ORIGINAL ARTICLE

https://doi.org/10.6063/motricidade.27905

What pacing is used by the best swimmers in the 200m freestyle?

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ABSTRACT

We examine the pacing strategies of elite swimmers of the 200 m freestyle from six long courses World Championships and three editions of the Olympic Games. The entries, partials, and total race times of the finalist swimmers were analysed. The results showed that the 1st lap is the one with the most significant difference, both for males (.0008) and females (< .0001), justified by the push-off against a solid (block). In addition, athletes perform their strategies assuming a negative correlation in the 1st half of the race and a positive correlation in the 2nd half. Also, the winner's time difference percentage was below compared with the median of total race time, where the Transition α (difference between 1st to 2nd and 3rd places, and the difference of 3rd place to other athletes) is faster in the 2nd half of the race by +3.23% for men and +2.50% for women. It is concluded that the 1st lap presents better reciprocity to the final time. The winners are faster than the median in the 2nd half of the race. Still, the %Time becomes an option, related to the possibility of using the pacing of different athletes, as an option for coaches and athletes.

KEYWORDS: pacing; swimming; performance.

INTRODUCTION

In competitive sports, seeking constant performance improvement is the primary objective of any athlete. When considering swimming, this performance is measured by the shortest time spent performing a certain distance (Garcia-Hermoso et al., 2013). Although different factors influence the swimmers' sports performance, establishing the best pacing during a competition is a crucial strategy for the success of these athletes, regardless of the context in which the swimmer is involved, being at the swimming pool (Barroso, Crivoi, Foster & Barbosa, 2021; Maglischo, 2010), open water (Rodriguez & Veiga, 2018) or triathlon (Wu et al., 2016).

The literature presents different strategies coaches and athletes have used in the pool. Maglischo (2010), for example, shows three different types of rhythm, uniform (constant), positive (with high-intensity block start and subsequent drop in speed) and negative (with the 2nd half of the race with a stronger intensity than the 1st). However, when specifically considering some distances, such as 800 and 1,500 m freestyle distances, athletes assume a parabolic rhythm, which results in a start and end of the race with stronger intensity and with a gradual slowing of pace in the middle laps (Oliveira et al., 2019; Lara & Del Coso, 2021). Another characteristic of long-distance events is the low stability in the pace of swimmers, as analysed in the study by Morais et al. (2020) in the 1,500 m event and Morais, Barbosa, Neiva & Marinho (2019), 800 m. It seems that elite swimmers are showing a sinusoidal (increase/decrease) profile in their pace. In both studies, in the analysis of the two races, it was observed that swimmers swim faster in the 1st half of the race. As observed by Morais et al. (2020), for European 1,500 m swimmers, variables such as the stroke frequency and stroke lenght seem to be the main predictors linked to rhythm, so the increase in the stroke frequency throughout the race allows for an improvement of total time. For the 800 m, the decrease in the turn speed variation can contribute to improving the performance (Morais et al., 2019).

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Conflict of interests: nothing to declare. Funding: none.
Received: 08/17/2022. Accepted: 11/29/2022.

Veiga, Rodriguez, González-Frutos, and Navandar (2019), when comparing and relating the total race time with the pacing of elite swimmers in events of 5, 10 and 25 km in open water, realised that the most efficient strategy is the negative one, that the maximum distance between the leaders could not exceed 20 seconds and that an increase in speed characterises the end of the race. It is also required, based on what was exposed by McGibbon, Pyne, Shephard, and Thompson (2018), that for sprint and middle-distance events, the maintenance of speed is crucial for a better result, while for long-distance events, what determines success is maintaining a low variability at each lap, in addition to the ability to increase the speed at the end of the race. Taken together, these pieces of evidence support that the strategies used to achieve success must consider the stroke and event. Regarding faster tests, a more detailed analysis seems to be important to provide objective feedback. In the 100m freestyle events, according to the analysis by Morais, Barbosa, Lopes and Marinho (2022), the swimmers who perform better seem to execute a faster exit from the block, turn and finish, in addition to the stroke length being a factor- key to increased speed.

