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Somatic, body composition and anthropometric characteristics of college level men students

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ABSTRACT

In the recent decade, a decline in physical activity and beginning of a sedentary lifestyle among college students has been observed. Sedentary lifestyle and overweight issues are major public health, clinical, and economical problems in modern societies. The purpose of the study was to find out anthropometric measurements, body composition variables and somatotype differences in college level physical education and non-physical education students. For this purpose 500 (250 physical education students and 250 non-physical education students) Indian college men students whose age range 18-25 years were selected as subject. All subjects were assessed 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). Body composition and somatotype of the subject were evaluated by standard procedure. The independent sample t-test revealed that physical education students had significantly higher BMI ($p< 0.01$), lean body mass ($p< 0.01$), % skeletal muscle mass ($p< 0.01$), and body surface area ($p< 0.01$) than the non-physical education students. Non-physical education students acquired extensively more amount of % body fat ($p< 0.01$) than the physical education students. The mean somatotype of the physical education and non-physical education students was endomorphic mesomorph (3.85-4.67-2.86) and mesomorphic endomorph (4.37-4.14-3.34) respectively. It may be concluded that in most of the parameter there were significant differences between physical education and non-physical education students and physical education students were showed better somatotype and body composition variables than the non-physical education students.

Keywords: Somatotype; Anthropometric measurements; % Body fat; Lean body mass; Body surface area.

INTRODUCTION

Physical education plays a critical role in educating the whole student. Research supports the importance of movement in educating both mind and body. Physical education contributes directly to development of physical competence and fitness. It also helps students to make informed choices and understand the value of leading a physically active lifestyle. The benefits of physical education can affect both academic learning and physical activity patterns of students. The healthy, physically active student is more likely to be academically motivated, alert, and successful. In the preschool and primary years, active play may be positively related to motor abilities and cognitive development. As children grow older and enter adolescence, physical activity may enhance the development of a positive self-concept as well as the ability to pursue intellectual, social and emotional challenges. Physical education is the supplementary and inseparable port of the public education and it is very much important for achieving

children's physical developments in accordance with the principle of wholeness of the organism, movement skill development, nerve muscle coordination development and social coherence [2].

In the recent decade, a decline in physical activity [20] and beginning of a sedentary lifestyle [16] among college students has been observed. Sedentary lifestyle and overweight issues are major public health, clinical, and economical problems in modern societies [8]. 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. The physical education and sports have the potential to make significant and distinctive contributions to students' development in a number of aspects: physical, lifestyle, affective, social, and cognitive [1]. Purpose of the present study was to investigate anthropometric, body composition and somatic characteristics of Indian college level physical education and non-physical education students. It is also useful to report on the physical development of young people who chose to study to become professional teachers of physical education, sports coaches, instructors of recreational and sports activities, or sports and recreation organizers. An additional reason for conducting research aimed at describing the physique of young people who aspire to occupy the aforementioned professions includes the fact that some of the physical education graduates will take positions in state administration or local government. It can be assumed that, if these people take away from the university health-conscious beliefs and habits associated with healthy lifestyles, their administrative decisions will better serve the whole society.

MATERIALS AND METHODS

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. The age of the subjects were calculated from the date of birth as recorded in their institution. Height of the subjects was measured with anthropometric rod to the nearest 0.5 cm (HG-72, Nexgen Ergonomics, Canada). Weight of the subjects was measured by using portable digital weighing machine to the nearest 0.5 kg. ('Libra' weighing machine, made in India). The five muscle girths (upper arm, fore arm, chest, thigh and calf) of the subjects were measured by using Freemans Flexible Steel Tape to the cm. Four bone diameters (humerus, bistyloid, femur and bimalleolus) of the subjects were measured by Lange Caliper (manufactured by GPM Swiss Med.) to the cm. Standard Harpenden Skinfold Caliper (GAIAM-PRO manufactured by "Baty International, Victoria Road, Burgess Hill, West Sussex, RH159LB, U.K". The spring pressure of the skinfold caliper was 10 gm./mm^2) was used for measuring eight skinfolds thickness (triceps, sub-scapular, suprailiac, pectoral, axilla, abdominal, thigh and calf) of the subjects. The skinfolds thickness of the subjects was recorded in mm.

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 measurer 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.

