

# Anthropometric, Morphological and Somatotype Characteristics of Water Polo Players: A Meta-Analysis

## Características Antropométricas, Morfológicas y Somatotípicas de los Jugadores de Waterpolo: Un Metanálisis

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**SUMMARY:** The objective of this meta-analysis is to synthesise available research that has evaluated the anthropometric, morphological and somatotype characteristics of water polo players. Studies were identified through electronic databases and manually searched volumes of pertinent journals. It has been determined that a substantial share of the mesomorphic component characterises both male and female water polo players. The somatotype of the junior male section belongs to the balanced mesomorph, while the junior female section belongs to the endomesomorph somatotype. The research of anthropometric characteristics has yielded an average body height and weight of male and female water polo players. It has been determined that the average water polo player has undergone certain changes in terms of some anthropometric characteristics resulting from the secular trend and the morphological adaptation. Higher numerical values in terms of some skeletal dimensionality, voluminosity and body height and mass have proven to be significant indicators of athletic achievement of water polo players.

**KEY WORDS:** Water polo; Somatotype; Morphology.

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## INTRODUCTION

Like other sports, water polo has developed due to historical development caused by changes to the rules and improvement of the material, technical and organizational conditions of the training and competition (Hraste *et al.*, 2013). Achievement in water polo, among other things, depends on the anthropometric characteristics of athletes, namely height and body mass, which are evaluated with respect to the current age of the athlete (Hraste, 2021). This should be considered during the period of growth and development of athletes, when their chronological and biological ages are often disparate. This is a specific period when future elite athletes are profiled (Malina & Bouchard, 1991). Considering the demands of a specific sport, it is possible to define the life period of an athlete when his/her greatest athletic achievements are expected. Besides, it is of the utmost importance to estimate the final body height for different sports and roles in specific sports. There are several formulae for the estimation of the final height. The current height is taken as the basis and then multiplied by a certain coefficient for a specific age. It is necessary to consider the

biological and chronological age of a child in order to make a precise estimate. The child's height should be measured during several different periods. Pre-adolescence height should be taken as the most reliable determinant for making the most accurate estimate of the final body height, because adolescent children may be biologically less mature, biologically more mature or characterised by an even level of growth and development.

Morphological characteristics describe the physical constitution and structure of a man. Anthropometry (Greek antropos = man; metrein = to measure) is a tool of physical anthropology used for a systematic measurement of the physical properties of a human body. In addition to the measurement, morphological anthropology includes the analysis and the study of obtained measurements. This scientific method is used for evaluating the nutritional status and for monitoring and controlling growth and development of a person (an athlete). The resulting morphological status of an athlete is impacted by the genetic

heritage and the adaptation changes caused by training or nutrition (Barr *et al.*, 1994). Morphological characteristics that may be significantly influenced by training are muscle tissue volume and the quantity of subcutaneous adipose tissue. It is rather interesting to monitor a water polo player's morphological status since the dominant training loads in water polo, as well as water as the training environment, cause numerous adaptation changes.

Morphological characteristics of a human body have been subject to research for a long time. Researchers have attempted to classify people into certain body types. After Sheldon *et al.* (1940) had defined three basic somatotypes in his book *The Varieties of Human Physique: An Introduction to Constitutional Psychology* as endomorph, mesomorph and ectomorph, many researchers have tried to design a precise method for calculating human somatotypes. Heath-Carter's method (Heath & Carter, 1967) has become the most commonly used method for calculating human somatotypes, therefore there are available formulae for calculating somatotypes according to this method.

Endomorphic component shows the relative fatness of subcutaneous adipose tissue and is displayed as the sum of three values. Mesomorphic component shows the robustness of the musculoskeletal system. Ectomorphic component shows the relative linearity of the body and is calculated from the height and body mass ratio.

In addition to determining the somatotype according to the Heath-Carter's method, it is also necessary to emphasise the research of manifest and latent morphological and anthropometric dimensions of water polo players by a factorial analysis. In his analyses, Momirovic (1969) determined four latent anthropometric factors: longitudinal dimensionality of the skeleton, transversal dimensionality of the skeleton, voluminosity and subcutaneous adipose tissue.

Anthropometric, morphological and somatotype characteristics of water polo players (Fig. 1). The somatotype of elite Spanish water polo players (Vila *et al.*, 2010) has been determined as endomesomorph, while those in the junior section belong to the balanced mesomorph.

In the research, it has also been determined that the anthropometric characteristics such as BMI, arm volume and biacromial diameter are important factors for the achievement of top performances in water polo. The dominance of the mesomorphic and

the endomorphic component for all types of water polo players has been confirmed by another research (Carter & Ackland, 1994). By observing the somatotype of water polo players according to their playing positions, research (Carter & Ackland, 1994; Ferragut *et al.*, 2011) has determined that the attacker is a balanced mesomorph, while the centre forward and the centre defender are endomesomorphs.

