YOUNG SWIMMERS' KINEMATIC AND HYDRODYNAMIC DETRAINING BETWEEN A TWO SEASONS' BREAK

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SUMMARY

The aim of this study was to analyze the effects of the two seasons' break period on young swimmers' biomechanics taking into account their biological development. Twenty-five competitive swimmers were submitted to several anthropometric, kinematic and hydrodynamic tests at the end of the competitive season and 10 weeks later at beginning of the 2012-2013 season. The results showed that: (i) young swimmers can still improve their swimming biomechanics despite the absence of swim training between a two seasons' break; (ii) those improvements can be explained by their biological development (i.e. anthropometrics).

INTRODUCTION

Young swimmers usually have several weeks of school break in the summer. During such period no swim training is conducted until the beginning of the next season. According to training principles, the prolonged absence of a regular external load may decrease the form status built up in a previous training period. Since the major focus of swim training in children is their technical enhancement, it is expected that some adaptations will occur namely in kinematics and hydrodynamic outcomes. Due to biological development, young swimmers also experience regular anthropometric changes in their daily life. Increases in height and therefore in limbs´ lengths are some of the aspects of growth process. Nevertheless, it still remains the question if such break between seasons affects their biomechanical ability acquired in the past season. The aim of this study was to analyze the effects of the two seasons' break period on young swimmers' biomechanics taking into account their biological development.

METHODS

Twenty-five young competitive swimmers (overall: 12.45 ± 0.94 years of age) with regular participation in regional and national level competitions participated in the study. Coaches, parents and/or guardians gave their consent for the swimmers participation on this study.

Subjects were submitted to several anthropometric, kinematic and hydrodynamic tests at the end of the 2011-2012 season (TP_1) and 10 weeks later at beginning of the 2012-2013 season (TP_2). No specific swim training was conducted during such period.

Height (H) and arm spam (AS) were considered as anthropometrical features. The H was obtained measuring the distance from vertex to the floor with a digital stadiometer (SECA, 242, Hamburg, Germany). The AS was considered the distance between the third fingertip of each hand and was measured with a flexible anthropometric tape (RossCraft, Canada).

The mean swimming velocity (v), stroke frequency (SF), stroke length (SL), stroke index (SI) and speed fluctuation (dv) were determined as kinematic variables. Each swimmer performed three freestyle swim trials of 25-m with underwater start. For further analysis the average value of the three trials was computed. The v was computed during the middle 15-m as:

$$\bar{v} = \frac{d}{t} \qquad (1)$$

where v is the mean swimming velocity (in m.s^{-1}), d is the distance swam (in m) and t is the time spent to cover that distance (in s). Stroke length was computed as [6]:

$$SL = \frac{v}{SF} \qquad (2)$$

where SL represents stroke length (in m), v represents the mean swimming velocity (in m.s^{-1}) and SF represents the stroke frequency (in Hz). The SF was measured with a chrono-frequency counter during three consecutive strokes by two expert evaluators (ICC = 0.97). The SI was computed as [5]:

$$SI = v \cdot SL \qquad (3)$$

where SI is the stroke index (in m^2.c^{-1}.s^{-1}), v is the swimming velocity (in m.s^{-1}) and the SL is the stroke length (in m). A speedo-meter cable (Swim speedo-meter, Swimsportec, Hildesheim, Germany) was attached to the swimmer's hip. Such procedure allowed acquiring display and process pair wises velocity-time data on-line during the swim trial. The dv was computed as [1]:

$$dv = \frac{\sqrt{\sum_i (v_i - \bar{v})^2 F_i / n}}{\sum_i v_i F_i / n} \qquad (4)$$

where dv represents speed fluctuation (dimensionless), v represents the mean swimming velocity in (m·s^{-1}), v_i represents the instant swimming velocity (in m·s^{-1}), F_i

represents the absolute frequency and n represents the number of observations. The active drag coefficient (C_{da}) was computed as hydrodynamic variable using the velocity perturbation method [10]. Final C_{da} was calculated as [8]:

$$C_{Da} = \frac{2 \cdot D_a}{\rho \cdot S \cdot v^2} \qquad (5)$$

where D_a is the swimmer's active drag (in N), p is the water density (assumed to be 1000 kg·m^{-3}), v is the swimmer's velocity (in m·s^{-1}) and S is the swimmer's projected frontal surface area (in cm^2).

Within-subjects mean differences were analyzed with paired Student's t-Test ($p \leq 0.05$). Cohen d was selected as effect size index.

RESULTS AND DISCUSSION

Table 1 presents the differences in anthropometric, kinematic and hydrodynamic variables during the detraining period. At the beginning of the new season (TP$_2$) the swimmers were taller and increased the AS. As part of their normal development, young swimmers should expect several anthropometric changes in their formative years [2].

Despite the prolonged absence of regular technical drills during the detraining period, their biomechanic ability still improved. While the v, SL and SI increased, the SF, dv and C_{da} remained unchanged. It is known that increases in v can be reached using different combinations between SF and SL [6]. At earlier ages, increases in SF by maintaining SL are limited, mainly due to muscle proprieties of the swimmers. Higher strength levels only are reached after the appearance of the H peak that is around the 14 years [3]. So, it is possible that the swimmers from the present study have not reached H peak yet, and the increases in SF while maintaining SL were not possible. Instead, the improvement in v was based on SL increases. This can be explained by an increased AS. An increased upper limbs' length allowed reaching higher distances during each stroke cycle (SL) maintaining the number of strokes performed (SF). Those kinematic changes based on anthropometrical features were already reported for swimmers from similar age and competitive level, but during several periods of training [9].

The biomechanical efficiency improved as well, as indicated by the increase in SI and maintenance of dv. This happened because both variables are estimations based on the other kinematic measures. Increases in both v and SL leaded to an obviously increase in SI. The dv maintenance should have coincided with stabilization in v. Indeed, there is an association between both variables as reported in previous studies [1]. However there are other factors affecting dv that were not considered in this case.

The C_{da} remained unchanged during the summer break. Similar result was previously reported during an 8 weeks' general training phase [10]. Conversely, one week of hydrodynamics training mainly with specific visual and kinesthetic feedbacks, was sufficient to decrease C_{da} of pubescent swimmers [7]. So, decreases in young swimmers' C_{da} might be strongly related to a rigorous hydrodynamics training design.

CONCLUSIONS

It can be concluded that young swimmers can still improve their swimming biomechanics despite the absence of swim training between a two seasons' break. Those improvements can be explained by their biological development (i.e. anthropometrics).

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Table 1: Variation in anthropometric, kinematic and hydrodynamic variables during the detraining period.

	TP$_1$	TP$_2$	p	*d*
H [m]	1.59 ± 0.08	1.62 ± 0.07	< 0.01	-0.40
AS [m]	1.63 ± 0.11	1.64 ± 0.10	< 0.01	-0.10
v [m.s^{-1}]	1.20 ± 0.21	1.36 ± 0.12	< 0.01	-0.94
SF [Hz]	0.84 ± 0.07	0.82 ± 0.21	0.16	0.04
SL [m]	1.42 ± 0.24	1.68 ± 0.19	< 0.01	-1.20
SI [m^2.c^{-1}.s^{-1}]	1.74 ± 0.59	2.30 ± 0.41	< 0.01	-1.10
dv [dimensionless]	0.09 ± 0.02	0.09 ± 0.02	0.84	0.0
C$_{da}$ [dimensionless]	0.35 ± 0.16	0.41 ± 0.16	0.13	-0.38

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