Table I. Technical error of measurements of the present study and normal value of TEM

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

Somatotype components (endomorphy, mesomorphy and ectomorphy) of the subjects were calculated according to Carter and Heath method (1990). For calculating body composition of the subjects following equations were used:

Assessment of Body Mass Index (BMI):

BMI = [Weight in Kg. ÷ (Height in m.)^2]

Measurement of % Body Fat as per Siri Equation (1956):

% Body Fat = [(4.95 ÷ Body Density)-4.5] × 100

Where body density was calculated as per Jackson and Pollock (1978) – seven sites equation:

Body density = 1.112 – 0.00043499(∑7skf) + 0.00000055(∑7skf)^2 – (0.00028826(X_2)

Where – ∑7skf = sum of 7 skinfolds i.e. Pectoral, Axilla, Abdominal, Suprailiac, Subscapular, Triceps and Midthigh.

Assessment of Lean Body Mass or Fat Free Mass (LBM):

LBM = (Body Weight – Total Body Fat Weight)

Measurement of Skeletal Muscle Mass (SMM) as per Poortman's Formula (2005):

SMM (Kg.) = Height[{0.0064 × (CAG)^2} + {0.0032 × (CTG)^2} + {0.0015 × (CCG)^2}] + (2.56 × Sex) + (0.136 × Age)

Where – Height in m.; Age in Years; Sex (Male = 1 & Female = 0); CAG = Corrected Arm Girth in cm. (Arm Girth in cm. – Triceps skinfold in cm.); CTG = Corrected Thigh Girth in cm. (Mid-Thigh Girth in cm. – Mid Thigh skinfold in cm.); CCG = Corrected Calf Girth in cm. (Calf Girth in cm. – Calf skinfold in cm.)

Assessment of % Skeletal Muscle Mass (% SMM):

% SMM = [SMM (Kg.) ÷ Body Mass (Kg.)] × 100

Measurement of Skeletal Mass (SM) as per Drinkwater et al. Formula (1986):

SM (Kg.) = [(HB + WB + FB + AB) ÷ 4]^2 × ht × 0.92Kg. × 0.001

Where - HB = Humerus Biepicondyler Diameter; WB = Bistyloideus Diameter; FB = Femur Biepicondylar Diameter; AB = Bimalleolar Diameter; ht = Height in cm.

Assessment of % Skeletal Mass (% SM):

% SM = [SM (Kg.) ÷ Body Mass (Kg.)] × 100

Measurement of Body Surface Area (BSA) as per Mosteller's Formula (1987):

BSA (m^2) = [{Height (cm.) × Weight (Kg.)} ÷ 3600]$^{1/2}$

Statistical Analysis

Values are presented as mean and SD. Independent samples t tests were used to determine if population means estimated by two independent samples differed significantly. Data were analyzed using SPSS Version 16.0 (Statistical Package for the Social Sciences, version 16.0, SPSS Inc, Chicago, IL, USA).

RESULTS

Anthropometric characteristics of physical education and non-physical education students are shown in table II. The physical education students were significantly heavier ($p<0.01$) than the non-physical education students. The

physical education students had possessed significantly grater muscle girth in chest ($p<0.01$), thigh ($p<0.01$), calf ($p<0.05$) and bone diameter in humerus ($p<0.01$) and femur ($p<0.01$) as compared to non-physical education students. Physical education students also possessed significantly lower skinfolds thickness in triceps ($p<0.01$), suprailiac, pectoral, axilla, abdominal, thigh ($p<0.01$) and sub-scapular ($p<0.05$) as compared to their counterpart. Table III presents the various body composition variables of the physical education and non-physical education students. The non-physical education students were found to have significantly higher % body fat, and body density ($p<0.01$) than the physical education students were as physical education students had significantly higher BMI, lean body mass and % skeletal muscle mass ($p<0.01$) as compared to the non-physical education students.

Table IV shows the somatotype components of the physical education and non-physical education students. The mean somatotype of the physical education student is endomorphic mesomorph (3.85-4.67-2.86), whereas the non-physical education students mean somatotype is mesomorphic endomorph (4.37-4.14-3.34). The non-physical education students had significantly higher somatotype components value in endomorphy and ectomorphy ($p<0.01$) as compared to their counterparts whereas the physical education students had significantly higher mesomorphic score ($p<0.01$) than the non-physical education students.

