

# Assessment of the morphological profile of young swimmers using bioimpedance analysis of body composition

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## Abstract

**Objective of the study** is to determine the characteristics of body composition and phase angle in young athletes prior to commencing regular swimming training.

**Methods and structure of the study.** A bioimpedance analysis of the body composition of young athletes aged 7 (a total of 67 participants, comprising 25 girls and 42 boys) with no prior experience of regular swimming training was conducted. The ABC-01 'Medass' device was used to assess body fat mass, body fat percentage, skeletal muscle mass and skeletal muscle percentage, active cellular mass, phase angle and body type.

**Results and conclusions.** It has been established that in young athletes who are beginning to swim regularly, the key body composition parameters fall within the age-appropriate range. However, boys tend to have a higher proportion of lean body mass and a higher level of active cellular mass, whilst girls have a higher percentage of adipose tissue. Phase angle indices in both groups correspond to low values, reflecting the functional immaturity of cell membranes in children of this age. A predominance of the ectomeso-morphic body type was identified, indicating harmonious physical development and favourable conditions for young athletes to master swimming movements.

**Keywords:** : young swimmers, bioimpedance analysis, body composition, initial training, pedagogical monitoring, somatotype.

**Introduction.** Modern athlete training is a complex and dynamic process, the effectiveness of which depends largely on the extent to which the individual characteristics of the athletes, as well as their level of functional and physical development (the condition of their bodily systems, optimal body dimensions, and body composition), are taken into account when selecting training methods and techniques. In this regard, in-depth assessment of anthropometric indicators becomes particularly relevant, especially during the initial training phase [1, 2].

Swimming is a sport in which morphological characteristics and body composition have a significant impact on competitive performance. An optimal ratio of fat, muscle and lean body mass contributes to improved hydrodynamic qualities, movement efficiency and the athlete's overall performance capacity. In particular, for swimmers, a specific body composition is regarded as one of the factors determining their per-

formance in competition; therefore, monitoring this indicator is important at all stages of training and is taken into account in the management of the training process [3].

**Objective of the study** is to determine the characteristics of body composition and phase angle in young athletes prior to commencing regular swimming training.

**Methods and structure of the study.** The study was conducted at the 'Neftyanik' Sports School in Surgut in 2025. The testing involved 67 young athletes aged 7 (25 girls and 42 boys) who were beginning regular swimming training. Measurements were taken of height, body weight, and chest, waist and hip circumferences. Body composition analysis was carried out using bioimpedance analysis with the Medass ABC-01 multi-frequency analyser.

**Results of the study and discussion.** An analysis of body composition and phase angle revealed that,

among young swimmers enrolled in first-year beginner training groups and assessed prior to the start of systematic training sessions, the key indicators fell within the age-appropriate range, whilst gender differences and signs of functional immaturity were identified (Table 1).

Boys exhibited higher group-mean values for skeletal muscle mass and active cellular mass, as well as a higher proportion of SMM, indicating a predominance of lean body mass and intensive muscle development. This may be linked to higher levels of physical activity and individual rates of somatic growth. Girls exhibited slightly higher fat mass values whilst maintaining an overall balanced body composition. Such differences correspond to the physiological manifestations of sexual dimorphism and reflect the characteristics of energy metabolism in childhood [1, 2].

The distribution of individual bioimpedance measurements among young swimmers by level showed that in the majority of children, the proportion of fat mass is within the normal range (Fig. 1).

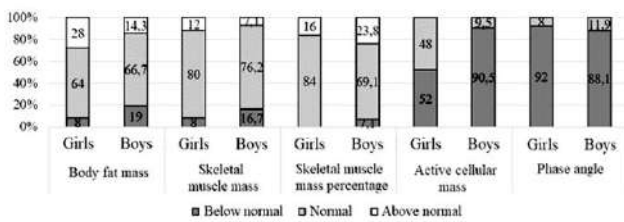


Figure 1. Distribution of individual bioimpedance measurements for young swimmers by performance level (in %)

The higher proportion of boys with low body fat reflects the increased energy expenditure and high levels of physical activity typical of this age group. In contrast, a higher proportion of girls were found to have increased body fat mass, which may be linked to the physiological characteristics of fat metabolism

and the early development of hormonal mechanisms regulating energy metabolism [2].

Analysis of SMM indices revealed that the majority of children had values within the age-specific normal range. The greater variability in indicators among boys indicates the influence of somatotrophic growth factors and individual rates of physical development. Among girls, the more uniform distribution of SMM values reflects the balance of metabolic processes and the morphological maturation of muscle tissue [2, 4].

