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COMPARISON OF SOME KINEMATIC PARAMETERS IN THE 100 M FREE STYLE SWIMMING PERFORMANCES OF DIFFERENT AGE GROUPS

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Abstract

The purpose of the present study was to determine the effect of stroke length and stroke frequency on 100-m freestyle swimming performance. Participants comprised a total of twenty-four swimmers from Antalya Kulac Swimming Club. These swimmers were allocated to two groups. Group 1 consisted of twelve swimmers with a training duration of seven years and Group 2 consisted of twelve swimmers with a training duration of three years. The athletes' 100m freestyle swimming performance (as 4x25m) were recorded with two digital (50 Hz) cameras and the kinematic parameters stroke frequency, stroke length and speed were analyzed at each 25 m. There was a statistically significant difference between the two groups in the second 25-m and fourth 25 m stroke length values of 100-m freestyle swimming performance($p < .05$). The stroke length values of swimmers in Group 2 followed an irregular form for every 25 m while Group 1 swimmers increase their 100-m freestyle swimming performance by using SL without losing the stroke frequency value at all. In order to increase the swimming speed, swimmers in Group 2 have compensated for the decrease in stroke length by increasing the stroke frequency.

Keywords: Stroke length" stroke frequency" swimming biomechanics" swimming velocity

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1. Introduction

Swimming Performance as with cycling, running and other cyclic sports, is also directly related to physiological, technical and physical capacity. However, as the water locomotion requires more energy per unit than the locomotion on land, the technical level becomes more important to increase propulsive force and reduce active drag (Barghamadi et al., 2012; Greco et al., 2007).

The swimming velocities (V) depend on stroke length (SL) and stroke frequency (SF). SF refers to number of arm cycles (strokes) in per unit time, while SL refers to the displacement of the body in each arm cycles. These two parameters showed a significant correlation in the definition of swimming performance of swimmers at different performance levels in short and long tests (Greco et al., 2007, Bartlett, 1997). The freestyle swimming is the fastest swimming style among other styles. The decrease in swimming speed during performance is due to the decrease in stroke length. For that reason a swimmer who does not have a longer SL will have to swim with more SF to get same swimming velocities. In previous studies it was determined that elite swimmers preferred longer SL for conservation of their velocities (Barbosa et al., 2010; Carla et al., 2011; McCabe et al., 2011).

Elite swimmers usually perform with stroke length, while stroke frequency and velocities continue to decrease throughout the competition. The general conclusion about the change of stroke length and stroke frequency in a competition is that stroke length and velocities are decreasing during the race. Similarly, there are different opinions about stroke frequency that it can remain steady, decrease or increase. However, the decisive factor of the average speed of the swimmer is the stroke length relative to the stroke frequency. Thus, the velocity decline during the race is explained completely by the loss in the stroke length. Therefore, the best way to identify the stroke parameters that make up the velocities is to examine the changes in stroke length for a given performance (Keskinen , 1997).

2. Problem Statement

Examination of the effect of stroke length and frequency parameters on the 100-m freestyle swimming performance will provide information for trainers about which parameters are used more and which parameters should be developed more for athletes with different training ages.

3. Research Questions

How do the changes in stroke frequency and length parameters improve along with regular training and what is the contribution to 100-m freestyle swimming performance?

4. Purpose of the Study

The aim of present study was to examine the changes in stroke length and stroke frequency during 100m free swimming performance depending on the training age and to determine which parameter was effective for performance.

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5. Research Methods

5.1. Participants

Participants comprised a total of twenty four swimmers from Antalya Kulac Swimming Club. Twenty four swimmers were allocated to two groups. Group 1 consisted of twelve swimmers with training duration of seven years (Mean Age:14.45±0.52 years; Mean Height :165.63±9.02 cm; Mean Weight:58.81±8.19 kg) and Group 2 consisted of twelve swimmers with training duration of three years (Mean Age:11.57±0.54 years; Mean Height:156.29±7.63 cm; Mean Weight:52.86±9.26 kg).

5.2. Methods

In present study, the swimming performance of 100-m freestyle of 24 male athletes were examined with some kinematic parameters (stroke length, stroke frequency).

The athletes performed 15 minutes of land and water warm-up activities. After 100-m freestyle swimming performance, 4 x 25 m performance was recorded with two cameras. The cameras were placed on both ends of the pool in order to see 10 m distance of the pool. The intermediate time and swimming performance time determined by hand-held, battery powered, digital read-out stopwatches. Afterwards, records obtained from the computer environment were re-examined, stroke frequency (SF), stroke length (SL), 25 m velocities (V) values were calculated. The analysis was performed using the VideoPoint 2.0 motion analysis program.

