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Research article

Comparison of the Start, Turn and Finish Performance of Elite Swimmers in 100 m and 200 m Races

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Abstract

The main aim of this study was to compare the start, turn, and finish performance of 100 m and 200 m events in the four swimming strokes in elite swimmers of both sexes. The performances of all 128 finalists (64 males and 64 females) of the 100 m, and 200 m events at a major championship were analyzed. A set of variables related to the start, turn, and finish were assessed. In the start a significant and moderate race effect was verified in both sexes (100 m vs 200 m). It was highest in butterfly events (males: $\Delta = 9.81\%$, $p = 0.046$, $\eta^2 = 0.60$; females: $\Delta = 7.96\%$, $p < 0.001$, $\eta^2 = 0.75$). In the turn a significant and moderate-strong race effect was verified in all strokes in both sexes, the highest being in butterfly (males: $\Delta = 12.26\%$, $p < 0.001$, $\eta^2 = 0.93$; females: $\Delta = 10.74\%$, $p < 0.001$, $\eta^2 = 0.92$). The finish had a significant and moderate race effect in butterfly and in breaststroke (females). The underwater variables were found to be the main contributors to a faster start. Over the turn, key determinants were the surface variables. As for the finish, mixed results were observed. It can be suggested that the underwater profile was the main determinant in starting, whereas the surface profile was the main determinant in turning. Therefore, coaches are advised to focus on such race phases to enhance the total race time.

Key words: Swimming, technique, performance, analysis.

Introduction

In competitive swimming, records at major events such as Olympic Games, World and European Championships are still being broken. The swimming fraternity is always aiming to enhance swimmers' final time by improving their performance in key moments of the race. Video analysis of elite swimmers' performance is a major tool for swimmers, coaches and researchers (O'Donoghue, 2006). The information that is retrieved by such analysis help swimmers in understanding their handicaps, and hence how to improve. If in the past the performance enhancement was underpinned by improving mostly the swim stroke (i.e. clean swim − refers to the swim speed during an intermediate distance, without the interference of the wall push-off) (McGibbon et al., 2018; Menting et al., 2019), now the focus is shifting more towards the remaining phases of a race (start, turn and finish) (Morais et al., 2019).

Lately there has been an increasing interest by practitioners, analysts and researchers in the role played by the start, turns and finish (Peterson Silveira et al., 2018; Veiga and Roig, 2016). As the race distance becomes longer (i.e. from 50 m to 1500 m), different phases of the race have different partial contributions to the final race time. In short events (e.g. 100 m events), the start and turn account for nearly a third of the final race time (Morais et al., 2018). Contrarily, in long-distance events (e.g. 800 m and 1500 m races), the swimming pace (i.e. swim stroke) plays the major role (Lipinska et al., 2016; Morais et al., 2019). Among the swimming community the 200 m events are claimed to be too long for sprinters and too short for long-distance swimmers (Madge, 2014). Moreover, these 100 m−200 m events are the only Olympic events where the distance can be doubled in all swim strokes (i.e. all swim strokes are raced in the 100 m and 200 m distances). Therefore, it is important to provide insights into a comparison of the phases of the race (namely the start, turn and finish) in these events for both coaches and swimmers, as stroke specialists could compete in both distances.

The literature has reported that the clean swim phase was the best predictor of the final race time in 200 m events (Arellano et al., 1994; Thompson et al., 2000). Nonetheless, differences can be observed in the clean swim between short- and middle-distance events, such as the 100 m and 200 m, respectively. Sprinters (100 m) achieve a faster speed in comparison to their middle-distance counterparts (200 m) (Arellano et al., 1994; Jesus et al., 2011). However, it is yet unclear whether differences in average race speed are also due to variations or changes in the performance delivered in the start and turning phases (Simbaña et al., 2018a). It is reported that swimmers racing the 100 m events reach the 15 m mark, and also break the water sooner in comparison to their 200 m counterparts (Jesus et al., 2011; Veiga et al., 2016).

In other studies, the 200 m events at major competitions were analyzed (Chengalur and Brown, 1992; Hellard et al., 2008; Skorsky et al., 2014). Such analyses included the start (Arellano et al., 1994; Jesus et al., 2011), and turn (Mason and Cossor, 2001; Veiga and Roig, 2016). Moreover, surface and underwater profiles in these segments of the race were also analyzed (Veiga and Roig, 2016; Veiga et al., 2016). Start and turn phases can be further broken down into subphases (surface and underwater). These subphases might explain the performance delivered in the start and turn. However, solid insights into other variables related to the start and turn subphases in elite swimmers are not found in the extant literature (e.g. Tor et al.,

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2015; Veiga and Roig, 2016). As far as our understanding goes, the literature remains unclear about the importance of underwater and/or surface profiles during the start and turn, which can ultimately affect the water entry and the water break (e.g. Veiga and Roig, 2016; Veiga et al., 2016). For instance, swimmers may choose to extend their underwater phase, and hence save energy for the swim stroke. Or to break the water sooner, leading to a faster start of the swim stroke (Vantorre et al., 2014). On top of that, very few studies have analyzed the finish, and how important it is for the final race time (Ikuta, 1998; Suito et al., 2015). Among coaches and swimmers there is the claim that finishing fast is paramount to delivering a good performance. Nevertheless, we failed to find solid evidence to back up such a claim. Overall, despite the start, turn and finish being understood in the swimming fraternity as important contributors to the performance, it might be suggested that more evidence on this matter could be of substantial importance.

Therefore, the main aim of this study was to characterize and compare a set of variables related to the start, turn and finish performance between the 100 m and 200 m events in the four swimming strokes by elite male and female swimmers. It was hypothesized that the start time, turn time and the finish present a significant race effect (i.e. significant differences between races).

