the dominant hand both in cases of right hander and left hander. The findings of this study were also supported by the work of O'Driscoll *et al.* [35] and Richards *et al.* [36]. They reported higher grip strength values in the dominant hand compared to the non-dominant hand. However, there was a disagreement with above finding with that of the work done by Reikeras [37] and Harkonen *et al.* [38] who reported that there was no significant difference in grip strength of dominant hand and non dominant hand. According to Rabergs and Roberts [39], one explanation for the differences in grip strength may be due to the use of more muscle and muscular hypertrophy in the dominant hand which leads to increased strength.

Concerning the relation of somatotype with hand grip strength, it should be stressed-out that, more important than the association of each major component with performance, it is the critical to consider the degree of relative presence of each component, defined by morphological typology. Endomorphy was positively related (Fig.3) with handgrip strength, these being the same tests in which % body fat had a positive association.

These two variables are very close, either in terms of definition, or by the way they are calculated. Here, endomorphy expresses the degree of adiposity development [40]. Mesomorphy reflects muscle development positively associated with strength and motor performance in general [40]. This component is highly positively correlated (Fig. 4) with hand grip strength. Ectomorphy reflects linearity and muscular hypotonic [41]. On this, there were significantly negative associations for ectomorphy (Fig. 5) with hand grip strength.

CONCLUSION

As physical education students regularly participated in physical activity that's why they possess higher amount of % skeletal muscle mass, lean body mass and higher mesomorphic component in somatotype leads to better in hand grip strength than the non-physical education counterparts. It may be concluded that physical activity has strong positive relationship with hand grip strength. This study gives fresh reference value data of college aged male population's body composition, somatotype and hand grip strength. It can be considered as main limitations: (i) there are several other biological and physiological variables that might also determine the muscular strength performance; (ii) it was only applied field tests. Laboratory tests with a higher control standard might present more accurate data. Further studies with regard to the correlation between handgrip strength, overall strength and overtraining may be warranted.

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