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Full Length Research Paper

Differences in Morphological Characteristics between Swimmers and Fin Swimmers

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ABSTRACT

The purpose of this research is to identify the differences of anthropometric characteristics of classical and fin swimming athletes. The study involved 114 athletes of aquatic sports. According to MANOVA, the results of the study showed that there are statistical significant differences between the two sports with Wilk's Λ: 0.60 corresponding to F (20,89) = 2,9, p <.05. Following, 39% of the dispersion of the linear combination of the dependent variables is explained by the effect of the variable 'sport'. These findings can help coaches of aquatic sports for better selection of athletes and effective programming of training.

Keywords: classical and fin swimming, anthropo-morphological characteristics

INTRODUCTION

Knowledge of individual anthropological characteristics of athletes and their development is essential for guidance of sports training. This fact can be crucial in the selection of a particular sport for an athlete. It is generally assumed that every sport requires a predetermined morphological profile, which is directly linked to success and gives the opportunity for more objective selection of solutions over time.

The anthropometric characteristics constitute a valuable means of understanding and interpretation of the relationship between the physical structure and biomechanical and understanding of the morphological, physiological, biomechanical and nutritional requirements of performance for successful competition [Noutsos, 2016].

Morphological anthropometry is a method which includes the measurement of the human body and examination of the measured variables [Mišigoj-Duraković, 1995]. In swimming, this method is used for the selection of athletes, for monitoring and evaluation of the training process, the objective assessment of the overall development of the body, for the control of the athletes diet, as well as their recovery [Misigoj - Durakovic, 1995; Milanovic & Heimer, 1997].

Swimming as well as fin swimming belongs to those sports where training and competition activity is conducted in water i.e., in an environment which is not natural to humans [Dopsaj, 1993; Smith, 1998].

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Fin swimming is a new sport in which athletes, after adapting the monofin to their feet, stretch their hands above their head and swim in the prone position in order to reach higher speed when swimming. The movement of the swimmer resembles that of dolphins and the movement is generated with the entire body [Videler, 1981]. The hands are not used in the movement [Gautier et al., 2004]. The way swimmers move in the water and the movement of their body can provide is the most efficient swimming in terms of hydrodynamics [Thanopoulos, et al., 2006].

During competition, swimmers should implement various technical-tactical elements that also require the features of the corresponding swimming model in terms of physiological characteristics and are important for success in many sports [Platanou, et al., 1999]. The effect of the characteristics on physical activities has been the subject of many studies [Reilly et al., 2000].

The morphological characteristics of high performance athletes contribute to our better, functional, metabolic and anthropometric characteristics of swimmers.

The morphological characteristics of the athletes, such as body composition, body weight, body height, maturation, and somatotype, are elements that help researchers see any performance limitations [Carter & Heath, 1990].

Various swimming events have shown that morphological characteristics have either a positive or negative effect on the achievement of competitive results. [Verma, et al.. 1979; Vitasalo, 1982; Dopsaj & Miljus, 1995; Roche, et al., 1996; Meszaros, et al., 1998].

There are many studies that evaluate body dimensions and composition of swimmers [De Garay, et al., 1974; Hebbenlinck, et al., 1975; Novak, et al., 1977; Novak, et al., 1978; Carter, et al., 1982; Grimston & Hay, 1986; Mazza, et al., 1993; Siders, et al., 1993; Sprague, 1976]. Some of them investigate the relationship between the anthropometric characteristics and performance in swimming [Grimston & Hay, 1986; Klentrou & Montpetit, 1991; Siders, et al., 1993; Sprague, 1976].

The fact that some anthropometric characteristics, such as body height and length of the upper and lower limbs, are particularly important to achieve high performance, it is widely accepted and has been confirmed in several studies [Chatard, Collomp, Maglisco, & Maglisco, 1990; Grimston, & Hay, 1986; Taxtalis, et al., 2014]

[Sprague, 1976] reported that in 100m freestyle swimming 100m in male aged from 7-17 years, performance depends more on the morphological and mechanical characteristics and less on aerobic and anaerobic abilities.

