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Body proportion and physique of all India inter varsity male sprint swimmers

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Abstract
Individual physique and body proportion or composition has been discovered to impose constraints upon capacity for optimal performance in sports. This study was carried out to determine the body composition (%body fat, lean body mass) and somatotype characteristics of university male swimmers and compare it with their overseas counterparts. 24 all India Inter varsity male swimmers from LNIPE Gwalior were chosen for the investigation. Their mean age was 18.9 (+/-1.5) years, height 169.1 (+/5.73) cm and weight 65.4 (+/- 5.74) kg. Anthropometric measurements included triceps, sub scapular, suprailiac, abdomen and calf skin folds, biceps and calf circumferences and humerus and femur breadths.
The body fat percentage was calculated using the formula prescribed by Faulkner. The somatotype of the subjects was calculated by the Health and Carter method. The swimmers under this study have a body fat percentage of 12.3 (+/-1.15) %. Their mean Lean Body Weight (LBW) was 57.4 (+/- 3.65) kg and Total Weight of Fat was 8.03 (+/- 1.01) kg. Regarding the somatotype, they fell into the somatotype category of balanced mesomorphs with a value of 3.1 – 4.5 – 2.6. Mesomorphic component is highly developed which confirms the general notion that mesomorphs make good swimmers because they tend to be muscular, and therefore capable of sprinting through a very dense medium of water. Similarly, the moderate fat adiposity (12.3%) under the subcutaneous skin may provide adequate buoyancy that will facilitate greater floatation during freestyle swimming.

Keywords: Lean body weight, Anthropometric measurements, Mesomorphic

1. Introduction
In the endeavor to achieve excellence in sport, all of the possible concomitants of performance have been subject to scientific research. Modern sport science is characterized by the purposefulness of its endeavor to improve elite athletes and to discover talents as precisely as possible.
There is evidence to support the concept that an individual's physique greatly limits or enhances successful participation in physical activity (Wilmore J & Haskell, 1972; Fahey *et al*., 1975; Wickkiser & Kelly, 1975; Pipes, 1977) [4]. Elite and world class athletes have different physiques than individuals in the non athletic population (Tanner, 1964).
The body composition and anthropometry of elite athletes has been the subject of much research. The practicing athletes might be expected to exhibit structural and functional characteristics that are specifically favorable for the sport and thus separate him from the general population and athletes involved in other sports. Such differences in body physique might reflect (a) genetic characteristics that have been selective in determining athletic pursuit and (b) changes due to the conditioning effect of high level of training. Specific physique or morphological features play a major role, arguably critical role in competition success. The size, shape and proportions of athletes are important considerations in player performance and better the performance more critical the relationship (Toriola *et al*., 1987) [15].
The morphologic classification of men has a scientific and general interest since the times of Hypocrates, that is, around 400 B.C. Later, other physical descriptions were elaborated and it was denominated somatotype by Sheldon and colleagues in 1940, Parnell in 1954, and that classification was reviewed and modified by Heath and Carter in 1967 (Nevill *et al.* 2004) [11].
The somatotype consists of three components: the endomorphy, which is the greasy component indicating the fat content of the body; the mesomorphy, which is related to the muscular component and presents the solidity and "square" body aspect, and the ectomorphy in which it pre-dominates the linearity and the fragility of the body (Powers SK, Howley ET, 2000) [13].

Swimming performance depends on optimizing propulsion and minimizing the opposing factor drag (Berger *et al*. 1997, Chatard *et al*. 1990) [1, 2]. Factors related to minimizing drag include the anthropometric characteristics and body composition. Swimmer's physical characteristics have been examined to determine the characteristics of successful sprint and endurance swimmers (Lavoie, J.M., and R.R. Montpetit 1986, Leone *et al*. 2002) [8, 9] in order to assess the relative importance of specific characteristics to performance (Sharp *et al*., 1982, Collet *et al*., 1997) [14, 3]. Despite the game's world-wide popularity, there have been few other investigations of anthropometric and physiological characteristics of swimmers: most notably, recent data are lacking in India. Hence, the present study is an attempt to analyze several anthropometric variables with a view to establishing the current morphological characteristics of collegiate male freestyle swimmers from Kerala state, India, and compare the data with their overseas counterparts.

2. Methodology

2.1 Subjects: 24 all India Inter varsity male swimmers from LNIPE Gwalior, were randomly selected for the purpose of the study. Their average age (SD) was 18.9 (+/-1.47) years, height 169.5 (+/-6.31) cm and weight 65.4 (+/-4.41) kg. The subjects have been undergoing training regularly and have participated in university championship.