Table II. Anthropometric characteristics of physical education and non-physical education students

Variables		Physical education		Non-physical education		
		Mean	S.D.	Mean	S.D.	t-Value
	Height (cm)	168.33	5.59	168.82	5.63	0.97
	Weight (Kg)	60.44	5.53	58.43	6.48	3.71**
Muscle Girth (cm)	Upper Arm	28.92	1.75	28.67	2.14	1.42
	Fore Arm	24.84	1.37	24.88	1.43	0.31
	Chest	87.48	4.87	85.53	4.96	4.41**
	Thigh	50.56	3.06	48.56	3.94	6.31**
	Calf	33.56	1.85	33.11	2.28	2.41*
Bone Diameter (cm)	Humerus	6.79	0.26	6.66	0.31	5.05**
	Bistyloid	5.34	0.29	5.36	0.35	0.69
	Femur	9.53	0.48	9.27	0.53	5.72**
	Bimalleolus	7.17	0.38	7.14	0.44	0.81
Skinfolds (mm)	Triceps	10.2	2.13	13.54	3.43	13.02**
	Sub-scapular	12.88	3.67	13.62	3.52	2.29*
	Suprailiac	14.96	4.54	16.44	4.46	3.66**
	Pectoral	10.51	3.15	11.47	3.06	3.44**
	Axilla	10.21	3.04	11.09	2.84	3.33**
	Abdominal	16.96	5.2	22.11	7.2	9.13**
	Thigh	12.34	2.84	13.35	2.51	4.19**
	Calf	10.33	6.52	10.91	2.11	1.33

(*) indicates p< 0.05 and (**) indicates p< 0.01.

Table III. Body composition variables of physical education and non-physical education students

Variables	Physical education		Non-physical education		
	Mean	S.D.	Mean	S.D.	t-Value
BMI	21.31	1.35	20.51	2.06	5.11**
% 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**

(**) indicates p< 0.01.

Table IV. Somatotype components of physical education and non-physical education students

Variables	Physical education		Non-physical education		
	Mean	S.D.	Mean	S.D.	t-Value
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**

(**) indicates p< 0.01.

DISCUSSION

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 [10,15,18,21]. As for body composition, physical education students shows higher amounts of skeletal 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. The literature describes a positive association between lean body mass and bone mass [3,17].

The height, weight and BMI of the non-physical education students in the present study is lower whereas the % body fat is almost equal to the college level students of Iran as reported by Habibi et al. (2012). The physical education students of the present study have lower body density and higher amount of % body fat than the students of School of Physical Education and Sports located in Aydın province of Turkey as reported by the Yildiz et al. (2009) whereas the % body fat of the physical education students of the present study approximately accords with the Poland physical education students as reported by the Gorner et al. (2006). On the other hand, the present data regarding % body fat of the physical education students is inferior to the physical education students of Ege University of Bornova as stated by Kurt et al. (6^{Th} Fiep European Congress). This study indicates the existence of differences in body composition variables between the physical education students and non-physical education students. The overall result shows that physical education students possess high amount of lean body mass and skeletal muscle mass whereas lower amount of % body fat than the non-physical education students. Similar findings were found in the studies on Poland male college students studying physical education [21] which reported that muscle mass and lean body mass was grater and % body fat was lower of the students studying physical education as compared to the general students.

A higher mesomorphic rating in physical education students than in non-physical education students suggests that the former are more muscular than the later (Table IV). High mesomorphic ratings in physical education students can be attributed to take part in obligatory physical activities under their course of study, as there is positive association between mesomorphic component and physical activity [4,10,13,22]. In present study the mean somatotype of the physical education students is endomorphic mesomorph (3.85-4.67-2.86) which is similar to the previous findings reported by Grasgruber (2008) and Bernacikova et al. [Proc Physiol Soc 26, PC44 (London) 2012]. On the other hand Riegerova et al. (1995); Pavlik (1999); Kutac et al. (2006) reported that the mean somatotype of the physical education students is mesomorphic ectomorph. The mean somatotype of non-physical education students in this study are similar to the study carried by Nikbakht (2011). Nazmi et al. (2010) in their study proposed that the somatotype components endomorphy, mesomorphy, and ectomorphy of the physical education and non-physical education students of Erciyes University is significantly differ. This fact corroborates with the findings of somatotype components differences between physical education students and non-physical education students of present investigation.

CONCLUSION

There were significant differences in most of the somatotype components, body composition variables and anthropometric characteristics between physical education and non-physical education students. Physical education students can be regarded as a group of the population with a large volume of physical activities, therefore a significant development of their physical build was observed, as well as somatotype components, body composition variables and anthropometric characteristics. More research would be helpful along with fitness and physiological variables to compare superiority between physical education and non-physical education students.

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