According to [Tanner, 1964], body dimensions are important criterion for certain sports.

The anthropometric characteristics of fin swimming athletes have been investigated by [Hue, et al., 2006] but this field has not been thoroughly studied.

Also, [Pendergast, et al., 1978] indicate that body dimensions are important especially for aquatic sports where training and performance are affected by the drag and the buoyancy. Both these elements are influenced by the absolute sizes of body parameters and the measurements of body composition.

The aim of this research is to investigate the differences in anthropometric characteristics of Greek male and female swimmers between classical and fin swimming in order to understand the significance of anthropometric profiles of those two aquatic sports.

The information obtained can be used as a guide for coaches and swimming

teachers for the selection of young athletes in this sport, because anthropometric characteristics contribute to high-level performance.

METHODS

Anthropometric techniques provide prediction of body composition and are popular because they are inexpensive, simple, and can easily be done in any area [Behnke & Willmore, 1974; Pollock and Wilmore, 1990]. The measurement protocol is developed and written by the Anthropometric Standardization Conference on 1985 with the scientific opinion of specialists [Lohman, Roche, and Martorell, 1988]. Circumferences are measured individually or sometimes together with skin fold measurements, providing with information on body composition and its development [Behnke and Wilmore, 1974; Jackson & Pollock, 1976; Lohman, et al., 1988].

SAMPLE

The sample consisted of 114 athletes. 69 athletes of classical swimming (30 male and 39 female, age 15 ± 1 and 15 ± 1,1 years, height 174,1 ± 6,7 and 165,7 ± 6,1cm and weight 61,8 ± 9 3 and 56,4 ± 7,4 kg respectively for male and female) and 45 fin swimming athletes (32 male and 13 female, age 16 ± 0,8 and 16 ± 1,2 years, height 173 ± 4, 8 and 162,4 ± 4,5cm and weight 69,8 ± 9,1 and 55,5 ± 8,0 kg respectively for male and female). All participants were active athletes and participated in systematic training six times per week.

EQUIPMENT

In this study, 18 anthropometric variables were chosen to be measured so as to be related to the structure of aquatic sports.

All measurements were performed with the use of simple instrumentation. For the measurement of body weight the electronic scale type Sega alpha770 was used [Vogel & Halke Hamburg, Germany] with measurement accuracy 0.1kg and for the height a measuring rod type Sega Bodymetar 208 [Vogel & Halke Hamburg, Germany] with 1mm accuracy. For the measurement of skin folds we used a metal Harpenden Skinfold Caliper [HSP-BI; British Indicators, England] with 0.2mm accuracy, and for the diameters of the body a bone caliper was used. In this study 18 anthropometric variables were chosen to be measured so as to be related to the structure of aquatic sports.
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MEASUREMENT PROCEDURE

The field of this study in which anthropometric characteristics of swimmers are evaluated, includes the measurement of body weight, body height, sitting height, sitting height with arm straighten over the head, arm span, shoulders opening, pelvis opening, chest depth, perimeter of chest, thigh skin fold, biceps skin fold, triceps skin fold, subscapular skin fold, iliac skin fold, the gastrocnemius skin fold, thigh circumference, biceps circumference

flexed, elbow opening, and knee opening.

All measurements were made in October and November, at the beginning of the swimming training season. They took part in the gym of each swimming club with the equipment of the Department of Aquatic sports of Physical Education and Sport Science of the University of Athens (Greece). The temperature during measurement was such that subjects were feeling comfortable wearing their swimsuits. All variables were recorded once in the morning by the same researcher, except skin folds that were measured three times.

STATISTICAL ANALYSIS

Means and standard deviations of anthropometric characteristics are presented in Table 1. The results went through descriptive statistics analysis and normality of the distribution of the variables was tested. For the identification of differences between the two aquatic sports in selected anthropological variables the MANOVA was applied. For the detection of individual differences among male and female of classical and fin swimming, ANOVA analysis was applied. The statistical program used was SPSS 22.

