CORRELATION BETWEEN MORPHOLOGICAL CHARACTERISTICS, BIO-MECHANIC CHARACTERISTICS OF THE STROKE AND SWIMMING VELOCITY AMONG PUBESCENT SWIMMERS

Original scientific paper

Dragan Toskić1, Ljubiša Lilić1 and Lazar Toskić2

1,2 University of Priština, The Faculty of Sport and Physical Education, Serbia
2 University of Belgrade, PhD student, The Faculty of Sport and Physical Education, Serbia

Abstract

Success in sports swimming depends on numerous factors. The morphological and biomechanical characteristics play an important role in many sports, including swimming. Even though the correlation between these parameters among older swimmers is well known, in the case of pubescent swimmers this correlation varies, considering that this is a period of intense growth and development. The aim of this research is to determine the existence and nature of the correlation between morphological characteristics, the biomechanical characteristics of the stroke and the swimming velocity for the 50 m freestyle among pubescent swimmers. The sample of participants consisted of 25 young swimmers (15 boys and 10 girls) aged 12 to 15. By calculating Pearson’s correlation coefficient we obtained results which indicate that there is a statistically significant correlation between morphological characteristics, biomechanical characteristics of the stroke and the swimming velocity for the 50 m freestyle among pubescent swimmers. Young swimmers who are higher, heavier, who have a greater arm range and hand length swim with a greater velocity, have a longer stroke and at maximum swimming velocity use a smaller number of strokes.

Keywords: Morphological characteristics, biomechanical characteristics, swimming velocity, freestyle, pubescent age

INTRODUCTION

Success in competitive swimming depends on numerous factors. Daily high-intensity training sessions, the level of manifested motor and functional abilities, the swimmer’s diet and tactical preparations are just some of the factors which contribute to the achievement of top sports results in swimming. However, success in swimming to a great extent depends also on morphological and biomechanical characteristics.

The biomechanical characteristics of the stroke, such as frequency or the number of strokes and stroke length, are parameters which give us insight into the technique and effectiveness of the stroke of swimmers. Research has shown that the swimming velocity to a great extent depends on the length and number of strokes (Craig, & Pendergast, 1979; Craig, Skehan, Pavelczyk, & Boomer, 1985; Wakayoshi, D’Acquisto, Cappaert, & Troup, 1995; Pelayo, Sidney, Kherif, Chollet, & Tourny, 1996). The increase in the swimming velocity is a consequence of the increases in the number of strokes or an increase in the length of the stroke. Elite swimmers are characterized by great stroke length and high stroke frequency (Chollet, Pelayo, Deleplace, Tourny & Sidney, 1997). The length and number of strokes also depend on the distance of the swim (Arellano, Brown, Cappaert, & Nelson, 1994; Pelayo et al.,1996; Laffite et al., 2004). At short distances, stroke frequency is a more significant parameter for swimming velocity than stroke length.
Swimmers who are taller and have a wider arm span have longer strokes than swimmers with a smaller arm span.

In the case of the correlation between morphological characteristics, biomechanical characteristics of the stroke and swimming velocity among pubescent children, research shows similar results as those found among adult swimmers. The results of many studies indicate that there is a correlation between these variables among pubescent swimmers (Kjendlie, Stallman, & Stray-Gundersen, 2004; Jürimäe et al., 2007; Lätt et al., 2009; Lätt et al., 2010; Saavedra, Escalante & Rodriguez, 2010; Silva et al., 2012; Tsalis et al. 2012; Morais et al., 2012; Morais et al., 2013; Toskić, Lilić, & Toskić, 2013; Mezzaroba & Machado, 2014). However, among them, the correlation between morphological characteristics, biomechanical characteristics of the stroke and swimming velocity varies, considering that this period is one of rapid growth and development, so further research in the field is necessary. The aim of this research was to determine the correlation and nature of the correlation between morphological characteristics, biomechanical characteristics of the stroke and swimming velocity for the 50 m freestyle among pubescent age swimmers.