2.2 Procedures: A Harpenden skin fold caliper (British Indicators, St Albans, Hertfordshire, UK) with a precision of 0.1 mm was used to collect skin fold measurements to the nearest 0.2 mm two seconds after the full pressure of the caliper jaws had been applied; the skin fold value was taken as the average of 3 skin fold measurements separated by at least 1 minute to avoid tissue compression. The triceps skin fold was taken vertically from the back of the arm, at the mid-point between the acromion and olecranon processes. The subscapular skin fold was measured at an angle of 45 degrees to the vertical, running laterally and downward in the natural cleavage line of the skin at the inferior angle of the scapula. The suprailiac skin fold was obtained superior to the iliac crest on the mid-axillary line. For calf skin fold, the subject sat with legs slightly spread while the vertical skin fold on the medial side of the leg at the largest circumference on the posterior midline of gastrocnemius was measured. A vertical fold is raised approximately in the midline of the belly of the Rectus Abdominis from the right hand side of the midpoint of the navel for measuring the abdominal skin fold. (Norton K *et al*.). Femur epicondylar breadth was measured while the participants were sitting on a table with their knees bent at right angles. The width across the outermost parts of the lower end of the femur was recorded. Humerus epicondylar breadth was measured across the outermost parts of the lower end of the humerus. The following formulas were used to assess the body composition of the subjects.

% Body Fat or PBF = (triceps + subscapular + suprailiac + abdominal

Skin folds x 0.153) + 5.783 (Faulkner J.A. (1968)

Total Weight of Fat or TWF (kg) = (Weight x percent of fat) / 100

Lean Body Weight or LBW (kg) = (Total Body Weight – Total Weight of Fat)

The method of Heath and Carter, which is based on the Sheldon's somatotype classification, was applied to determine the somatotype characteristics of the subjects (Heath B and Carter J, 1967) [7].

2.3 Statistical Analysis

Basic statistical descriptive parameters such as mean and standard deviation were calculated for the analysis of the data.

3. Results

Table 1: various physical parameters and anthropometric characteristics of the subjects

variables	Min	Max	mean	SD
Age (Yrs)	17	24	18.9	1.50
Height (cm)	158	180	169.1	5.73
Weight (kg)	57	74.5	65.4	5.74
Biceps Girth (cm)	26.5	32.0	28.9	1.34
Calf Girth (cm)	29.5	35.0	33.4	1.62
Humerus Breadth (cm)	7.20	6.75	0.29	6.40
Femur Breadth (cm)	8.20	10.3	9.34	0.62
Triceps Skin fold (mm)	12.3	10.6	1.50	8.0
Sub-scapular Skin fold (mm)	14.5	10.9	2.31	7.70
Supra-iliac Skin fold (mm)	8.0	14.3	11.2	2.29
Abdominal Skin fold (mm)	7.1	11.3	9.82	1.86
Calf Skin fold (mm)	5.3	10.4	7.67	1.79

Various physical parameters of the subjects are depicted in table 1. The average height of the swimmers is 169.1cm (+/-5.73) and their mean weight 65.4kg (+/-5.74). Calf circumference (33.4+/-1.62cm) is found to be greater than biceps circumference (28.9+/-1.34cm). Regarding bicondylar breadths Femur exhibited higher value (9.34+/-0.62cm) than humorous (6.75+/-0.29cm). The results of the study also revealed that among all skin fold measurements calf skin fold is the lowest with a value of 7.67mm (+/-1.79) and highest was supra-iliac skin fold with a value of 11.2mm (+/_2.29).

Table 2: Different components of somatotype and Body Composition of subjects

variables	Min	Max	mean	SD
Endomorphy	2.0	4.5	3.1	0.57
Mesomorphy	3.5	6.0	4.5	0.67
Ectomorphy	2.0	4.0	2.6	0.70
PBF (%)	10.5	13.9	12.3	1.15
Total Weight of Fat (kg)	9.64	8.03	1.01	7.20
Lean Body Mass (%)	86.1	89.5	87.7	1.09
Lean Body Weight (kg)	65.4	57.4	3.65	50.3
BMI (kg/m2)	20.1	25.4	22.9	1.17

Table 2 represents the values of somatotype and body composition of the subjects. It reveals that the adolescent male swimmers under this study fall into the somatotype category of balanced mesomorphs with a score of 3.1-4.5-2.6. Mesomorphic component is found to be highly developed in them while endomorphic is greater than ectomorphic component. Regarding body composition, their average percent body fat (PBF) was 12.3% (+/-1.15) indicating a moderate adiposity in the subjects. Their average total weight of fat (TWF) is 8.03kg (+/-1.01) while their average percent lean body mass (%LBM) is 87.7% (+/-1.09). It was also observed that the average lean body weight of the male freestyle swimmers under this investigation was 57.4 (+/-3.65) kg.

4. Conclusions and Discussions

The somatotype category of the present study swimmers are balanced mesomorphs which indicate that mesomorphic component is highly developed in them. This confirms the general notion that mesomorphs make good swimmers because they tend to be muscular, and therefore capable of sprinting through a very dense medium of water.

With regard to the body composition it can be observed that they possessed moderate quantity of fat adiposity. This layer of fat under the subcutaneous skin may provide adequate buoyancy that will facilitate greater floatation during freestyle swimming. Their body fat percentage of the subjects is almost similar to the finding of another study in which elite male swimmers who were members of the Canadian National or Youth National Teams were found to possess %body fat of 11.9% (Gregory *et al*. 2006) [6]. In contrary to this higher level of body fat% was reported for competitive swimmers studied by Lowensteyn *et al*. (1994) [10]. Their mean fat% was 15%.

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