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Original Article

Reaction time on swimming block start in competitors swimmers on World Swimming Championship

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Abstract:
The purpose this study was compare the reaction time (RT) in swimmers competitors on World Aquatic Championships in different events and qualifying, introducing than a new perspective about the RT behaviour in high performance swimmers athletes. The study included 103 athletes of different nationalities from the XVII World Swimming Championships in Budapest in July 2017. Female (n = 45) with mean age of 23,67 ± 3,39 years, and male (n = 57) with mean age of 24,63 ± 4,28 years, that competed the finals on 50m, 100m and 200m events, on breaststroke, butterfly and freestyle styles. Descriptive statistics of the date used were the mean and standard deviation. To compare the data between distances, ANOVA was used one way multicompare to verify the difference between RT at different distances and for comparison of the differences between stages was used the model of repeated measures, of each test was selected the 8 athletes finalist and their respective times of the qualifiers, semi-finals and finals. No significant differences were observed on RT between the qualifying heats on male ($p > 0.05$) and female ($p > 0.05$), and about the distances, athletes than swan 200m had a upper RT than 100m and 50m ($p < 0.05$) in both gender. The results show that in the world championship, the RT values on the high performance athletes were statistically different when compared between distances, but not different on stages, which means that swimmers' coaches need implement a strategic training aimed at the start phases.
Key Words*:* - performance; reaction time; swimming; swim start

Introduction

In high-performance sports, the success during competition is determined by small differences in performance, and when dealing with swimming, milliseconds do the difference. Therefore, it is necessary to optimize the performance of the athletes so that they reach the high performance in the sport (Bishop et al. 2009).

During a competition, particularly in short distance events, the ability to perform a good race start may depend on the combination of the following variables: Reaction time (RT), applied force on the block, low resistance when entering the water, underwater slide and underwater propulsion (Bishop et al. 2013; Potdevin et al. 2011; Rebutini et al. 2016)

Experts affirm that the most common form of RT assessment has been the kinematics of the start, seeing that the biomechanical parameters also influence the final performance of the athlete (Seifert, Chollet, and Ningo & Mujika 2011; Everett 2015; Lima 2016).

Recently, the use of technologies for performance analysis has been used in different sports, and quantify the reaction time (RT) of block may be a determining factor in the competitive result in speed swimming races, changing the result between the placements in different races and distances (Delalija and Babic 2008; Murrell and Dragunas 2012).

In a swimming competition, the RT of the athletes is measured through an electronic board attached to the swimming block. However in the last decades the Fédération Internationale de Natation (FINA) has used this board to more accurately measure the RT at a precision angle that allows the athlete to perform better (Everett 2015). In a more in-depth way some authors have done analyses to find out which type of swim start can provide kinetically a better result to the athlete during the moment of starting (Galbraith 2008; Takeda, Takagi, and Tsubakimoto 2012; Welcher, Hinrichs, and George 2008).

Regarding the start of the swim, the current literature has shown different researches regarding the training of the leave of the block and also verified that external factors can interfere in the moment of the start on

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the block as, grip strength, start techniques, leg strength, center of mass and even the athlete's body weight may interfere with the athlete's results (Garcia-Hermoso et al. 2013; J. Vantorre et al. 2010).
However, the investigations present in the literature describe on the influence of the RT in races of speed (García-Hermoso et al. 2017) or about the different types of swim start (Blanksby, Nicholson, and Elliott 2002; Murrell and Dragunas 2012; Barlow et al. 2014) although, there are no investigations into RT relationships at each stage of a competition.

Knowing that in an international level competition, each event is held in three stages. It is believed that during a competition the performance in the RT can be improved to the advance of each stage, and that in a championship final the athlete performs his best result in his time of race along with his best RT, however it is still necessary to investigate the behaviour of RT during the stages of a high level championship for better understanding. The purpose of this study was to compare the RT of swimmers participating in the Budapest World Swimming Championships in different stages and events, contribute to a new perspective about RT behaviour in high performance swimming athletes.

Material & methods

Participants

Participated in the study 103 athletes of different nationalities in the XVII World Swimming Championships in Budapest in July 2017. The female (n = 45) with mean age of 23.67 ± 3.39 years, and male (n = 57) with mean age of 24.63 ± 4.28 years, who competed in the finals in the 50m, 100m, 200m Breaststroke, Butterfly e Freestyle. In each event, the 8 final male and female athletes and their respective RTs were selected.

Procedure

All Time and RT results were obtained from the official FINA website (http://www.fina.org/). These values are in the public domain, so informed consent of the swimmers was not necessary. The RTs for the swim start of the block in the qualifying, semi-final and final stages of the tests of the feminine and masculine in the styles of 50m, 100m and 200m Breaststroke, Butterfly e Freestyle which were manually entered into an XML file and double-checked in order to avoid possible errors. The age values were taken from the official league schedule page (http://www.omegatiming.com/), data unavailable were taken directly from the websites of each athlete's federations.