METHODS

The sample of participants consisted of 25 swimmers (15 boys and 10 girls). The participants were aged between 12 and 15. The young swimmers belong to the category of younger pioneers and pioneers. All of the participants had actively been training swimming for a period of more than three years and were active competitors in their age categories. The participants and their parents were informed of the aim and goals of the study, and they all voluntarily agreed to take part in it.

The sample of variables consisted of 4 variables from morphological space, 2 variables from the space of biomechanical characteristics of the stroke, and the average swimming velocity for the 50 m freestyle. The sample of morphological variables consisted of:

- body height (BH)
- body weight (BW)
- arm span (AS)
- hand length (HL)

Of the biomechanical parameters, the length of the stroke was measured (SL) along with the number of strokes (SN) for the 50 m freestyle. The participants swam in a 50 m length pool. The number of strokes was measured visually. The stroke made by each hand was counted, and not the stroke cycle. The length of the stroke was obtained based on the relation between the number of strokes and the length of the swim distance $SL = 50 m/ SN$. The average swimming velocity ($\nu$) was obtained based on the relation between the swim distance and the time needed for the distance to be covered $\nu = 50 m/ t$. All of the measurements were taken by two experienced measurers, and the props used included a stopwatch, anthropometric tape and scales.

In this paper we used a descriptive statistical procedure (Mean, Sd, Cv%, Min, Max), and Pearson’s correlation coefficient was calculated. Descriptive statistics were used to describe the measured variables, while the correlation coefficient was calculated in order to determine the correlation and nature of the correlation between the measured variables. All of the statistical procedures were carried out using the SPSS 19 program.

RESULTS

Table 1 shows the descriptive indicators of the biomechanical characteristics of the stroke and swimming velocity for the 50 m freestyle among pubescent swimmers. We can determine that the average swimming velocity for this group of participants was 1.44 m/s, and the average length of the stroke was 1.68 m, while the average number of strokes was 27.39. This group of participants, according to the homogeneity result (Cv%), differed the least in terms of the swimming velocity and the most in terms of the number of strokes for the 50 m freestyle.

Table 2 shows the descriptive indicators of the measured morphological variables among the young swimmers. Based on the showed results we can conclude that the average body weight for this group of participants is 47 kg, the average body height is 156.11 cm, the average arm span is 158 cm, while the average arm length is 15.96 cm. This group of participants differs the least in terms of body height (Cv=7.82%), and the most in terms of body weight (Cv=26.96%).

Table 3 shows the correlation coefficients between the morphological characteristics, biomechanical characteristics of the stroke and swimming velocity for the 50 m freestyle among pubescent swimmers. The average swimming velocity for the 50 m freestyle has a posi-

<table>
<thead>
<tr>
<th>$\nu$ (m/s)</th>
<th>SL (m)</th>
<th>SN (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1.44</td>
<td>1.68</td>
</tr>
<tr>
<td>Sd</td>
<td>0.19</td>
<td>0.26</td>
</tr>
<tr>
<td>Cv%</td>
<td>13.19</td>
<td>15.69</td>
</tr>
<tr>
<td>Min</td>
<td>1.19</td>
<td>1.2</td>
</tr>
<tr>
<td>Max</td>
<td>1.74</td>
<td>2</td>
</tr>
</tbody>
</table>
the average swimming velocity for this group of participants was 1.44 m/s, with an average stroke length of 1.68 m, and an average number of strokes of 27.39. This group of participants is classified as average in relation to the population of swimmers of their age (Jürimäe et al., 2007; Lätt et al., 2009; Saavedra et al., 2010; Silva et al., 2012; Morais et al., 2012).