Methods

Participants

The performances of all 128 finalists (64 males and 64 females) in the 100 m, and 200 m events (four swim strokes, 8 swimmers per event) at the 2018 long course meter LEN European Aquatics Championships held in Glasgow were analyzed. Mean performance of the males corresponded to 96.83%, and 95.84% in the 100 m and 200 m freestyle world records, respectively; 96.75%, and 95.88% in backstroke; 96.58%, and 98.31% in breaststroke, and; 96.78%, and 96.26% in butterfly. Mean performance of the females corresponded to 96.15%, and 96.04% in the 100 m and 200 m freestyle world records; 97.15%, and 96.14% in backstroke; 95.83%, and 96.32% in breaststroke; and 96.22%, and 95.12% in butterfly. All procedures were in accordance to the Helsinki Declaration regarding Human research.

Data collection

The official race times (final race times, every 50 m split time and reaction time) were retrieved from the official competition website (www.europeanchampionships.com). The championships organization provided the video clips of all races in high-definition video (f = 50 Hz). The set-up system delivered real-time multi-angle recordings using individual tracking from high-definition pan-tilt-zoom cameras (AXIS v5915, Lund, Sweden). Each swimmer was recorded by one camera (i.e. one camera per lane). Two other high-definition fixed cameras (AXIS q1635, Lund, Sweden) recorded both ends of the swimming pool, one enabling the analysis of the start and finish, and the other the turn(s). The start flashing light was synchronized with the official timer and were visible by all cameras. The start flashing light was used as reference to set the time-stamp on an in-house customized software for race analysis in competitive swimming. The distances used for the start and turn variables were calibrated based on the pool's marks (i.e. 5 m and 15 m marks in the swim lanes) (Morais et al., 2018; Morais et al., 2019). Each start, turn and finish performance were analyzed individually for each swimmer. Two expert evaluators performed all race analyses individually and separately. The agreement between both evaluators was verified with the Intra-Class Correlation Coefficient (ICC). This ranged between 0.989 and 0.999 (very high agreement).

Start and finish

The following variables were selected for analysis: (i) reaction time (also known as block time, the time lag between the starting signal and the instant the swimmer's feet left the block). This was retrieved from the championship official website (www.europeanchampionships.com); (ii) flight time (the time lag between the instant the toes leave the block and the hands entered the water); (iii) entry time (the time lag between the starting signal and the instant the hands enter the water); (iv) entry distance (the distance between the starting head-wall and where the hands entered the water); (v) underwater time (the time lag between the instant the hand entered the water, and the head broke through the water surface); (vi) underwater distance (the distance between where the hands entered the water and the head broke through the water surface); (vii) underwater speed (between the entry time and water break time); (viii) water break time (the time lag between the starting signal and the head breaking through the water surface); (ix) break distance (the distance between the starting head-wall and the head water break); (x) 15 m time (the time lag between the starting signal and the swimmer's head reaching the 15 m mark). The 15 m time was selected as the main start outcome (Morais et al., 2018; Vantorre et al., 2010). The finish was considered as the last 5 m (Suito et al., 2015). Therefore, it was assessed as the time spent to travel the last 5 m of the race, and the corresponding speed ($v = d/t$). The clean swim speed (during the intermediate 30 m) was also calculated, to compare the difference between the clean swim speed and finish speed.

Turn

The following variables were selected for analysis: (i) the 5 m-in (the time lag between reaching the 45 m mark and touching the wall − retrieved by the official split time); (ii) water break time (the time lag between the touch on the wall and the head breaking through the water surface); (iii) water break distance (the distance between the wall and the head breaking through the water surface); (iv) underwater speed (between the touch on the wall and the head breaking through the water surface); (v) 15 m-out (the time lag between the touch on the wall and reaching the 15 m mark); and (vi) the total turn (the time lag between reaching the 45 m mark and the 15 m mark of the following split). The latter variable (total turn time) was chosen as the main turn outcome (Morais et al., 2019; Morais et al., 2018). In the 200 m events, the mean value of the three turns is reported as suggested elsewhere (Veiga and Roig, 2016).

Statistical analysis

The Kolmogorov−Smirnov and Levene tests were used to assess the normality and homoscedasticity assumptions, respectively. The mean and one standard deviation were computed for all variables of the 100 m and 200 m races. The relative difference (Δ, in %), and the 95% confidence interval (95CI) were computed between the 100 m and 200 m races, for all selected variables (i.e. start, turn and finish).

The one-way ANOVA ($p < 0.05$) was used to: (i) verify a race effect (i.e. variation between the 100 m and 200 m races) for all the start, turn and finish variables of each swimming stroke; and (ii) verify a speed effect (i.e. variation between the swimming speed in the intermediate 30 m, and the swimming speed during the last 5 meters before finishing).

The eta square (η^2) was selected as magnitude of the effect size in the race effect, and deemed as: (i) without effect if $0 < \eta^2 \leq 0.04$; (ii) minimum if $0.04 < \eta^2 \leq 0.25$; (iii) moderate if $0.25 < \eta^2 \leq 0.64$; and (iv) strong if $\eta^2 > 0.64$ (Ferguson, 2009).

Results

Start and finish

The 15 m time (main start outcome) showed a significant and moderate race effect (100 m vs 200 m) for males in freestyle (Δ = 4.50%, $p = 0.01$, $\eta^2 = 0.39$), backstroke (Δ = 5.23%, $p = 0.035$, $\eta^2 = 0.28$), and butterfly (Δ = 9.81%, $p = 0.046$, $\eta^2 = 0.60$) (Figure 1). The 15 m time took longer (i.e. a worse performance) in the 200 m than 100 m events. The variables related to the underwater profile, such as the underwater time (Δ = 18.24%, $p = 0.002$, $\eta^2 = 0.50$) and underwater distance (Δ = 13.10%, $p = 0.033$, $\eta^2 = 0.29$) showed a significant and moderate race effect only in breaststroke.