Specifically for the 200 m races, the higher metabolic demand on the glycolytic system imposes, in athletes, great difficulty in withstanding fatigue and maintaining the time performance between laps (Campos et al., 2017). In this way, it becomes difficult to maintain the effort in a homogeneous way, which evokes the need to analyse the existing relationship between the partials of each lap and the total time. Robertson, Pyne, Hopkins, and Anson (2009), when analysing the relationship of specific lap times to the final time of different strokes and distance, including the 200 m freestyle, of the finalist athletes in nine international competitions, concluded that there was a strong and positive correlation for the partials that corresponded to half of the 200 meters events (third partial). In general, the study by Robertson et al. (2009) reinforces the importance of knowing the influence of lap time on the result of 200 m races , serving as a parameter for organising training. However, it is still unclear whether, in these events, other types of analysis, such as the relative time of the laps in relation to the total race time, the relative analysis between the 1st placed and the subsequent positions (Transition α), also would be interesting for decision making in training and competitions.

The aim of the present research was to examine the pacing strategies of elite swimmers of the 200 m freestyle.

METHODS

Participants

The entries, partials and total race time of the finalist swimmers of the 200-meter freestyle races of six long course World Championships (2009, 2011, 2013, 2015, 2017 and 2019) as well as three Olympic Games editions (2012, 2016 and 2021) were analysed. All data are in the public domain and were obtained from the World Aquatics website, the organiser of the events. No swimmers were identified in this study.

Procedures

This analysis derived the following: four of them were four lap times, and one was the race time per athlete, generating 718 data. Microsoft Excel® was used to process the data, according to the following rationale: (a; b) Lap and total race times are presented as median (MD-Time) due to non-normal data distribution; (c) W-Time: median times of winners; (d) W-Pace: percentage time that the swimmer should be faster than the median of the race at the time when the correlation is positive (2nd half of the race); (e) Transition α: relationship between the median of the 1st place with that of the 2nd and 3rd, and of the 3rd with the athletes who did not make it to the podium; (f) %Time: the percentage of the time was chosen because, in this way, it is possible to define the pacing used by the athletes and, from the percentage, to infer analysis and training organisation from this distribution for any athlete to be evaluated/trained.

Statistical analysis

Descriptive and inferential statistical methods were applied to evaluate the results. Qualitative variables were presented by distribution of absolute and relative frequencies, measures of central tendency and variation, and the D'Agostino-Pearson test was used to test their normality. In the inferential analysis, the following methods were applied: (a) Spearman's Correlation to evaluate the interdependence between the lap times and the final time of the race since the variables did not present a normal distribution. (b) To determine the Transition α, the Cutoff Point test described by Ayres, Ayres Junior, Ayres, and Santos (2007) was applied. The alpha error was previously set at 5% for rejection of the null hypothesis, and the statistical processing was performed using software programs BioEstat version 5.3 and IBM SPSS version 27.

RESULTS

Concerning the analyses conducted on the male athletes (Table 1), the Spearman coefficients presented a negative correlation between the race time and the 1st lap (r_s= -.38; *p*< .001; *df*= 35) and a tendency for 2nd lap (r_s= -.19; *p*> .05; *df*= 35). On the other hand, a positive correlation was observed between the total race time and the 3rd and 4th laps. In the 1st and 2nd lap times, the winning swimmers (fastest time) spent %Time higher than the median of the respective lap times, and in the 3rd and 4th lap times, they spent %Time lower than the median. Additionally, a significant difference in the 1st lap was found with better interdependence in relation to the total race time (*p*= .0008*). Furthermore, the Transition α from 1st to 2nd place is performing the 1st lap time spending 23.75% of the total race time.

