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Effects of Aerobic Training on Biomechanical and Lactate Responses in Sprint Swimming Performance in Adolescent Swimmers¹

Erkan GÜNAY¹, Bekir ÇOKSEVİM², Cem Şeref BEDİZ³

¹Dokuz Eylül University, School of Sports Science and Technology, Izmir, TURKEY

²Erciyes University, School of Medicine, Sports Physiology Department, Kayseri, TURKEY

³Dokuz Eylül University, School of Medicine, Sports Physiology Department, Izmir, TURKEY

E-Posta: erkanswim@gmail.com

Abstract

The aim of this study was to determine the effects of aerobic training on biomechanical parameters and lactate response (La) during sprint swimming test (SST) and evaluate their relations with the progress of swimming time in adolescent swimmers.

Twenty-eight swimmers (15 males and 13 females aged 13-16 years) performed an all-out 100-m sprint swimming test twice pre and post 12 weeks of aerobic training. Basic anthropometrical measurements including body height, body weight, body fat percentage and physiological and biomechanical parameters in SST were obtained and such measurements repeated after 12-week training period. Video analysis determined the stroke count, stroke rate, stroke length, split time, swimming speed during 100m-sprint swimming test. Heart rates and blood samples for La were taken from the fingertip pre exercise and at the fifth minute of recovery. Results were processed with SPSS 20.0.

The results showed that the swimming time and stroke count decreased and stroke length, stroke rate and La levels increased significantly ($P < .05$ for all). No significant changes was seen in antropometry. Swimming time was correlated with both biomechanical parameters and La response. La was also correlated with stroke rate and swimming speed.

In conclusion instead of excessive training loads, just aerobic training may remarkably contributes to sprint swimming performance in adolescent swimmers.

Keywords: adolescent swimmers, aerobic training, biomechanical parameters, peak lactate

¹ This study was presented in 12th International Scientific Conference on Transformation Processes in Sport Performance-2015, Montenegro.



1. Introduction

Swimming is an individual and cyclic sport influenced by several determinant factors (Barbosa et al., 2010). Also there are a lot of factors that affect age group swimming performance such as Growth and development, Physical and Antropometrical parameters (esp. Body Height, arm span, feet) and Swimming techniques (Amaro, Marinho, Batalha, Marques, & Morouço, 2014). especially in physical differences due to growth and development are distinctive age group swimmers. The results of some studies from this field indicate the fact that Growth and development to a significant effect influence swimming velocity (Toskić, Lilić, & Toskić, 2016; Zampagni et al., 2008).

Main training goal of this session maximize their swimming / athletic performances (physically and mentally) and swimming techniques during this period. The endurance training is an important indicator of swimming performance. the most focused parameter in the training content of adolescent swimmers. Especially Aerobic Endurance and Aerobic Capacity are key factor for maximize the performance in age group adolescent swimmers (Pelarigo, Machado, Fernandes, Greco, & Vilas-Boas, 2017).

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, effectiveness of the stroke and swimming velocity of adolescent swimmers. In this period physical development may also lead to changes in the stroke mechanics and metabolic demands (Grimston & Hay, 1986; Komar et al., 2012). The other critical role of biomechanical stroke parameters is an important variable underpinning the energetics of swimming and swimming velocity. The change or improvement in these parameters can be considered as an improvement in swimming performance. The aim of this study was to determine the effects of aerobic training on lactate response (La) and biomechanical parameters during sprint swimming test (SST) and evaluate their relations with the progress of swimming time.

2. Materials and Methods

Twenty-eight swimmers who gained 450-500 FINA points from 100m Freestyle performance (15 males and 13 females aged 13-16 years; height 1.76 ± 0.09 m; body mass 63.3 ± 10.9 kg) performed an all-out 100-m sprint swimming test twice in a 25-m short course indoor pool (27° C of water temperature, 26° C of air temperature and 60% of air humidity): in trial 1, after summer break, and trial 2, after 12 weeks of aerobic training. Swimmers performed aerobic and technical training for 120min/3,5 km 6 days per week. In addition, they applied dryland training consisting of strength, coordination and flexibility work outs of 60 minutes 3 times per week. Basic anthropometrical measurements included body height, body mass and body fat percentage (Tanita MC780/USA) and physiological and biomechanical parameters in SST repeated after 12-week training period. Video analysis determined the stroke count, stroke rate, stroke length, split time, swimming velocity during 100m-sprint swimming test. To exclude the influence of turning, the effective velocity of each swimmer was measured over 10 m within two points at 7.5 m distance from each end of the pool. Stroke rate (SR) was computed from the time taken to complete three consecutive stroke cycles and Stroke Length (SL) was calculated from the ratio of the velocity and the corresponding SR. ^[1]Heart rates and blood samples for La were taken from the fingertip pre SST and at the fifth minute of recovery (Lactate Scout/USA). In addition, swimmers parents provided written consent for their participation in the current study, which was approved by the ethics board of the Erciyes University.