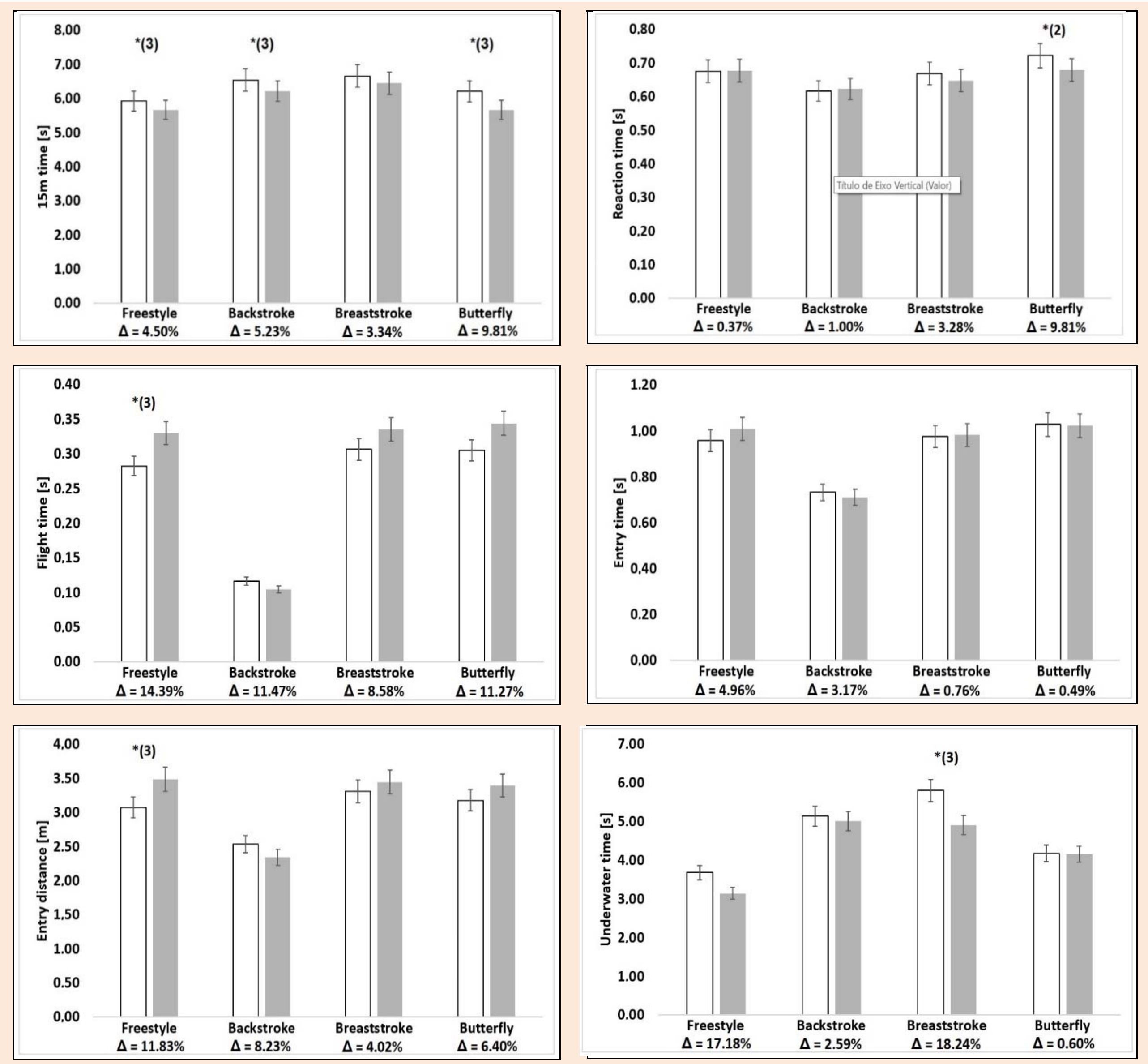

Figure 1. Males start and finish variables comparison between the 100 m and 200 m races (freestyle, backstroke, breaststroke, and butterfly). White background represents the 200 m races, and grey background the 100 m races (bars represent the 95% confidence interval). Δ − relative difference; * − significant differences ($p < 0.05$); (2) − minimum effect size; (3) − moderate effect size; (4) − strong effect size.