Table 2 shows the descriptive indicators of morphological characteristics of pubescent swimmers based on which we can conclude that the average body weight for this group of participants is 47 kg, the average body height is 156.11 cm, the average arm span is 158 cm, while the average hand length is 15.96 cm. In the case of the morphological characteristics, this group of participants also belongs to the average group (Jürimäe et al., 2007; Lätt et al., 2009; Saavedra, Escalante & Rodríguez, 2010; Silva et al., 2012; Morais et al., 2012; Toskić, Lilić & Toskić, 2013; Toskić et al., 2014).

The results shown in table 3 present the correlation coefficients and significance of these correlations between the morphological characteristics, biomechanical characteristics of the stroke and the swimming velocity for the 50 m freestyle. The average swimming velocity for the 50 m freestyle has a positive and statistically significant correlation with the length of the stroke, body weight, body height, arm span and hand length, while with the number of strokes it has a statistically significant negative connection. This means that swimmers who are taller, heavier, who have a greater arm span and hand length swim with greater velocity. In addition, swimmers who swim at greater ve-
locity have a longer stroke length and a smaller number of strokes. These results were expected. Swimmers who are taller and heavier have a greater arm span and hand length, and we can assume that they are at the highest level of the biological level of development, and thus they manifest greater power and strength and have a longer stroke trajectory, a greater area which the stroke covers and greater propulsion. Thus, it is logical that they will have a greater swimming velocity and longer strokes. The obtained results are in accordance with the results obtained in previous studies carried out in this field (Kjendlie et al. 2004; Jüriä, et al., 2007; Lätt et al., 2009; Lätt et al., 2010; Saavedra et al., 2010; Silva et al., 2012; Tsalis et al., 2012; Morais et al., 2012; Morais et al., 2013; Toskić et al., 2013; Mezzaro, & Machado, 2014).

In addition to the correlation between the mid-level swimming velocity and morphological, that is, biomechanical characteristics, Table 3 shows the correlations between the morphological characteristics and biomechanical characteristics of the stroke. The length of the stroke has a positive and statistically significant connection with all the morphological variables. The swimmers who are taller, heavier, who have a greater arm span =nd longer hands achieve greater values for stroke length. These results were expected. Body weight is directly connected to muscle strength, and thus it is assumed that heavier swimmers have greater propulsion which, to a great extent, determines the length of the stroke. Swimmers who are taller have a greater arm span and hand length, and thus have a greater stroke trajectory and a greater area which is the propulsion part of the stroke. The number of strokes has a statistically significant negative correlation with the variables of body height, arm span and hand length, while between the variables of the number of strokes and body weight there is no statistically significant connection. This means that swimmers who are taller and heavier, who have a greater arm span and longer hands, achieve a smaller number of strokes. These results were also expected, especially if we take into consideration the correlation and nature of the correlation between the length of the stroke and morphological characteristics. Between the number of strokes and body weight there is no statistically significant connection, which means that body weight is a more important factor for stroke length than for the number of strokes. All of the aforementioned data are in accordance with the results of the previous studies carried out in this field (Jüriä et al. 2007; Lätt et al. 2009; Lätt et al., 2010; Saavedra et al., 2010; Silva et al., 2012; Morais et al. 2012; Morais et al., 2013; Mezzaro, & Machado, 2014).

Based on the results of this study, we can conclude that there is a statistically significant correlation between the morphological characteristics, biomechanical characteristics and swimming velocity for the 50 m freestyle among pubescent swimmers. Young swimmers who are taller, heavier, who have a greater arm span and longer hands, swim with a greater mid-level velocity, have a longer stroke and at maximum swimming velocity use a smaller number of strokes. These data can have an important role in the selection of swimmers. It is necessary for further studies in this field to include a larger sample of participants, as well as a greater number of variables from morphological space in order to explain the correlation between these parameters with more clarity.

REFERENCES


Morais, J.E., Jesus, S., Lopes, V., Garrido, N.D., Silva, A.,


Correspondence:
Dragan Toskić
University of Priština,
The Faculty of Sport and Physical Education, Serbia
Str. Dositej Obradović bb, 38218, Leposavić
Kosovo-Metohija, Serbia
E-mail: dragantoskic@gmail.com