Statistical Analysis

In evaluating the data, intra group evaluations were carried out with Wilcoxon matched two sample test. The Correlations between each parameters of biomechanic was used Spearman's rho test. The difference was considered statistically significant whenever $P \leq 0,05$

3. Results

Table 1. Pre- test and post-test Physical Characteristics and Body Fat Percentage values of the swimmers

	Height(cm)		Body Weight(kg)		Body fat percentage(%)	
	<i>pre</i>	<i>post</i>	<i>pre</i>	<i>post</i>	<i>pre</i>	<i>post</i>
<i>Males (n=15)</i>	173± 0,9	174±1,1	63,3±10,9	64± 9,5	17,5± 4,2	17,5± 4,1
<i>Females (n=13)</i>	163±1,6	164±2,2	53,3±2,9	53,7±3,3	26,1± 1,5	26,7±1,9

Table 2. Correlations among delta values of ST, SL, SR, Peak Lactate

	ST	SL	SR
SL	,26		
SR	-.65**	-.33	
PeakLa	,14	,39*	-.26

*. Correlation is significant at the 0.05 level

** . Correlation is significant at the 0.01 level

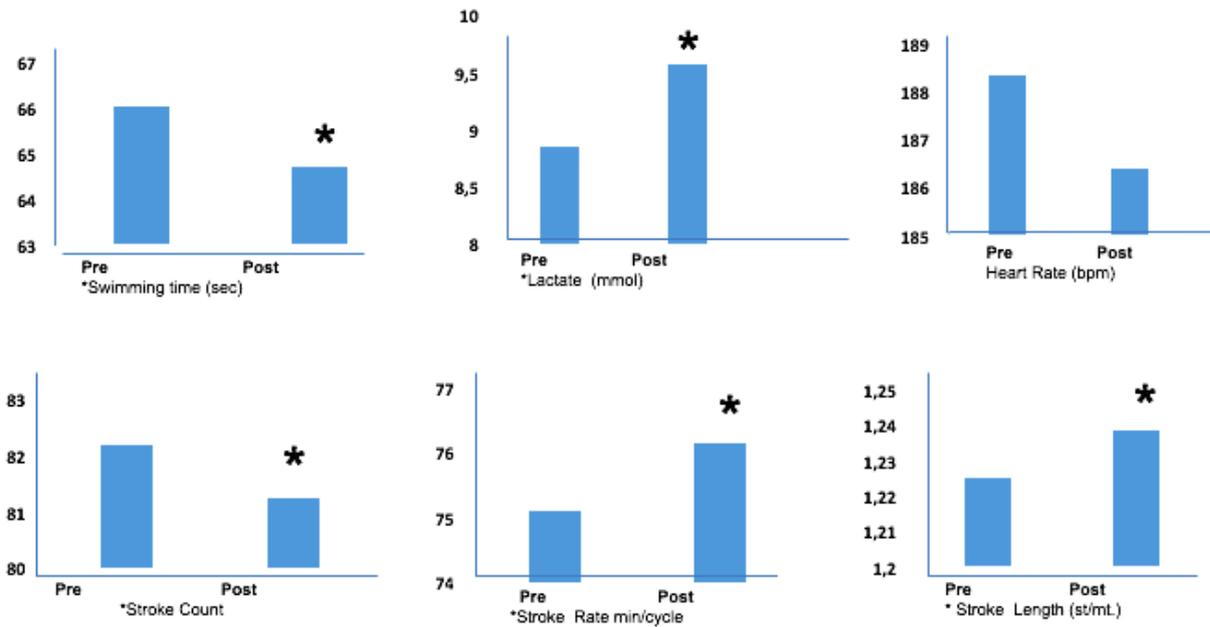


Figure 1. The biomechanical, heart rate and peak lactate values of swimmers at the pre and post training. (* $P < 0,05$)

It was presented physical parameters and Body Fat Percentage values of swimmers in Table 1. No differences between pre and post training session in Physical parameters. Swimming time and stroke count decreased and stroke length, stroke rate and La levels increased significantly ($P < .05$ for all). No significant changes was seen in antropometry. Swimming time was correlated with both biomechanical parameters and La response. La was also correlated with stroke rate and swimming velocity.(Table 2)

In response to the 12-wk training period, swimming time and stroke count decreased and stroke length, stroke rate and La levels increased significantly ($P < .05$ for all). No significant changes was seen in antropometry. Swimming time was correlated with both biomechanical parameters and La response. La was also correlated with stroke rate and swimming velocity (Figure1).

4. Discussions and Conclusions

There were no significant differences between pre and post training session in physical parameters and Body fat percentage. In the Literature were shown similar findings these parameters (Lätt et al., 2009; Siervogel et al., 2003). The body fat percentage parameter was considered to be related to the growth period.

Our key findings indicate that aerobic training improves swimming time and biomechanical parameters. Due to aerobic improvements, swimmers performed better performance with same heart rates in SST. Similar studies revealed that aerobic training improves swimming kinematics and enhances metabolic responses (Schnitzler, Seifert, Chollet, & Toussaint, 2014; Wakayoshi, Yoshida, Ikuta, Mutoh, & Miyashita, 1993). In this sport needs the ability to high levels of oxygen consumption. Aerobic training increases oxygen consumption capacity (Craig, Skehan, Pawelczyk, & Boomer, 1985)and use of aerobic energy in high intensity exercise (Sousa, Vilas-Boas, Fernandes, & Figueiredo, 2017). Study results demonstrated the



development of biomechanical parameters with aerobic training in adolescents.

Also increase in peak La may be attributed to the development of metabolic processes, decrease in stroke count and increase in stroke length and stroke rate may be based on to progress in biomechanical abilities. In the evaluation of sprint performance, all related metabolic and biomechanical parameters should be considered.

In conclusion, instead of excessive training loads, just aerobic training may remarkably contributes to sprint swimming performance in adolescent swimmers.

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