The mean value of body height and body mass in elite water polo players ranges between 184.2 and 189.5 cm and 85.9 and 89.2 kg, respectively (Mazza *et al.*, 1994; Lozovina & Pavicic, 2004; Villa *et al.*, 2010). According to Nekooei *et al.* (2016), a wider palm and the breadth of the wrist have a statistically significant influence on the better ball control, while longer arms and taller stature and the overall larger body voluminosity represent a significant advantage in the final water polo performance.

Female water polo players in the senior section belong to the endomesomorph somatotype, while those in the junior section belong to the mesoendomorph somatotype (Varementi & Platanou, 2008). By observing the somatotype of female water polo players according to their playing positions (Martínez *et al.*, 2015), it results that the wing players, centre forwards and centre defenders belong to the mesoendomorph somatotype, while the goalkeepers belong to the endomesomorph somatotype. The average height and weight of female water polo players is  $172 \pm 6.9$  cm and  $67.4 \pm 7.5$  kg. Statistically, the wing players have a significantly lower body height and arm span with respect to other playing positions. The goalkeepers have significantly longer forearms with respect to other playing positions. It has been demonstrated that certain values of skeletal dimensions and voluminosity have a statistically better influence on improved shooting performances of female water polo players.

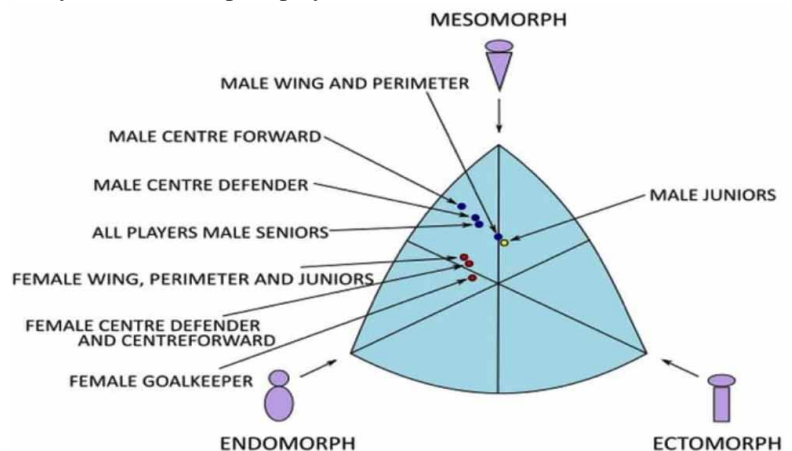


Fig. 1. Somatotype of water polo players by gender, playing position and age.

Interesting research has been conducted by Uljevic & Spasic (2009) on young water polo players. The dominant somatotype of twelve-year-old water polo players who trained year-round was endomesomorph, while the dominant somatotype of seasonal players was ectomesomorph. The somatotype differences were attributed to the primary selection in water polo (Table I).

In the research conducted by a group of authors (Hraste *et al.*, 2018), the reasons for the statistically significant differences in four values of morphological characteristics (two variables of voluminosity and body height and body mass) in young water polo players between 12 and 14 years of age may be explained by the fact that growth and development are most prominent in the adolescent period between the age of 13 and 15 in young boys. It is also possible that the changes in circumferences were additionally influenced by a systematic one-year or a two-year water polo training.

Examination of anthropometric characteristics and body composition in two groups of water polo players up to the age of 15 found significant differences in some of the observed variables (Gardasevic *et al.*, 2020), while there was no statistically significant difference between even six groups of eighteen-year-old water polo players (Gardasevic *et al.*, 2021). The existence of the aforementioned differences in fifteen-year-old water polo players probably stems from unequal biological growth and development as well as changes caused by different training processes.

Lozovina *et al.* (2009) determined that in terms of manifest anthropometry, three different quality level water polo players significantly differ in the majority of variables of skeletal dimensionality and voluminosity. Higher quantitative indicators of skeletal dimensionality,

voluminosity, height and weight are proportional to the higher quality level of water polo players.

Changes in morphology were detected in elite water polo players (Lozovina & Pavicic, 2004). The factor of longitudinal dimensionality of the skeleton has the highest distinctive power. The factor defined by the values of circular dimensionality with added weight and BMI (body mass index) has a smaller, yet significant, negative discriminatory power. The body shape has changed in terms of taller height, extended limbs, thinner waist and broader shoulders. The body mass has increased. The ratio of muscle mass and fat has also increased. The observed changes result from the secular population trend, and even partly from the sports and morphological adaptation. An interesting fact is that, according to said research, the fist length was significantly longer in 1980s water polo players with respect to 1995 water polo players. These differences may be attributed to the demands of pressing down the ball for improved performances in the later period.