RESULTS AND DISCUSSION

In the present study, anthropological characteristics of Greek fin- and classical swimming athletes were examined. The results of the descriptive statistics of the measured variables for both, sports and gender are presented in Table 1.

Table 1. Means and standard deviation of anthropological characteristics of classical and fin swimming athletes.

	Classical swimming			Fin swimming		
Variables	Male	Female	Total	Male	Female	Total
Body height	173,7±8,1	165,7±5,7	169,3±7,9	173,03±4,7	162,4±4,5	169,9±6,7
Body weight	61,6±9,2	56,6±7,0	58,8±8,4	69,8±9,1	55,5±8,0	65,7±10,9
Sitting height	88,1±5,3	87,03±3,1	87,5±4,2	90,4±2,7	85,4±2,2	89,0±3,4
Sitting height with arm over head	141,03±9,9	133,3±5,9	136,7±8,7	140,0±8,2	129,1±4,4	136,8±8,8
Arm span	178,7±7,7	167,6±6,2	172,6±8,8	176,3±6,2	164,1±6,3	172,8±8,3
Shoulders opening	39,7±3,1	37,6±1,8	38,5±2,7	39,5±2,1	37,2±2,9	38,9±2,5
Pelvis opening	32,01±1,9	32,2±1,7	32,1±1,8	32,6±1,6	31,9±1,7	32,4±1,6
Chest depth	19,6±2,6	19,2±1,4	19,4±2,04	19,9±1,4	18,6±1,9	19,5±1,7
Chest perimeter	85,7±8,3	86,6±4,9	86,2±6,6	88,8±4,8	84,5±6,1	87,5±5,5
Biceps skin fold	4,5±1,7	6,6±2,0	5,7±2,2	4,5±1,4	7,8±2,0	5,5±2,2
Triceps skin fold	7,8±2,2	12,6±2,7	10,5±3,4	9,04±2,9	12,6±3,4	10,1±3,5
Subscapular skin fold	7,1±1,7	9,5±3,1	8,5±2,9	9,3±3,2	11,1±3,03	9,8±3,2
Iliak skin fold	8,5±3,4	13,4±5,2	11,2±5,1	9,7±4,6	12,7±3,5	10,5±4,5
Gastrocnemius skin fold	9,9±3,2	13,2±3,2	11,7±3,5	10,0±3,2	11,6±1,8	10,4±2,9
Thigh circumference	47,1±10,1	49,4±10,2	48,4±10,2	53,9±4,3	51,8±3,7	53,3±4,2
Biceps circumference flexed	28,5±6,1	28,7±5,8	28,6±5,9	29,4±2,5	25,0±1,7	28,2±3,1
Elbow opening	7,2±0,43	6,4±0,4	6,8±0,56	7,3±0,5	6,1±0,5	6,9±0,72
Knee opening	10,1±0,5	9,5±0,5	9,8±0,56	10,2±0,7	9,3±0,5	9,9±0,76

The results of multivariate analysis MANOVA showed a significant effect of the variable 'sport' to the linear combination of the dependent variables. The multivariable index Wilk's L was equal to 0.60, corresponding to F (20,89) = 2,9, p <.05. The index η^2 is equal to 0.39, i.e., 39% of the distribution of the linear combination of the dependent variable was explained by the statistical effect of the independent variable 'sport'. The results show that athletes of classical swimming have lower weight, smaller hand opening, less fat of subscapular skin fold and greater thigh circumference than fin swimmers in their total.

Significant is also the effect of the variable 'gender' to the linear combination of the dependent variables. The multivariable index Wilk's L was

equal to 0.25, corresponding to F(20,89) = 12,8, p <.05. The index η^2 is equal to 0.74, i.e., 74% of the distribution of the linear combination of the dependent variable was explained by the statistical effect of the independent variable 'gender'. The results show that in most variables male athletes have higher levels than female athletes, except the pelvis opening, the chest circumference and the thigh circumference, where no differences were observed.