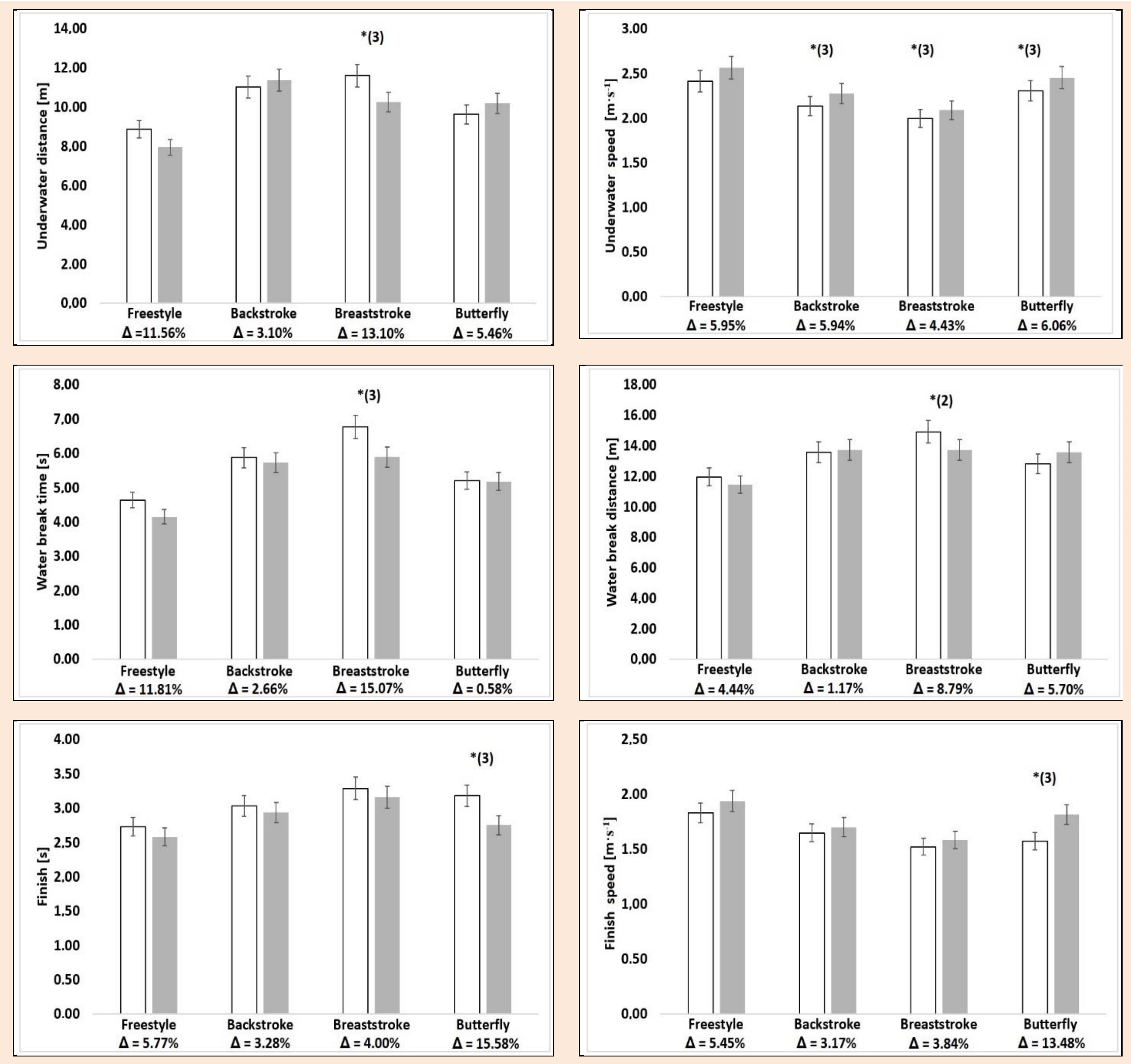

Figure 1. Continue… White background represents the 200 m races, and grey background the 100 m races (bars represent the 95% confidence interval). Δ − relative difference; * − significant differences ($p < 0.05$); (2) − minimum effect size; (3) − moderate effect size; (4) − strong effect size.

As for the finish, a significant and moderate race effect was verified only in the butterfly (finish time: Δ = 15.58%, p = 0.001, $\eta^2 = 0.58$; finish speed: Δ = 13.48%, $p < 0.001$, $\eta^2 = 0.62$) (Figure 1). In the 100 m event, a non-significant effect was noted in the speed (i.e. speed between the middle 30 m stretch, and the last 5 m) in all swim strokes. Nevertheless, it was noted that only in freestyle the speed increased in the 5 m finish. In the 200 m event, a significant and moderate speed effect (faster in the finish) was only noted in freestyle (Δ = 4.08%, p = 0.04, $\eta^2 = 0.26$). On the other hand, only in the butterfly the speed slowdown in the final 5 m of the race.

In female swimmers the 15 m time (main start outcome) showed the same trend as in males. Significant and moderate-strong race effect was verified in freestyle (Δ = 5.75%, p = 0.005, $\eta^2 = 0.44$), and butterfly (Δ = 7.96%, $p < 0.001$, $\eta^2 = 0.75$) (Figure 2). Again, the 15 m time took longer in the 200 m than 100 m events. It is also noteworthy that backstroke did not show a significant race effect, whereas breaststroke did (Δ = 6.47%, p = 0.005, $\eta^2 = 0.44$). The underwater profile was similar to that of their male counterparts. Only in breaststroke was a significant and moderate race effect verified (underwater time: Δ = 16.85%, p = 0.007, $\eta^2 = 0.41$; underwater distance: Δ = 11.94%, p = 0.017, $\eta^2 = 0.34$).

The finish in women's events showed a significant and moderate race effect in breaststroke (finish time: Δ = 6.22%, p = 0.006, $\eta^2 = 0.42$; finish speed: Δ = 5.82%, p = 0.006, $\eta^2 = 0.43$) and butterfly (finish time: Δ = 7.24%, p = 0.024, $\eta^2 = 0.32$; finish speed: Δ = 6.71%, p = 0.024, $\eta^2 = 0.31$) (Figure 2). In the 100 m event, a non-significant speed effect was verified. Females slightly decreased their finish swim speed in comparison to the clean swim (except in breaststroke, which was slightly faster in the finish). In the 200 m event, a significant and moderate speed effect was noted in freestyle (Δ = 4.31%, p = 0.01, $\eta^2 = 0.39$), and backstroke (Δ = 3.13%, p = 0.02, $\eta^2 = 0.31$). That is, the speed increased in the final 5 m (the same trend was observed in breaststroke, but not significantly). In butterfly, the speed in the final 5 m slowed down (non-significantly) in comparison to the intermediate swim.

Turn

Total turn time in males showed a significant and moderate-strong race effect in all events, being higher (poorer performance) in the 200 m events (freestyle: Δ = 7.11%, $p < 0.001$, $\eta^2 = 0.82$; backstroke: Δ = 8.76%, $p < 0.001$, $\eta^2 = 0.73$; breaststroke: Δ = 5.27%, $p = 0.002$, $\eta^2 = 0.50$; butterfly: Δ = 12.26%, $p < 0.001$, $\eta^2 = 0.93$). Regarding the variables related to the underwater profile, a significant and moderate-strong race effect was noted only in butterfly (water break time: Δ = 19.83%, $p = 0.006$, $\eta^2 = 0.43$; water break distance: Δ = 26.06%, $p < 0.001$, $\eta^2 = 0.64$; underwater speed: Δ = 7.96%, $p = 0.007$, $\eta^2 = 0.41$).