Statistical analysis

Descriptive statistics of the date used were the mean and standard deviation. The data were normal using the Shapiro-Wilk test. In order to compare the data between distances, ANOVA was used one way multicompare to verify the difference between RT at different distances and for comparison of the differences between stages was used the model of repeated measures, of each test was selected the 8 athletes finalist and their respective times of the qualifiers, semi-finals and finals. Bonferroni's post-Hoc test was used to identify the differences between the variables. The level of significance was set at $p < 0.05$. All analyses were performed in the Statistical Package for Social Sciences software (SPSS Inc., Chicago, IL, USA).

Results

Figure 1A show differences on mean RT in each distance for they correspondently style on men. The results for men athletes showed that did not occurs differences statistically significant between the distances in breaststroke swimming style ($p > 0.05$). On 100m and 200m butterfly style were statistically greater than 50m ($p < 0.05$) and the 100m butterfly were not different than 200m ($p > 0.05$; $p = 0.42$). On freestyle, there was difference between them ($p < 0.05$). The RT on 50m freestyle was lowest than 100m freestyle ($p < 0.05$) and, lowest than 200m freestyle ($p < 0.05$), and 100m was significant different from 200m in this style ($p < 0.05$).

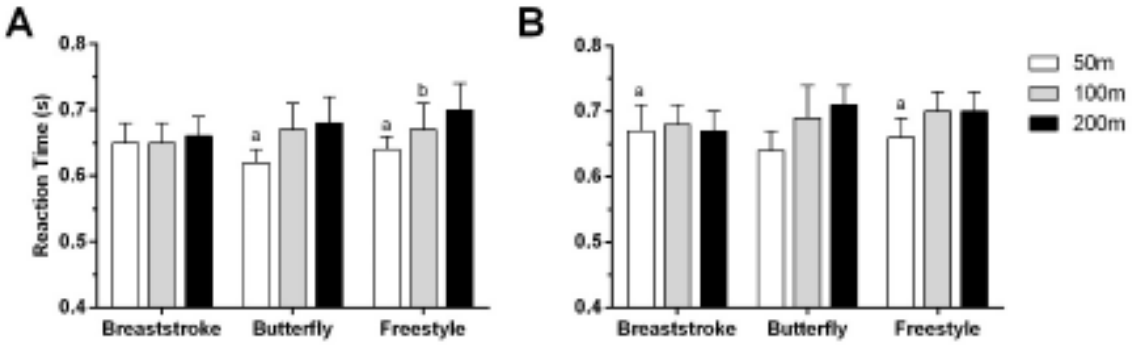

Figure 1. Comparisons of RTs at distances 50m, 100m, 200m Breaststroke, Butterfly e Freestyle swimming styles on men (A) and women (B) athletes. a Statistically lowest from 100m and 200m, b Statistically different from 200m. ($p < 0.05$). NOTE: Values expressed as mean ± standard deviation.

In Figure 1B the women athletes were not found differences in the RT at distances of 50m, 100m, and 200m for the butterfly style ($p > 0.05$). In the Breaststroke style the distance of 50m, less than 100m and 200m ($p < 0.05$), but 100m and 200m ($p > 0.05$, $p = 0.47$) are not different in this style. In freestyle, the 50m was lower than the 100m and 200m ($p < 0.05$), but the 100m was not statistically different from the 200m ($p > 0.05$).

Table 1 shows the difference of RT in different stages, qualifying, semifinal and final of the 50m, 100m and 200m races in Breaststroke, Butterfly and freestyle. It was verified that there is no statistically significant difference between the stages of all the races analyzed. It was identified that there is no predominant stage with greater or lesser reaction time between the different tests. The group of swimmers that competed in the final could have a reaction time worse than in the qualifiers as well as swimmers who swam semifinals to have a better RT than in the qualifiers and finals.

Table 1. Comparison of RTs in different stages in the 50m, 100m, and 200m races in Breaststroke, Butterfly and Freestyle men and women.

	50m		**100m**		**200m**	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**
Breaststroke						
Qualifying	0.65 ± 0.04	0.65 ± 0.04	0.66 ± 0.03	0.69 ± 0.06	0.66 ± 0.03	0.70 ± 0.02
Semi-finals	0.64 ± 0.03	0.64 ± 0.04	0.65 ± 0.03	0.69 ± 0.05	0.67 ± 0.03	0.71 ± 0.03
Final	0.65 ± 0.03	0.64 ± 0.03	0.63 ± 0.03	0.70 ± 0.05	0.67 ± 0.04	0.71 ± 0.03
Butterfly						
Qualifying	0.63 ± 0.02	0.67 ± 0.04	0.66 ± 0.04	0.66 ± 0.03	0.67 ± 0.04	0.66 ± 0.03
Semi-finals	0.62 ± 0.01	0.68 ± 0.05	0.67 ± 0.04	0.67 ± 0.03	0.68 ± 0.03	0.67 ± 0.03
Final	0.62 ± 0.02	0.67 ± 0.04	0.67 ± 0.03	0.67 ± 0.04	0.69 ± 0.04	0.67 ± 0.04
Freestyle						
Qualifying	0.64 ± 0.03	0.66 ± 0.03	0.66 ± 0.04	0.68 ± 0.03	0.68 ± 0.05	0.70 ± 0.02
Semifinals	0.64 ± 0.02	0.66 ± 0.03	0.66 ± 0.04	0.69 ± 0.03	0.70 ± 0.04	0.70 ± 0.04
Final	0.64 ± 0.03	0.66 ± 0.04	0.69 ± 0.05	0.71 ± 0.04	0.71 ± 0.03	0.71 ± 0.03