Finally, a statistically significant interaction occurred between the variables 'sport' and 'gender' to the linear combination of the dependent variables. The multivariable index Wilk's L was equal to 0.72, corresponding to F (20,89) = 1,73, p <.05. The index η^2 is equal to 0.28, i.e. 28% of the distribution of the linear combination of the dependent variable explained by the statistical interaction of the independent variables.

According to MANOVA, statistical significant differences between the two sports, classical and fin swimming were presented in Table 2. On the same table differences between genders are shown.

In order to identify individual differences among male athletes of classical and fin swimming and female of classical and fin swimming, Anova (Table 3) was applied. We observe that fin-swimming athletes had statistical significant higher weight, higher sitting height, more fat in the subscapular skin fold, bigger thigh circumference compared with athletes of classical swimming. Female fin swimming athletes had significantly lower sitting height with the hands over head, more fat in biceps skin fold, smaller circumference of flexed biceps and smaller elbow opening.

In literature there are not enough references concerning anthropological characteristics of fin swimming athletes. Regarding the sport of swimming, earlier studies have reported that height and arm span play an important role in performance [Latt et al., 2010].

Also, [Geladas, et al., 2005] in a research on Greek prepubertal swimmers reported that male had higher body weight, body height and longer limbs than female. [Klentrou and Montpetit, 1991] found that body height is highly correlated with performance in 100m freestyle swimming but not with 400m. No similar correlation was observed for arm span.

Table 2. MANOVA results. Significant statistical difference between the two sports, two genders, and their interaction.

	Sport	Gender	Sport*Gender
Body height	NS	.00	NS
Body weight	.040	.00	.009
Sitting height	NS	.00	.012
Sitting height with arms over head	NS	.00	NS
Arm span	.034	.00	NS
Shoulders opening	NS	.00	NS
Pelvis opening	NS	NS	NS
Chest depth	NS	.032	NS
Chest perimeter	NS	NS	.042
Biceps skin fold	NS	.00	NS
Triceps skin fold	NS	.00	NS
Subscapular skin fold	.002	.00	NS
Iliak skin fold	NS	.00	NS
Gastrocnemius skin fold	NS	.00	NS
Thigh circumference	.008	NS	NS
Biceps circumference flexed	NS	.033	.023
Elbow opening	NS	.00	.022
Knee opening	NS	.00	NS

Table 3. ANOVA results. Significant statistical difference between male of the two sports and female of the two sports.

	Male	Female
Body height	NS	NS
Body weight	.001	NS
Sitting height	.035	NS
Sitting height with arm over head	NS	.018
Arm span	NS	NS
Shoulders opening	NS	NS
Pelvis opening	NS	NS
Chest depth	NS	NS
Chest perimeter	NS	NS
Biceps skin fold	NS	.049
Triceps skin fold	NS	NS
Subscapular skin fold	.002	NS
Iliak skin fold	NS	NS
Gastrocnemius skin fold	NS	NS
Thigh circumference	.001	NS
Biceps circumference flexed	NS	.033
Elbow opening	NS	.010
Knee opening	NS	NS

CONCLUSION

The results of our research suggest that it is possible to create a structure of physical characteristics of active classical swimmers and fin swimmers athletes. It should be the coaches' and kinesiologists' responsibility to evaluate the anthropological characteristics of the athletes in order to encourage them to follow these sports.

Statistically significant differences among athletes of classical- and fin swimming in general but also on individual level, indicates that although both sports take place in the water, each one has its peculiarities and requirements in terms of body composition and anthropological characteristics. Therefore, this investigation was an attempt for a clearer identification of anthropological features that encourage athletes in each sport. Also, with further attention and monitoring we can take concrete answers to the problems of training in each discipline.

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