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THE RELATIONSHIP BETWEEN SWIMMING PERFORMANCE AND TIME PARAMETERS OF THE START AND TURN

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Summary. The start and the turn are factors that influence performance in different swimming disciplines. The aim of this study was to find out the relationship of selected time parameters of the start and the turn with sport performance of 100 m and 1 500 m freestyle finalists in the Olympic Games 2016. Monitored parameters of the start were the start reaction, time under water after the start, and time at a distance of 15 m after the start. The monitored parameters of the turn were the time of 5 m before the turn, the duration of the turn, the time under water after the turn, and time reached at a distance of 15 m after the turn. There was any significant correlation of the resulting time to 1 500 m and the observed start indicators. The significant correlation of the resulting time to 1 500 m and the observed turn indicators was time 5 m before the turn $r = 0.952$ ($p = 0.000$); the duration of the turn $r = 0.830$ ($p = 0.011$); time at a distance of 15 m after the turn $r = 0.886$ ($p = 0.003$). The significant correlation of the resulting time to 100 m and the observed start indicators was time under water after the start $r = -0.714$ ($p = 0.047$). The significant correlation of the resulting time to 100 m and the observed turn indicators was the duration of the turn was $r = 0.905$ ($p = 0.002$). The results point out the existing relations between 100 m freestyle and time under water after start and duration of the turn. And for 1 500 m existing relations with time 5 m before the turn, the duration of the turn and time at a distance of 15 m after the turn. Therefore, our recommendations for sports practice include development of speed, power and coordination skills with technical execution of the start and the turn into regular swimming training.

Key words: aquatic sport, freestyle, Olympic games, finalists

Introduction

The start and the turn are factors that significantly affect performance especially in shorter swimming disciplines. Coaches should pay attention to these factors, because final ranking of

swimmers at the end of the race can be very close and could depend on these details. For example, the results of the top events in the sprint disciplines at 50 m confirms this significance. Improving the start can improve the resulting time of a given discipline by up to 0.1 s (Maglischo 2015). The start may contribute to short sprint disciplines up to 30 % (Lyttle and Benjamvatra 2006). Cossor and Mason (2001) reported that time from sound signal until the head of the competitor reaches 15m can contribute to final sport performance in 50 m disciplines at level of 26,1 % while in the1 500 m it is only 0,08 %. At the Rio Olympics in 2016, in the 50 m freestyle discipline, the difference between the first American Ervin and the second Frenchman Manaudu was only 0.01 s, and between winner and third American Adrian was 0.09 s. Although the French had a faster reaction than the Americans he finished second (0.69 s to 0.63 s), (Olympic 2016). The elite swimmers' start usually lasts from 5,5 to 8 s and average percentage contribution for each start phase is 11 % (0.74 s) spent at the start block stage, 5 % (0.30 s) in the flight phase, 56 % (3.69 s) in the underwater phase and 28 % (1.81 s) free swimming (Elaine Tor 2014).

According to Maglischo (2015) the turn also affects sports performance. During the 100 m freestyle in long course, the turn can be realized with an underwater phase within 15 m distance, which is 15 % of the whole performance. In the same discipline, but in short course, the athlete must make three turns, which is 45 m in total - in other words 45 % of the total length of the discipline. Maglischo (2015) further states that improving the turn technique can reduce the duration of the discipline by as much as 0.20 s at each turn, which again confirms the significance of this factor. Hay (1984) reports that the turn is a 33 % share of sports performance in short course.

The aim of this study was to find out the relationship of selected time parameters of the start and the turn with sport performance of 100 m and 1 500 m freestyle finalists in the Olympic Games 2016.

Methods

The research group consisted of elite swimmers, participants of the finals of the Rio 2016 Olympic Games in the selected disciplines of freestyle (100 m FSD; 1 500 m FLD). The basic biometric indicators were age, body height, body weight, and point performance. Individual indicators were observed at the time of the Olympic Games. Basic Biometric Indicators were age, body height, body weight, and best point performance (Table 1 and Table 2).

Table 1
Basic biometric indicators for 1500m Freestyle

	Age [y]	**High [cm]**	**Weight [kg]**	**Points**
Average	22.25	187.25	75	947.37
Max	27	192	88	987
Min	19	178	66	898
Var	8	14	22	89

Table 2
Basic biometric indicators for 100m Freestyle

	Age [y]	**High [cm]**	**Weight [kg]**	**Points**
Average	22.37	191.75	85.62	935.5
Max	28	200	100	958
Min	17	185	70	909
Var	11	15	30	49

We collected the data from available databases on the Internet. The basic biometric characteristics of the monitored group were obtained from the website https://swimswam.com/bio/. The characteristics we used to clarify the relationship to sports performance were obtained from the website*:* https://results.tritonwear.com *and* http://www.fina.org/competition-detailed-results.

To clarify the relationship of selected time parameters of the start and the turn with sport performance in 100 m and 1 500 m freestyle disciplines, we used Spearman correlation coefficient, determination coefficient, and T test in linear regression model. Cohen's methodology was used to interpret relationships.

