Relationship of Selected Morphological Variables with Swimming Performance of Male Age Group Swimmers

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ABSTRACT

The aim of the study is to find out the relationship among selected morphological parameters like height, weight, body fat%, lean body mass, somatotype and swimming performance. Ninety age group (9-10 years, 11-12 years and 13-14 years) swimmers undergoing training under specialised coaches were selected as subjects. The morphological variables and performance criterion like 50 m swimming time were measured by using standard methodology. Correlation coefficient among body composition, somatotype and performance variables were computed. The analysis of the results revealed that swimming performance is significantly correlated ($p<0.05$) with height, body weight, mesomorphoic component and lean body mass. Body fat and endomorphic component are significantly and negatively correlated ($p<0.05$) with swimming performance. It was that concluded that besides techniques and tactics the physical attributes play an important role in swimming performance which can help the swimmers to achieve excellence in higher level of competition and swimmers having better morphological qualities can obviously perform better.

KEY WORDS

Body fat%, Lean body mass, mesomorphic component

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INTRODUCTION

Sports talent is the sum total of pre-requisites (and possibilities of their development) possessed by a person which will enable him to achieve high performance in a sport in future. The pre-requisites include physical abilities, physiological profile, biochemical function, technical skills, physique, personality, motives and interest. High performance sports necessitate specific biological profiles of children with outstanding motor functions, strong physiological and psychological traits. To determine children's potential for motor functions at a given age, we must consider the status of their physical growth and maturation. Knowledge of normal growth includes not only the average extent of growth at a given age but also the normal variation of growth. These standards identify the range within which children's measurements should fall, at a given age if their bodies are growing properly. Notably a child's progress in motor performance is related to physical size and maturity.

Swimming, over milliner a survival activity like swimming has globly developed into one of the most popular competitive sports. In swimming performance curve has been rising steeply and swimmers have attained incredible standards at a relatively much younger age. One factor of such a high performance is the human organism is organically and physically in a state of readiness even just a few months after the birth, which is not true in the case of other sports, where a certain level of physical and mental maturity is necessary before one can understand such sports (Freeman, 1978). Swimming is valuable as a complete physical exercise and as an aid to health. Swimming involves literally each and every muscle of the body and it makes you burn more calones than many other sports. It is a tonic to body and mind, keeping you healthy, fit and active through out life.

Grimston & Hey (1986) developed a theoretical model to identify anthropometric variables relevant to success in swimming. Frontal areas, cross-sectional areas and lengths of body segments were measured on twelve member of a men's college team using a photograph procedure. Sprague (1975) studied the relationship of certain physical measurement with swimming speed in male swimmers. Matheson (1978) studied the relationship between swimming and selected physiological and anthropometric development and skill variables in 10-20 years old female competitive swimmers. Hebelinck (1971) attempted a study on anthropometric of 66 male divers and 71 male water polo players participated in Mexico Olympic Games. Cozen (1930) found height and weight as influencing

factors of physical performance.

In general, participation in sports during adolescence does not appear to be detrimental to maturational process. The area of adolescent exercise provides useful and challenging information. It will, however, require an aggressive pursuit of knowledge if campaigns to increase physical activity and attract younger population to participate are to succeed. Identifying the mechanisms, responsible for changes in the physiology of adolescent athletes, may facilitate the development of specific programmes for adolescents. The exercise prescription to produce the most desirable and long-term benefits for adolescents, requires dynamic and individual programming (Naughton et. al, 2000). They have reported that active adolescent boys may improve their aerobic and anaerobic power through mechanisms that appear to be related to body composition, haemoglobin increase, hormonal changes and relatively high levels of habitual physical activity. There is a change in body composition during growth and with aging, in relation to health, nutrition and physical activity (Khanna et al, 1998). It is reported that the magnitude of change in body composition varies with the intensity and duration ostill, 2004). Tanner (1964) had shown that those who become the best in the world in 1960 Olympics had definite body characteristics that were clearly specific to different events, in which they completed. Majumdar (1989) studied the body fat percentage of trained Indian children, elite group spo. spersons and children of other countries. The present study is aimed to find out the relationship among morphological variables and swimming performance of different age group swimmers.

METHODS AND MATERIALS

The present study was conducted on 90 age group male swimmers of 9 to 10, 11 to 12 and 13 to 14 years, selected from different Swimming Pools of Bangalore City. The level of performance of the subjects was National level and they were training under specialised coaches. Selected morphological variables i.e. height, body weight, body fat, lean body mass, somatotype and performance criterion like 50 m swimming time were measured using appropriate measuring devices. Body density was calculated by using the formulae of Durnin and Rahaman, (1967). From body density the body fat percentage was calculated by using the formulae of Siri (1956). First the body fat% was converted into total fat weight in kg. Then lean body mass was calculated by deducting the fat weight from total body weight. Health-Carter method of

Somatotyping was used for the description of morphological conformations. Somatotype was expressed in three numerical ratings consisting of three sequential numerals always recorded in the same order, which represented endomorphy, mesomorphy and ectomorphy. Height, weight, bi-epicondylar diameter of humerus and femur, and calf girth, biceps, triceps, calf, subscapular and suprailiac skinfolds were used to evaluate the Somatotype ratings. Somatotype was calculated by using the modified equation of Heath and Carter (1967). For assessment of performance 50 m swimming timings were taken for all the swimmers and speed was also calculated. All the values of morphological variables and performance variable were put in to a data base for further calculations. Then correlation coefficients among morphological and performance variables were computed.