The total turn time in females showed a similar trend to that of their male counterparts. A significant and moderate-strong race effect was verified in all swim events (freestyle: Δ = 7.84%, $p < 0.001$, $\eta^2 = 0.85$; backstroke: Δ = 8.31%, $p < 0.001$, $\eta^2 = 0.78$; breaststroke: Δ = 4.45%, $p = 0.001$, $\eta^2 = 0.55$; butterfly: Δ = 10.74%, $p < 0.001$, $\eta^2 = 0.92$). For the turn underwater variables, the water break time did not show a significant race effect (i.e. no significant differences between races), but the water break distance in backstroke (Δ = 27.64%, $p = 0.0043$, $\eta^2 = 0.26$), and the underwater speed in butterfly (Δ = 8.11%, $p = 0.001$, $\eta^2 = 0.56$) did.

Discussion

The main aim of this study was to characterize and compare a set of variables related to the start, turn and finish performance between the 100 m and 200 m events of elite swimmers in the four swimming strokes. Overall, a significant and moderate race effect was observed in the main start and turn outcomes between the two events in both sexes. As for the finish, a race effect was only noted in butterfly in both sexes, and breaststroke in females.

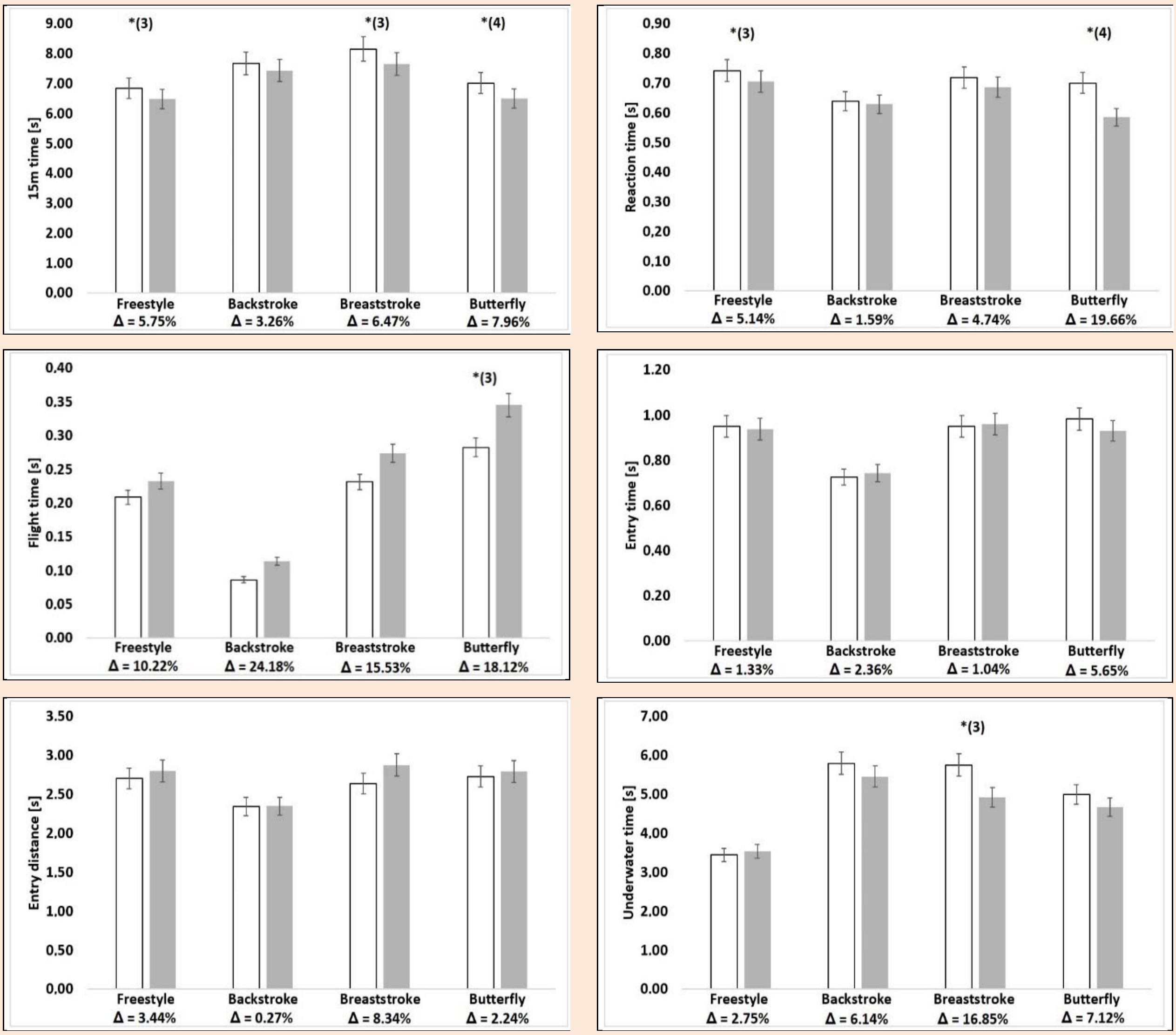

Figure 2. Females start and finish variables comparison between the 100 m and 200 m races (freestyle, backstroke, breaststroke, and butterfly). White background represents the 200 m races, and grey background the 100 m races (bars represent the 95% confidence interval). Δ − relative difference; * − significant differences ($p < 0.05$); (2) − minimum effect size; (3) − moderate effect size; (4) − strong effect size.