The stroke length was calculated for each 5 m swimming distance by using the formula;

Swimming velocity= Stroke Frequency x Stroke Length

6. Findings

6.1. Physical characteristics of participants

Table 01. Physical characteristics of participants' swimmers in both groups.

Parameters	Group 1 (n=12)	Group 2 (n=12)
Age (year)	14.45 ± 0.52	11.57 ± 0.54
Height (cm)	165.63 ± 9.02	156.29 ± 7.63
Weight (kg)	58.81 ± 8.19	52.86 ± 9.26
Arm span (m)	1.24 ± 0.23	0.96 ± 0.14

6.2. One Hundred meter performance parameters of participant's swimmers

Table 02 shows the stroke length (SL), stroke frequency (SF) and the velocity (V) values in the range of 4x25 m in the 100-m freestyle swimming performance of the swimmers in group 1.

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Table 02. Stroke length (SL), stroke frequency (SF) and the velocity (V) values in the range of 4x25 of the swimmers in Group 1.

Group 1	25_1 m M ± SD	25_2 m M ± SD	25_3 m M ± SD	25_4 m M ± SD	100 m M ± SD
SL (m)	0.94 ± 0.2	0.91 ± 0.15*	0.91 ± 0.78	0.86 ± 0.16*	0.90 ± 0.32
SF (Hz)	1.04 ± 0.125	0.99 ± 0.12	0.92 ± 0.21	0.92 ± 0.09	0.96 ± 0.13
V(m/sn)	0.98 ± 0.19	0.98 ± 0,15*	0.85 ± 0.22	0.79 ± 0.15	0.90 ± 0.17*

p<.05

Table 03. Stroke length (SL), stroke frequency (SF) and the velocity (V) values in the range of 4x25 of the swimmers in Group 2.

Group 2	25_1 m M ± SD	25_2 m M ± SD	25_3 m M ± SD	25_4 m M ± SD	100 m M ± SD
SL (m)	0.86 ± 0.14	0.75 ± 0.13*	0.83 ± 0.12	0.68 ± 0.11*	0.78 ± 0.12
SF (Hz)	0.97 ± 0.17	0.93 ± 0.18	0.92 ± 0.16	0.95 ± 0.16	0.94 ± 0.16
V(m/sn)	0.85 ± 0.23	0.68 ± 0.08*	0.77 ± 0.19	0.65 ± 0.16	0.66 ± 0.16*

p<.05

When the average speed values of 100-m freestyle performance of swimmers in both groups were compared, swimmers in Group 1 performed faster than swimmers in Group 2 (p<.05). When group performances were evaluated at 25 m intervals, it was found that group 1 swimmers had longer stroke length values at second and fourth 25 m and higher velocity values at second 25 m (p<.05).

7. Conclusion

When the swimming performance is examined in a comprehensive way, it is obvious that competition among participants is influenced by individual differences (stroke frequency, stroke length and swimming velocity). These differences are based on the interaction between the biomechanical requirements of the skill (swimming technique) and skill level of athletes. For instance, long distance swimmers have longer SL and lower SF values (Craig et al., 1985).

It can be said that differences in height and stroke length contribute to differences in stroke length, as the swimming speed is generated by the stroke length multiplied by the stroke frequency. In present study, the reason of having larger stroke length values of group 1 swimmers may be resulting from their anthropometric characteristics.

In previous studies it was well documented that Olympic swimmers have longer stroke length than other swimmers and that they have effective indexes for producing propulsive effectiveness force in stroke length (Wakayoshi, et al., 1993; Wakayoshi, et al., 1995). Higher propulsive forces associated with more effective swimming techniques and coordination will allow faster and longer stroke length. Fewer stroke frequency rates will allow for less energy consumption while providing continuity in generating propulsion power for arm and leg movements (Hellard et al., 2007; Seifert et al., 2007,Kucia-Czyszczon et al., 2013, Seifert et al., 2004).

In present study, it can be seen that swimmers with more training ages increase their 100-m freestyle performance by using stroke length without losing stroke frequency value at all. The stroke length values

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of swimmers in group 2 were irregular for every 25 m and in last 25 m there was a 20.93% decline from the initial value. The stroke frequency is increased to compensate for the decrease in the stroke length and therefore the speed. However, some results indicate that biomechanical factors (90.3%) explained most of 100-m front crawl swimming performance variability in adolescent male swimmers, followed by anthropometrical (45.8%) and physiological (45.2%) parameters(Lätt et al.,2010) .

As a result, swimming performance is highly correlated with energy profile and technical level. Fewer variations in swimming speed, greater stroke length and arm coordination are important factors in improving the swimming economy.

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