The above analysis was done using standard statistical package SPSS.

RESULTS AND DISCUSSION

The data obtained on morphological and performance variables have been analysed by Pearson's product moment correlation in order to determine the relationship of morphological and physical fitness

Table-1: Correlation matrix of morphological variables and performance of 9-10 years age group swimmers

	Height	Weight	Body fat%	Endo--morphy	Meso--morphy	Ecto-morphy	Lean Body Mass
Weight	0.631*						
Body fat%	-0.323	-0.313					
Endomorphy	-0.417*	-0.301	0.889*				
Mesomorphy	0.383*	0.584*	-0.671*	-0.458*			
Ectomorphy	0.181	-0.621*	0.126	0.056	0.511*		
Lean Body Mass	0.816*	0.822*	-0.631*	-0.582*	0.663*	-0.616*	
50 meter timing	-0.585*	-0.637*	0.756*	0.737*	-0.837*	0.289	-0.783*

*Signficant at $p<0.05$

variables to performance of swimmers of different age groups. Correlation matrix of morphological variables and performance of 9-10 years age group swimmers is presented in table-1.

Table 1 depicts that in case of 9-10 years age group, swimming performance is significantly correlated with height, weight, body fat%, endomorphy, mesomorphy and lean body mass. There was no significant correlation between swimming performance and ectomorphy. Height is significantly correlated with weight, body fat%, endomorphy, mesomorphy and lean body mass. Weight is significantly correlated with mesomorphy, ectomorphy and lean body mass. Body fat% is significantly correlated with endomorphy, mesomorphy and lean body mass. Amongst the three components of somatotype, significant correlations are found between endomorphy and mesomorphy; and mesomorphy and ectomorphy. All the three components are significantly correlated with lean body mass.

Correlation matrix of morphological variables and performance of 11-12 years age group swimmers is presented in table-2

Table-2: Correlation matrix of morphological variables and performance of 11-12 years age group swimmers

	Height	Weight	Body fat%	Endo--morphy	Meso--morphy	Ecto-morphy	Lean Body Mass
Weight	0.675*						
Body fat%	-0.213	-0.284					
Endomorphy	-0.537*	-0.296	0.799*				
Mesomorphy	0.238	0.613*	-0.712*	-0.517*			
Ectomorphy	0.179	-0.598*	0.213	0.121	0.575*		
Lean Body Mass	0.756*	0.796*	-0.712*	-0.612*	0.598*	-0.599*	
50 meter timing	-0.623*	-0.685*	0.812*	0.834*	-0.797*	0.187	-0.812*

*Significant at $p<0.05$

Table 2 depicted that in case of 11-12 years age group, swimming performance was significantly correlated with height, weight, body fat%, endomorphy, mesomorphy and lean body mass. There was no significant correlation between swimming performance and ectomorphy. Height was significantly correlated with weight, endomorphy and lean body mass. Weight was significantly correlated with mesomorphy, ectomorphy and lean body mass. Body fat% was significantly correlated with endomorphy, mesomorphy and lean body mass. Amongst the three components of somatotype, significant correlations were found between endomorphy and mesomorphy; and mesomorphy and ectomorphy. All the three components are found significantly correlated with lean body mass.

Correlation matrix of morphological variables and performance of 13-14 years age group swimmers is presented in table-3

Table- 3: Correlation matrix of morphological variables and performance of 13-14 years age group swimmers

	Height	Weight	Body fat%	Endo-morphy	Meso-morphy	Ecto-morphy	Lean Body Mass
Weight	0.765*						
Body fat%	-0.197	-0.194					
Endomorphy	-0.581*	-0.238	0.738*				
Mesomorphy	0.198	0.594*	-0.683*	-0.536*			
Ectomorphy	0.127	-0.612*	0.193	0.139	0.519*		
Lean Body Mass	0.567*	0.691*	-0.751*	-0.579*	0.762*	-0.432*	
50 meter timing	-0.539*	-0.631*	0.798*	0.751*	-0.812*	0.165	-0.769*

*Significant at $p<0.05$

Table 3 depicted that in case of 13-14 years age group, swimming performance was significantly correlated with height, weight, body fat%, endomorphy, mesomorphy and lean body mass. There was no significant correlation between

swimming performance and ectomorphy. Height was significantly correlated with weight, endomorphy and lean body mass. Weight was significantly correlated with mesomorphy, ectomorphy and lean body mass. Body fat% was significantly correlated with endomorphy, mesomorphy and lean body mass. Amongst the three components of somatotype, significant correlations were found between endomorphy and mesomorphy; and mesomorphy and ectomorphy. All the three components were significantly correlated with lean body mass.