Regarding the analysis of female athletes and the correlation with the total race time, a negative correlation with 1st lap (r_s= -.47; *p*< .001; *df*= 35) and a tendency for 2nd lap (r_s= -.07; *p*> .05; *df*= 35) and positive with 3rd and 4th were identified (Table 1). Like the male athletes, the winning female swimmers in the 1st and 2nd lap spent %Time higher than the median of the respective laps and in the 3rd and 4th laps spent %Time lower than the median of the respective laps. A significant difference was also identified in the 1st lap, showing better interdependence in relation to the final race time (*p*< .0001*). Furthermore, the Transition α from 1st to 2nd place performed the 1st lap spending 23.68% of the total race time.

The percentiles (P20, P35, P50, P65 and P80) of the 4 lap times of the 200 m freestyle, for men and women, are illustrated in Figure 1. It was found that the 1st lap is performed at a higher speed and different from the other laps for both sexes. The choice of dividing the percentiles was aimed at identifying the behaviour of the rhythm before and after the turns.

Finally, when analysing Figure 2, it is possible to observe the dispersion graphs of both sexes for the 200m freestyle with the interdependence between the 1st lap in %Time and the total race time. The 1st lap was selected, as it was the only one that exhibited a significant difference for both males and females (Table 1). From the analysis of the data dispersion obtained from the relationship between the total race time and the time only in lap 1, it is possible to observe that regardless of gender, the fastest athletes in this lap are not the winners of this race (Figure 2).

DISCUSSION

The aim of the present research was to examine the pacing of elite swimmers of the 200 m freestyle, checking the strategies used by them. In general, both for males and females, the 1st lap presented a significant difference in relation to the total race time. Additionally, concerning the total race time, a negative correlation was observed in the 1st half (100 meters) of the race and a positive correlation in the 2nd half. Finally, the Transition α showed that the winning athletes presented a different strategy when compared with the analysed median.

The results were obtained from the analysis of the lap times and total race times of athletes of both sexes in the