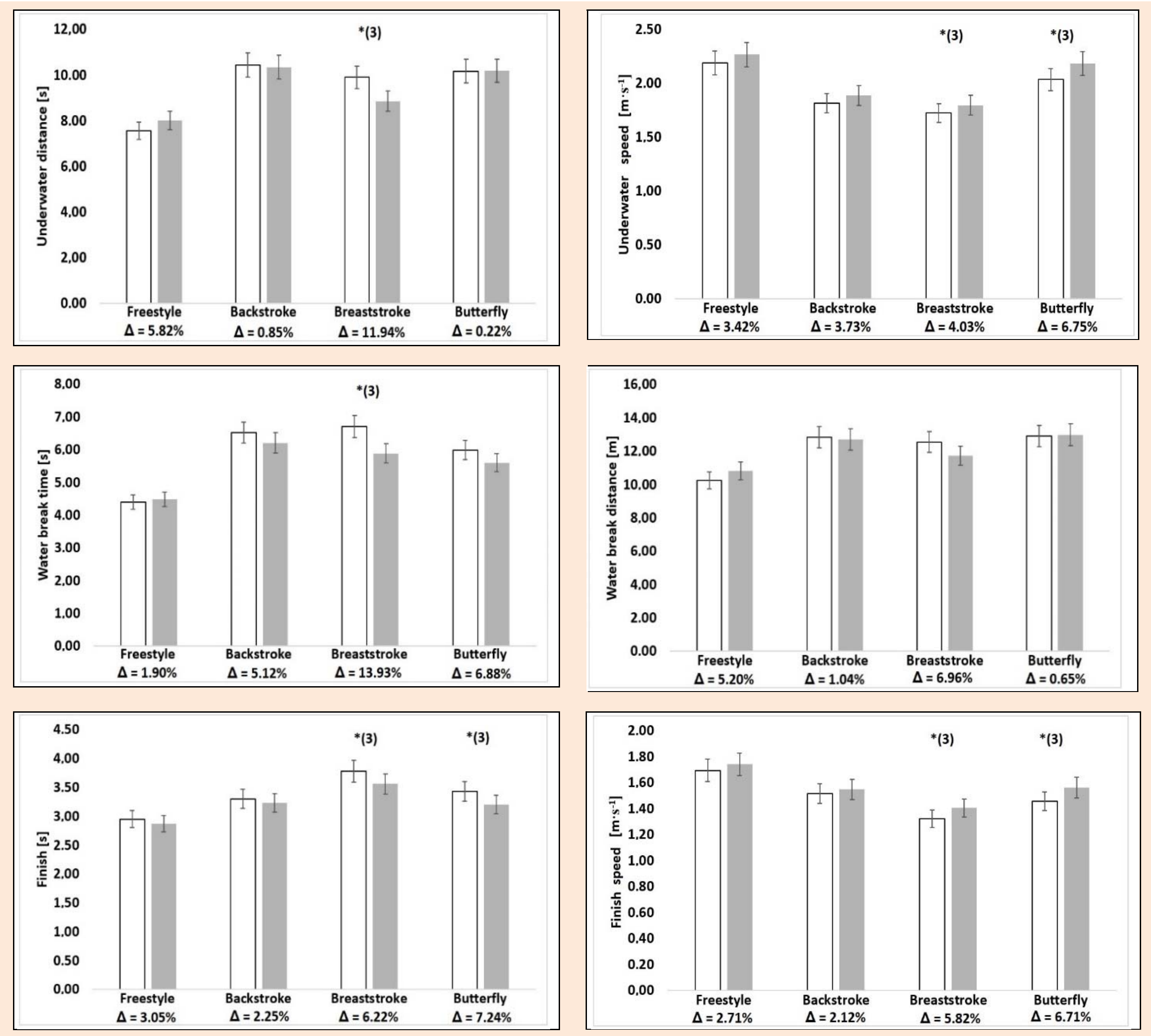

Figure 2. Continue… White background represents the 200 m races, and grey background the 100 m races (bars represent the 95% confidence interval). Δ − relative difference; * − significant differences ($p < 0.05$); (2) − minimum effect size; (3) − moderate effect size; (4) − strong effect size.

Start and finish

A significant and moderate-strong race effect was verified in both males and females in the 15 m start time. Swimmers were significantly faster reaching the 15 m mark in the 100 m events. A non-significant effect was only verified in breaststroke (males), and in backstroke (females). In the 100 m events the 15 m start time may account for between 11% and 12% of the final race time in both sexes (Morais et al., 2018). As the 100 m is deemed to be a short sprint, any improvement in the start might have a substantial effect on the final race time. The literature has reported that 100 m freestyle elite sprinters spent less time and distance in the underwater phase than backstrokers (Morais et al., 2018; Veiga et al., 2016). Sprinting swimmers are prone to take less time on the block, mainly due to their strength, power and quick reaction to stimulus. This will lead to a faster water entry, and consequently to less time reaching the 15 m mark (Tonnessen et al., 2013).

Nevertheless, less evidence can be found about the start in the 200 m than in the 100 m races (Veiga et al., 2016; Veiga and Roig, 2017). This 'short' middle-distance presents pace differences (being slower) in comparison to 100 m events (Jesus et al., 2011; Robertson et al., 2009). As the race distance becomes higher, swimmers need to individually adapt this race constraint to manage fatigue. It was shown that elite swimmers managed the 200 m race based on a fast first lap (Robertson et al., 2009; Simbaña et al., 2018a).

However, one might claim that despite such differences in the first lap pace, the starting profile (i.e. 15 m time) could be similar. It was highlighted that the main predictor of the first lap speed in a 200 m race was the initial speed achieved as a consequence of the start (Simbaña et al., 2018b). In elite swimmers, the start performance is mainly related to the lower-limb strength and power generated in the block (Beretic et al., 2013), and the underwater phase (Peterson Silveira et al., 2018; Tor et al., 2015). Present data shows that swimmers racing in the 100 m events were significantly faster than their 200 m counterparts in reaching the 15 m mark. This was notably obvious in the butterfly (males: 9.81%; females: 7.96%) (Figures 1 and 2). Therefore, if 200 m swimmers adopt a similar starting profile as in the 100 m events (i.e. fast 15 m time), they could enhance their start performance with a substantial positive effect in the first lap.