DISCUSSION ON FINDINGS

Certain anthropometric characteristics must be taken into consideration in analysing sprint swimming performance, including body height, arm span and lean body mass (Jürimäe, et. al, 2007). These somatic attributes are largely inherited and determine swimming technique to a high degree. Since metabolic capacities as well as skill acquisition, are affected by growth and development (Malina, 1994), it can be suggested that factors predicting swimming performance may vary for young swimmers and may be different compared to adults. In the present study correlation matrix of morphological variables and swimming performance revealed that height was significantly correlated with swimming performance in 9 to 10 year 10 to 11 year and 12 to 13 year age group swimmers. So based on this finding height can be considered as one of the performance variables. The reasons why height is advantageous in swimming are easily explained. Firstly, from hydrodynamics theory it can be demonstrated that at the same speed a taller individual requires less power than a smaller person to advance in water (Orvel et. al., 1981). Secondly, in swimming events, races start from a standing dive (except for backstroke) and end with the outstretched touch of the fingers. Other things being equal, a taller swimmer covers a lesser distance in a race. Thirdly, additional advantages of height in swimming is derived from the greater distance covered by the limbs during the stroke (Ingen & Van, 1981) and in the ability to flip turn further from the end of the pool, thus reducing the distance swim. The consistent relationship between height and swimming performance could be explained by the fact that taller swimmers seem to glide better through the water (Geladas et. al., 2005) and taller swimmers usually show a larger arm span, which benefits swimming efficiency (i.e. larger stroke length (Saavedra et. al., 2010). The significant correlation between 100 m performance and arm span, consistent with

a previous reports suggests that the length of the upper extremities and shoulders width combined may be related with biomechanical factors relevant to propulsion.

Significant correlation between body weight and swimming performance in all the three age group swimmers was seen. Although there is no concrete evidence of direct influence of weight to swimming performance but if the body weight is contributed by muscular dominance then definitely swimming performance is significantly correlated with swimming performance as seen in the present study. In any swimming event, maximal performance in swimming is dependent on a number of factors, including body size, stroke efficiency and also on the amount of metabolic energy spent in transporting the body mass of the athlete over the unit of swimming distance (Zamparo et. al., 2005a). Previous reports have found that sprint swimming performance is related to body mass, lean body mass, body height and arms span (Grimston & Hey, 1986 and Silva et. al., 2007).

Parizkova (1985) reported that excess body fat has a negative impact on physical efficiency. Ekelund et. al. (2001) also reported that body fat percentage of adolescent boys and girls was significantly and negatively correlated to peak VO2. The adherence of higher body fat percentage depends on exercise or activity habits, genetics and dietary intake. Reilly (1986) and Rico-Sanz (1998) depicted that excess adipose tissue acts as dead weight in activities where the body mass must be lifted against the gravity. In the present study body fat% was found significantly correlated with swimming performance in all the three age groups. Seemingly body higher fat% may be the limiting factor for strength and endurance that possibly can hinder the performance.

In the present study results of somatotype revealed that endomorphic component is significantly correlated with swimming performance in all the three age groups. As measurement of body fat% and assessment of endomorphy rating requires same measurements so correlation of endomorphy with swimming performance and the probable reasons also follow the similar trend like body fat%. Mesomorphoic component and lean body mass are significantly correlated with the swimming performance in all the three age group swimmers. As for 50 m swimming ATP-CP system is one of the prerequisite, higher rating of mesomorphy and more fat free mass are always advantageous for the swimmers. From the present study it is clear that swimming [illegible] significantly correlated to body [illegible]

lean body mass and mesomorphic component. It is also clear that swimming performance is significantly but negatively correlated with body fat% and endomorphic component. From the above points it can be concluded that apart from techniques and tactics the physical and physiological attributes play an important role in swimming performance which can help the swimmers to achieve excellence in higher level of competition i.e. although the swimmers having similar quality of techniques and tactics, but those who are having better morphological qualities can obviously perform better.

CONCLUSION

Based on the above finding it is concluded that height can be considered as one of the major performance variables because height is advantageous in swimming in many ways like i) taller individual requires less power than a smaller person to advance in water ii) taller swimmer covers a lesser distance in a race iii) additional advantages of height in swimming is derived from the greater distance covered by the limbs during the stroke. From the present study it is revealed that body fat has got a negative impact on swimming performance which indicated that higher body fat% may be the limiting factor for strength and endurance which ultimately can hinder the performance. Endomorphy also follows the similar trend like body fat%, so this particular component of somatotype can also be considered one of the limiting factor in swimming performance. Mesomorphic component and lean body mass are significantly correlated with swimming performance which is found to beneficial in sprint swimming because of more ATP-CP store in the muscles. From this present study it can be concluded that apart from techniques and tactics the physical attributes play an important role in swimming performance which can help the swimmers to achieve excellence in higher level of competition and swimmers having better morphological qualities can obviously perform better.

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