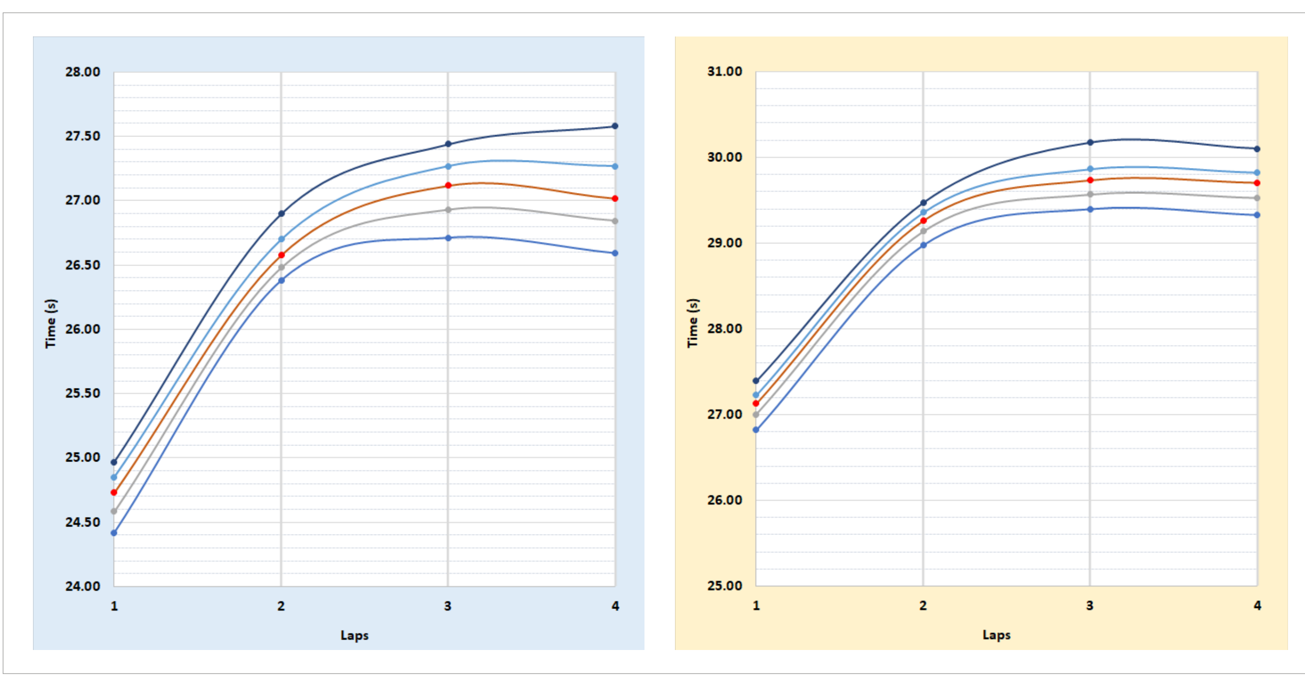

Figure 1. Evolution of Percentiles (P20, P35, P50, P65, and P80) in the men's (blue panel) and women's (red panel) 200m freestyle at the Olympic Games and World Championships in swimming (2009 to 2021).

200 m freestyle. Such results were represented as much by the median of the time (laps and total race time) as by the %Time. It was observed that, for both sexes, there is a significant difference only for the 1st lap (Table 1) and for a strategy in which there is a race division characterised by a faster 1st half and a slower 2nd half (Figure 1). Regarding the 1st lap, we could infer that the block start assumes great responsibility for the swimming speed, as suggested in the study by McGibbon et al. (2018). Campos et al. (2017) highlight that this trial presents a high glycolytic metabolic demand, making it difficult to maintain performance. In this way, an inadequate choice of speed to perform the 1st half of the race faster than 2nd half (Figure 2) may represent a failure, as it negatively impacts the performance in the 2nd half.

The W-Pace is the percentage that the swimmer must be faster than the 2nd half of the race in terms of the MD-Time (median times of winners). From Table 1, the MD-Time was the median time of the analysed group, while the W-Time was the winners' time. High-performance swimmers start with a faster 1st lap, from block start, followed by a decrease in speed during the 2nd half, and a progressive increase (3rd and 4th laps) until the end of the race (final sprint), characterised as a positive strategy (Maglischo, 2010; Abbiss & Laursen, 2008; Menting, Elfernink-Gemser, Huijgen & Hettinga, 2019). In this study, this strategy using the W-Pace (how effective an athlete must be compared to the median time to win a race), which identified that winners spent the 2nd half of the race 3.23% (men) and 2.50% (women) faster compared to the 1st half (Table 1). In practical terms, although the athletes maintain a high speed throughout the race, knowing which lap more swimming power should be applied can be a decisive factor for success (Figueiredo, Zamparo, Sousa, Vilas-Boas & Fernandes, 2011).

Table 1. Interdependence between the lap times and the total race time of men's and women's 200 m freestyle at the Olympic Games and World Championships in swimming (2009 to 2021).

200 m Freestyle	Men			Women		
	Time (s)	%Time	r_s Spearman	Time (s)	%Time	r_s Spearman
Lap 1	24.73	23.44	-.38*	27.13	23.46	-.47*
Lap 2	26.58	25.20	-.19	29.26	25.24	-.07
Lap 3	27.12	25.68	.27	29.73	25.66	.31
Lap 4	27.02	25.68	.18	29.70	25.64	.22
MD-Time	105.40			115.80		
W-Time	102.00			112.90		
W-Pace	+3.23%			+2.50%		
Transition α		**Lap 1**			**Lap 1**	
1st à 2nd e 3rd		23.75			23.68	
3rd à Others		23.53			23.50	

*Significant difference - *p*< .001 for both men and women; MD-Time: Median of total race time; W-Time: Median of winners (time); W-Pace: winner's time difference percentage compared to MD-Time.