The finish presented a significant and moderate race effect in butterfly (males and females), and in breaststroke (females) (Figures 1 and 2). Nevertheless, swimmers racing the four 100 m events were faster than their 200 m counterparts in the last 5 m. The finish is related to the ability of keeping or increasing the clean swim speed in the last 5 m stretch (Arellano et al., 1994; Suito et al., 2015). In the 100 m events, swimmers slightly slowed down in the finish (last 5 m) in butterfly, backstroke, and breaststroke, and therefore a position shift in the final classification was noted. In the 200 m events, male and female swimmers increased the swim speed in the last 5 m (in comparison to the intermediate 30 m) in all events (except in butterfly). It was shown that swimmers racing in the 200 m events presented a last lap slower when compared to the remaining laps (Robertson et al., 2009; Simbaña et al., 2018a). Nonetheless, these studies were based on the official lap times. So, one can argue that different swim velocities could have happened during that last lap. Indeed, our data showed that position shifts were noted in the last 5 m in the butterfly, and in freestyle. It was highlighted that swimmers showing a back-half clean swim speed increase, presented a higher success rate (Palaschuk, 2018). Hence, as claimed by most coaches and swimmers, the finish in both the 100 m and 200 m events are determinant in delivering a good performance (Suito et al., 2015). Therefore, it is important that the performance analysis should not only be performed based in the official lap times. That said, coaches and other practitioners should verify hypothetical variations/differences between the stroke kinematics (for example, changes in stroke frequency or stroke length) performed in the clean swim and in the finish.

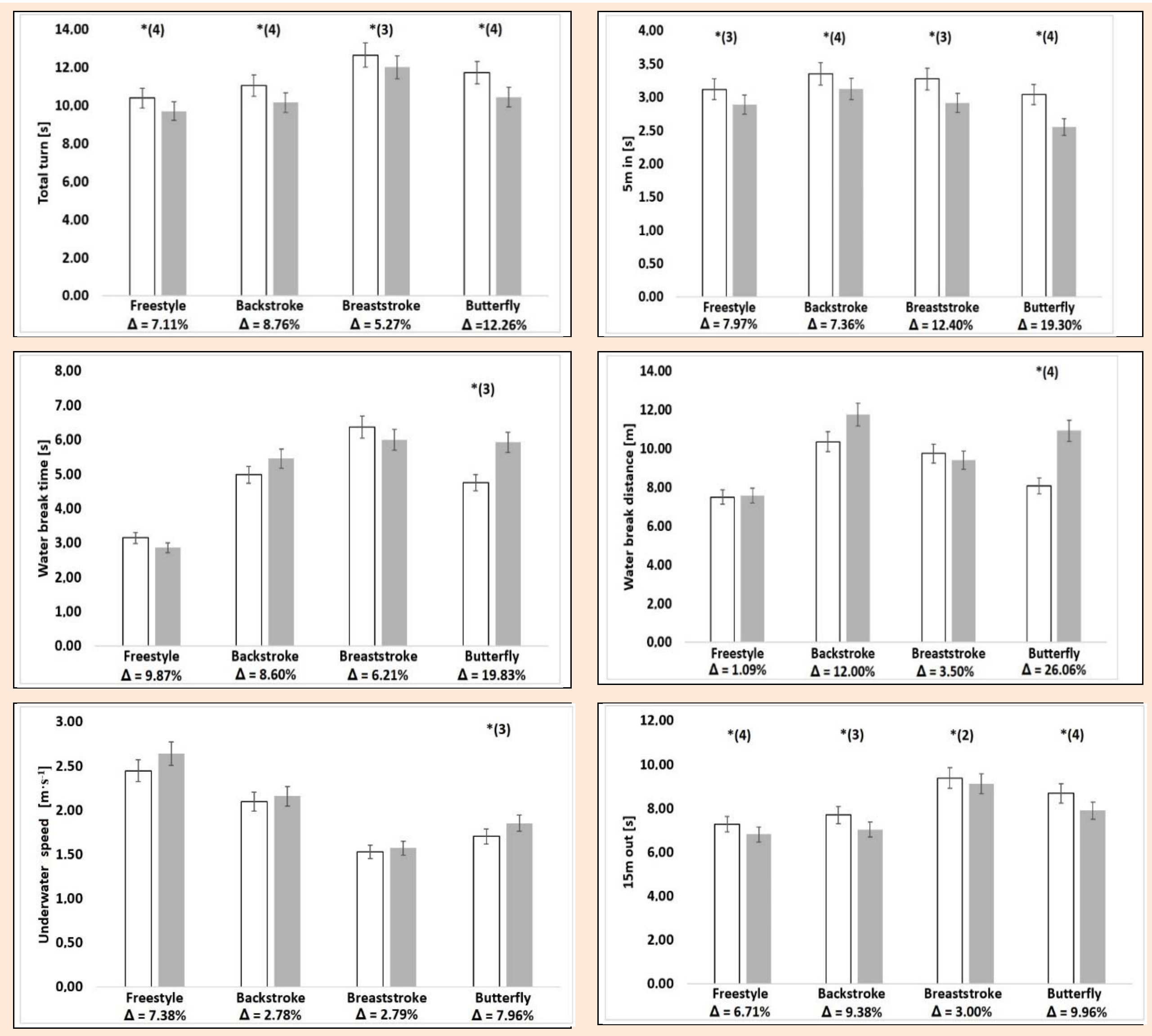

Figure 3. Males turn variables comparison between the 100 m and 200 m races (freestyle, backstroke, breaststroke, and butterfly). White background represents the 200 m races, and grey background the 100 m races (bars represent the 95% confidence interval). Δ − relative difference; * − significant differences ($p < 0.05$); (2) − minimum effect size; (3) − moderate effect size; (4) − strong effect size.