Results and discussion

When analysing the relationship between the achieved time to the 1500m freestyle and the selected time indicators of the start, we did not find any statistically significant relationship even in one of the monitored parameters (Table 3).

Table 3
Statistical Characteristics of Start Indicators in the 1500m and 100m Freestyle

	1 500 m Freestyle	**100 m Freestyle**
Start reaction	r = 0.084	r = 0.405
Time under water after the start	r = 0.095	r = - 0.714* (*p = 0.047)*
Time at a distance of 15 m after the start	r = 0.595	r = 0.190

* - statistically significant results

Given the total length of the performance in the 1500m freestyle, the results are not surprising. However, when comparing the average times measured for the endpoints, the results indicate differences between the groups. The FSD set reached an average start response of 0.685 s, which is on average 0.06 s better than the FLD file. We therefore assume that the group of 100 m specialists is better trained in speed-power and reaction capabilities.

In a closer look at the relationship between the achieved time in the 100 m freestyle and the selected time parameters of the start, we achieved relatively surprising results. A statistically significant correlation was recorded only in the case of time spent under the water after the start (Table 3). The correlation was not statistically significant in the case of the start and the time reached for the first 15 m. The best start reaction was recorded by Marcelo Ch. 0.62 s, who finished 8th in the final. On the other hand, Olympic winner Kyle Ch. recorded a start response of 0.71 s, which was even worse than the average (0.685 s) of the final.

The results of our research could be caused by the use of different methodology. For example Mason and Cossor (2000) found a high correlation between the start and the overall performance of the swimmer in almost all swimming disciplines. On the other hand Matúš (2012) found that the start reaction does not have a statistically significant effect on the time reached at a distance of 7.5 or 10 m. Therefore, based on the results, we assume that no start reaction, but the technical handling of the start with subsequent underwater work is ultimately more decisive for the performance.

When analysing the relationships between the achieved times of the 1 500 m freestyle and selected time indicators of turn, we found a statistically significant correlation between the 5 m distance before the turn, the turn, the time at the distance of 15 m after the turn, and time under water after the turn (Table 4).

Table 4
Statistical Characteristics of Turn Indicators in Disciplines 1500 m and 100 m of Freestyle

	1 500 m Freestyle	**100 m Freestyle**
Time at 5 m before turn	r = 0.952 * *(p = 0.000)*	r = 0.651
Duration of turn	r = 0.830 * *(p = 0.011)*	r = 0.905 * *(p = 0.002)*
Time under water after the turn	r = - 0.071	r = 0.690
Time at the distance of 15 m after the turn	r = 0.886 * *(p = 0.003)*	r = - 0.095

* - statistically significant results

A statistically significant relationship was shown not only for an indicator of time spent underwater after the turn. In this case, we assume that during the endurance disciplines the respiratory system demands are higher than in the case of shorter disciplines, so it is more difficult for swimmers to withstand a longer distance under water. As a result, the time spent under water is therefore shorter, as is confirmed by our results, when the average underwater time for a 100 m group was 2.32 s. In the case of the average time in the 1 500 m group it was 1.83 s. However, as in the case of the start, further research is needed to reveal closer relationships.

A statistically significant relationship between the achieved time per 100 m freestyle and the selected time indicators of turn was confirmed in our research only for the indicator of duration of turn (Table 4). In this case, we assume that due to the equilibrium performance of our group (the difference between the first and the eighth place was 0.83 s), the observed group was too small to show a statistically significant result.

However, as Mason and Cossor (2000) write:

"*in generalizing the conclusions of our research, we must be aware that strong correlation between race performances and turn time does not imply that the turning ability of a swimmer was the predominant contributing factor in determining the race result. If there is a strong correlation between two variables, this does not imply a cause and effect relationship*".

Conclusion

The results point out the existing relations between 100 m freestyle and time under water after start and duration of the turn. And for 1 500 m existing relations with time 5 m before the turn, the duration of the turn and time at a distance of 15 m after the turn. Therefore, we recommend

to sports practice to include development of speed, power and coordination skills with technical execution of the start and the turn into a regular swimming training.

There is a presumption that, with a higher number of subjects in the investigated group we could reveal a close relationship between the monitored variables and maximum performance at 100 m freestyle. Further research verification is needed to confirm these conclusions.

Based on our results, and in line with the authors' views on the importance of observation of sports performance (Masaryková 2005) we can formulate practical recommendations for swimming coaches and 100 m freestyle swimmers:

- develop reaction skills,
- develop the explosive power of the lower limbs and abdominal and back muscles which determine the fast start, the technique of swimming under water and the turn,
- regularly improve the start technique,
- focus on underwater work after the start and turn.

Practical recommendations for swimming coaches and 1 500 m freestyle swimmers:

- regularly improve the turn technique,
- develop the explosive power of the lower limbs and abdominal muscles which determine the fast turn.

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