## CONCLUSION

The previous research suggests that the selection, training methodology and specific sports nutrition has reflected on the somatotype characteristics of both male and female water polo players in terms of the prevalence of endomesomorphic component. Considering the different roles and playing positions in water polo, it was highly unlikely that all water polo players would fit under a common somatotype, however a substantial share of the mesomorphic component characterises both male and female water polo players. The somatotype of the junior male section belongs to the balanced mesomorph, while the junior female section belongs to the endomesomorph somatotype.

Table I. Overview of research on water polo somatotypes.

Author	Year	Age	Sex	Level	Role	N	Endo	Meso	Ecto
Vila <i>et al.</i>	2010	<22	M	NT	ALL	13	3.0 ± 1.0	5.6 ± 1.4	1.8 ± 0.9
Vila <i>et al.</i>	2010	U-21	M	NT	ALL	7	2.6 ± 1.9	4.7 ± 0.8	2.7 ± 0.8
Ferragut <i>et al.</i>	2011	<19	M	NT	ALL	19	2.9 ± 0.9	5.5 ± 1.3	2.0 ± 0.9
Ferragut <i>et al.</i>	2011	<19	M	NT	W, P	9	2.5 ± 0.6	5.0 ± 1.2	2.4 ± 0.7
Ferragut <i>et al.</i>	2011	<19	M	NT	CF	5	3.5 ± 0.9	6.1 ± 0.7	1.6 ± 0.8
Ferragut <i>et al.</i>	2011	<19	M	NT	CD	5	3.1 ± 1.0	5.8 ± 1.8	1.9 ± 1.3
Martinez <i>et al.</i>	2015	<18	F	HCL	W, P	21	4,1	4.5	2.3
Martinez <i>et al.</i>	2015	<18	F	HCL	CF, CD	17	3.9	4.3	2.3
Martinez <i>et al.</i>	2015	<18	F	HCL	G	8	4,1	3.7	2.7
Varamenti & Platanou	2008	<18	F	NT	ALL	13	4.1 ± 0.8	4.9 ± 1.2	2.6 ± 1.0
Varamenti & Platanou	2008	U-18	F	NT	ALL	13	5.0 ± 1.3	4.9 ± 1.8	2.4 ± 1.1
Uljevic & Spasic	2009	U-14	M	HCL	ALL	29	3.9 ± 1.4	4.5 ± 1.0	2.7 ± 1.3
Uljevic & Spasic	2009	U-14	M	LCL	ALL	30	2.9 ± 1.3	3.4 ± 0.8	3.3 ± 1.3

Legend: Year – year of publication, NT – national team, HCL – higher club level, LCL – lower club level, ALL – all players, W – wings, P – perimeters, CF – centre forwards, CD – centre defenders, Endo – endomorph, Meso – mesomorph, Ecto – ectomorph

The research of anthropometric characteristics has yielded an average body height and weight of male and female water polo players. By observing water polo players between two water polo eras resulting from the secular trend and the morphological adaptation, it has been determined that the average water polo player has undergone certain changes in terms of larger body mass, taller height, extended length of limbs, and, to some degree, transversality. Higher numerical values in terms of some skeletal dimensionality, voluminosity and body height and mass have proven to be significant indicators of athletic achievement of water polo players. It has also been determined that the longer palm and the wrist width make the water polo player more successful in the technical elements of offence. Female water polo players with the higher level of athletic achievement have larger skeletal voluminosity and dimensionality.

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**RESUMEN:** El objetivo de este metanálisis fue sintetizar la investigación disponible que ha evaluado las características antropométricas, morfológicas y somatotípicas de los jugadores de waterpolo. Los estudios se identificaron a través de bases de datos electrónicas y se realizaron búsquedas manuales en volúmenes de revistas pertinentes. Se ha determinado que una parte sustancial del componente mesomórfico caracteriza a los jugadores a los hombres y mujeres de waterpolo. El somatotipo de la sección masculina junior pertenece al mesomorfo balanceado, mientras que la sección femenina junior pertenece al somatotipo endomesomorfo. La investigación de las características antropométricas ha arrojado una estatura y un peso corporal promedio tanto de los hombre como de las mujeres jugadores de waterpolo. Se ha determinado que el jugador de waterpolo medio ha sufrido ciertos cambios en cuanto a algunas características antropométricas producto de la tendencia secular y la adaptación morfológica. Los valores numéricos más altos en términos de cierta dimensionalidad esquelética, voluminosidad y altura y masa corporal han demostrado ser indicadores significativos del rendimiento atlético de los jugadores de waterpolo.

**PALABRAS CLAVE:** Waterpolo; Somatotipo; Morfología.

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