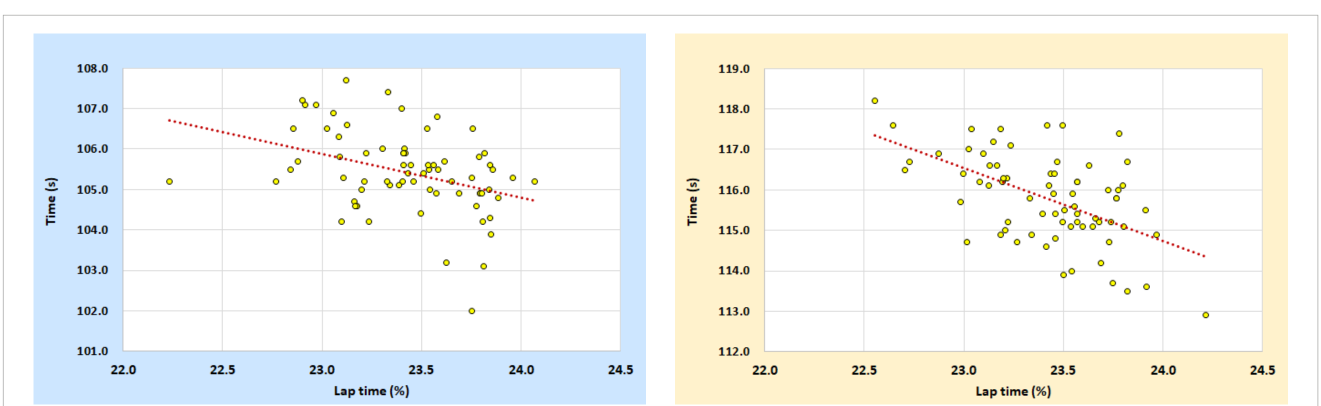

Figure 2. Interdependence between lap 1 (% of time) and the time that men's (blue panel) and women's (red panel) performed the 200m freestyle at the Olympic Games and World Championships in swimming (2009 to 2021).

Moreover, when considering the Transition α, winning athletes performed the 1st partial at a slower pace in comparison with those who finished 2nd and 3rd, besides being slower than the median. This pattern was also found among the athletes who came 3rd compared to those who did not achieve a podium position. They swan the 1st partial slower but with a higher partial time than the winners.

Our results partially correspond to Nikolaidis and Knechtle (2017), who investigated lap times in the 100 to 800 m freestyle events in different age groups. They concluded that in the 200 m race, there was a greater decline in speed during the 2nd lap, but the increase in speed was only observed in the last lap. De Koning et al. (2011) noticed that the world record holders of the 200 m freestyle swam at a less uniform pace, according to our findings, as well as Moser, Sousa, Olher, Nikolaidis, and Knechtle (2020), who found that a positive strategy was adopted, in addition to the fastest 1st lap.

Interpreting the correlations from %Time can be a method for the coach to instruct the athletes, in a practical way, to focus the optimisation of their performance in a specific partial or part of the race (Robertson et al., 2009; De Koning et al., 2011). In addition, it estimates how much the athlete needs to improve performance to have a chance of reaching the podium, also considering the Transition α. In other words, this approach combines analysis of the athlete's performance with themself and with other swimmers. Using only the time variable of the lap times restricts the analysis to that group of athletes. It is therefore assumed that any 200m athlete can benefit from such a proposal based on the distribution of pacing through the percentage of effort to be performed. The W-Pace shows how the winners swim the race. It allows the athlete to know a more refined strategy that enables them to improve their performance. This way, using %Time allows the athlete to train like the best, even if they are not in the same pool.

In fact, using the correct pace is an important strategy in swimming. However, research in this area has focused on analysing only competition data to characterise athletes' most used race strategies, leaving their reproducibility limited to competitions. Our study presents a training proposal for athletes to adapt to such race strategies. Future research must analyse other events and swimming strokes and the practical applicability of the proposal herein.

CONCLUSIONS

For both men and women, the 1st lap is the one that presents better interdependence in relation to the total race time, although the block start influences the time. The 2nd part shows a slight decrease in speed, which allows for a faster pace in the 2nd half of the race (3rd and 4th laps). The race winners (W-Time) use the W-Pace and are faster than the median in the 2nd half of the race. Finally, %Time serves as an option for coaches and athletes concerning the possibility of working with different athletes' pacing.

ACKNOWLEDGEMENTS

The authors of this study thank Professor Alex Assis Santos (Instituto Bioestatístico) for his participation in data analysis and statistical inference.

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