Dicussion

The purpose of this study was analyze and compare the RT of swimmers participating in the Budapest World Swimming Championships in different stages and races, it was verified that there are no significant differences in RT when compared between stages for male and female athletes. It was noted that in certain stages, variations occurred in the means of RT, making it clear that there is no specific step with greater or lesser value. Because it is a variable that is individual, the study demonstrated that the importance of the stage does not interfere in the athlete's RT.

According to the results shown in Tables 1 which compares different tests, athletes who swim greater distances tend to have a higher RT, although swimmers that choose to swim different race of their specialty in search of classification for medal dispute, in certain race can be influenced by RT performance, thus providing an imbalance in RT values in different stage.

It is important to consider according to the literature that the greater the degree of requirement for the athlete to visualize the execution of the ideal race, the higher the RT according to the increase in distance (Mason and Fowlie 2007). An athlete who swim 50m can better visualization of what would be an ideal race because the amount of factors that may interfere with the result is less than compared to a 200-meter race, where turns are required and swim speed control is required for an ideal race (Everett 2015).

When it comes to RT improvement, consider the importance of swim start from block. According to Vantorre et al. (2010) swim start training is essential in swimmers, the authors state that changing the exit technique can reduce the test time by up to 0.10 seconds and to achieve this improvement it is necessary for the athlete to perfect three basic elements: RT, impulse force and glide position in the submerged phase.

The importance of swim start training for 200m athletes should be emphasized by coaches as important in the end result of their competitive performance, because the study demonstrates that the athletes who swim these races, both for the male and for the female, have a slower reaction time in relation to the speed tests. According to Hay (1988), the swim start from block constitutes 5 to 11% of the total swim time, but tends to decrease as the distance increases, demonstrating in elite performance in swimmers that in short distance the leave the block can make the difference between winning and staying in third place (Breed and Young 2003).

A characteristic aspect of each athlete that can interfere in the result of the RT are the types of fiber, this factor can determine the results according to the distance. The proportions of the fibers within the muscles are genetically pre-determined, however with specific training it should improve the recruitment of the motor units of each muscle fiber. Races that require speed, strength and power swimmers tend to have a better RT than type 1 swimmers (Weineck 1999).

Blanksby, Nicholson, and Elliott (2002) in their study describe that the practice swim start during training has improved the reaction time and has had rapid responses to the starting signal, since this training has helped the swimmer to concentrate at the beginning of the signal sound rather than the output movement.

Perform swim start simulating to a competition during a swimming training becomes an important practice for swimmers of different characteristics, long and midlle distance swimmers. For it is possible with the training and the constant practice of swim start that the athlete improves his RT and that he has close values when analyzed in stages in a championship.

Studies have shown that experienced swimmers have a better result in applying impulse force on block at the time of starting compared to less experienced swimmers (Julien Vantorre, Chollet, and Seifert 2014). Competitive swimmers have a longer time of training performed for specific movement execution, which causes smaller RT to be produced by more directed concentration at start-up, auditory stimulus and faster processing of information in the nervous system when positioned to the swimming block (Maglischo 1999).

Pilianidis et al. (2012), and West et al. (2011), describe that physical trainers should emphasize in their trainings power stimuli interrelating muscle components and swim start performance, using in their physical preparation the plyometry, combined jumps and running, singly or jointly for the increase of this performance.

Another important point is to consider that the daily training programs involve the accomplishment of exits of the block without specific auditory stimuli, swimmers are regularly exposed to voice variations of their trainer at the time of leaving the block different from the sound stimulus of the competition. Papic et al. (2018) suggests that exit training with the voice of the trainer is more advantageous than performing dives without any auditory stimuli, because it is considered closer to the stimulus given in the competition, thus making the athlete have a better auditory perception.

Conclusions

According to the study, there was no difference in RT between stages, just as there is no predominance of better RT at any specific stages. Regarding the distances, the study showed that as the distance of the test increases, there is also an increase in the means of the swimmers RT. However it is clear that in a high-performance swimming championship there are differences of RT in distances, however, not between stages in different swimming events.

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