The distribution of relative skeletal muscle mass (% SMM) showed reduced values in 7.1% of boys; no such cases were recorded in girls, whilst values exceeding age-specific norms were observed in 23.8% of boys and 16% of girls. % SMM is one of the key criteria for a child's morphofunctional maturity and an indicator of the harmony of physical development [1, 3]. Elevated values indicate the formation of a 'muscular' body type and the development of lean body mass, which is consistent with their naturally higher levels of physical activity and growth rates [3, 4].

ACM characterises the number of metabolically active cells and reflects the level of anabolic processes and energy metabolism in the body. A prevalence of low values in boys may indicate limited cellular activity resources and a possible energy deficit associated with rapid growth rates and high levels of physical activity. In girls, more balanced indicators may indicate the stability of metabolic processes and better adaptation at the initial stage of physical development [1, 3].

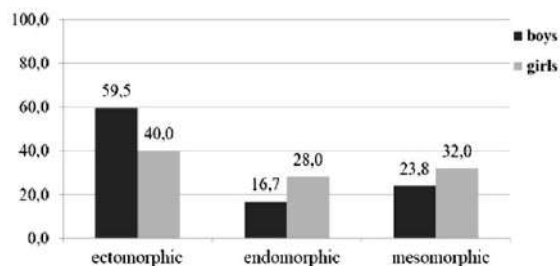
In the majority of the children examined, phase angle values were below the age-specific norm [4]. Physiologically low PA values indicate insufficient functional maturity of cell membranes, reduced intracellular hydration and a low level of energy metabolism, which is characteristic of children before the start of systematic training.

Table 1. Bioimpedance analysis results for young swimmers

Indicators	Girls			Boys		
	M±m	Max	Min	M±m	Max	Min
Body fat mass (kg)	4,46±0,47	10	1,3	3,53±0,27	8,2	1,2
Body fat percentage (%)	16,75±1,15	26,3	6,8	13,90±0,80	28,3	5,4
Skeletal muscle mass (SMM) (kg)	7,10±0,31	11,5	4,8	9,14±0,27	13,1	6,3
Skeletal muscle mass percentage (%)	33,98±0,63	46	30	43,00±0,66	51,2	34,8
Active cellular mass (ACM) (kg)	9,01±0,37	14,3	6,5	9,14±0,18	12,6	7,0
Phase angle (PA) (degrees)	4,26±0,09	5,17	3,2	4,26±0,06	5,05	3,32

Regarding the risk of metabolic syndrome, it should be noted that in 29.3% of boys and 69.2% of girls, the values correspond to the 'very low' level, and in 63.4% and 30.8% respectively – 'low'. An increased risk was identified in only 7.3% of boys. These results indicate a favourable state of lipid metabolism and the absence of signs of metabolic dysfunction. The data obtained characterise young swimmers as a metabolically stable group, ready for gradual inclusion in the training process with regular monitoring of body weight and physical performance [1, 2].

Analysis of the somatotype of young swimmers revealed a heterogeneous morphological profile (Fig. 2), with the ectomesomorphic body type predominating in the majority of children.



*Figure 2. Distribution of somatotypes among young swimmers enrolled in the first year of the introductory training programme (in %)*

Boys are more typically characterised by a combination of slenderness and moderately developed musculature, with a low body fat percentage. Girls exhibit a more varied distribution of somatotypes and a slightly higher prevalence of variants with an endomorphic component [1, 2, 3].

Thus, it is appropriate to consider the results obtained in the context of current views on the initial sports training of children, where the primary objective is not selection based on morphological characteristics, but the creation of conditions for harmonious physical development and the formation of a motor foundation. In this regard, the identified characteristics of body composition should be interpreted as the initial morphofunctional background, rather than as a criterion for sporting potential.

From a pedagogical point of view, the identified variability in body composition indicators is of particular interest. It indicates the heterogeneity of be-

ginner training groups in terms of their level of morphofunctional maturity. In the context of standardised programmes, this requires a flexible approach to the intensity of training loads, particularly during the stage of acquiring swimming skills.

**Conclusions.** It has been established that the physical development of 7-year-old children with no prior experience of regular swimming lessons, who were assessed prior to the start of the training programme, generally corresponds to age-appropriate standards. Body composition is characterised by a harmonious ratio of fat, skeletal muscle and active cellular mass. The obtained indicators reflect the initial morphofunctional status of young swimmers at the stage of enrolment in beginner training groups and can be used as a baseline for subsequent monitoring.

A comprehensive assessment of body composition and somatotypological characteristics can be used as an element of a pedagogical monitoring system aimed at ensuring harmonious physical development, improving the effectiveness of swimming instruction and maintaining the health of young swimmers during the initial sports training phase.

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