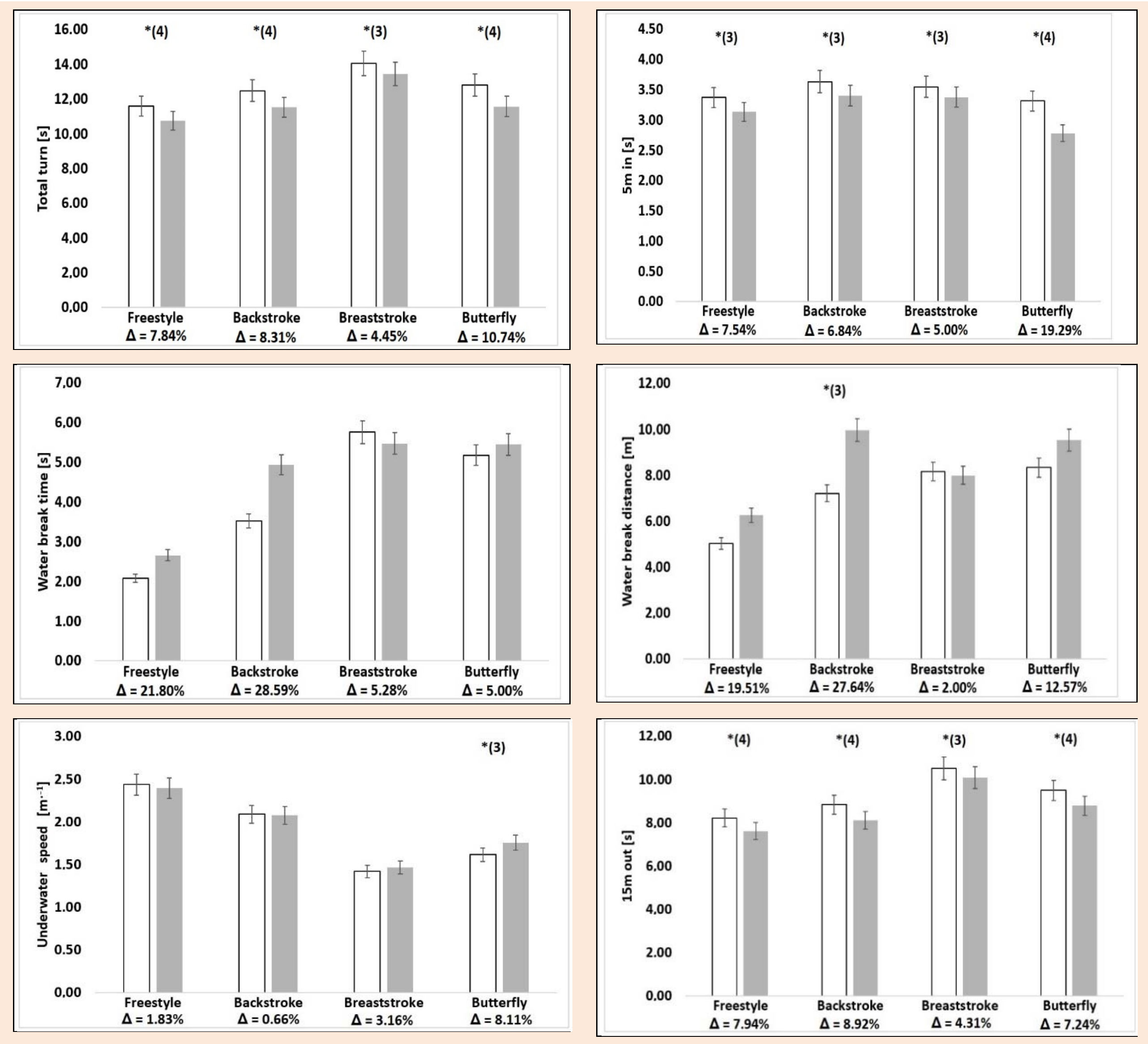

Figure 4. Females turn variables comparison between the 100 m and 200 m races (freestyle, backstroke, breaststroke, and butterfly). White background represents the 200 m races, and grey background the 100 m races (bars represent the 95% confidence interval). Δ − relative difference; * − significant differences ($p < 0.05$); (2) − minimum effect size; (3) − moderate effect size; (4) − strong effect size.

Turn

The total turn time showed a significant and moderate-strong race effect (i.e. variation between the 100 m and 200 m races) in all swim strokes. Overall, it is noteworthy that non-significant differences were observed between races in the underwater profile (Figure 3 and Figure 4). Differences were only observed in butterfly for males (all underwater variables), and females (underwater speed), and backstroke for females (water break distance). It was reported that elite 100 m swimmers break the water sooner in freestyle (males: 7.76±1.88 m; females: 6.61±0.77 m), and further in backstroke (males: 11.02±1.31 m; females: 10.61±2.05 m) (Morais et al., 2018). The same phenomenon was verified in elite 200 m swimmers (Veiga and Roig, 2016; Veiga et al., 2016).

Present data showed that swimmers racing the 100 m events were significantly faster in the turning phase in comparison to their 200 m counterparts. This fact occurred mainly due to the 5 m-in and 15 m-out times (surface profile), where a significant variation (with moderate-strong effect) was verified between the 100 m and 200 m events in all strokes. Swimmers could choose from two main strategies: (i) increase their underwater break distance/time to save energy (underwater profile); or (ii) start the swim stroke sooner, and hence breaking the water sooner as well (surface profile) (Veiga et al., 2014). Swimmers from both races (i.e. 100 m and 200 m) did not significantly differ in the underwater break distance, but 100 m swimmers were faster achieving the 15 m mark after the turn. This faster achievement might be related to the swim speed until the 15 m mark after the water break. While 100 m swimmers try to maintain or increase their swim speed to finish the race, 200 m swimmers slightly decrease the swim speed in comparison to the first lap (Simbaña et al., 2018a). It seems that swimmers racing the 200 m events are aware that they should not maintain the first lap speed in order to save themselves energy for the remaining distance. Therefore, it can be suggested that in elite 100 m and

200 m events, the total turn time is mostly related to the management of the surface profile used (i.e. 5 m-in and 15 m out).

A start, turn and finish race effect between the 100 m and 200 m race events was hypothesized. Altogether, for all race phases analyzed (start, turn and finish) a significant and moderate race effect was verified between the 100 m and 200 m events, with swimmers being faster in the 100 m. The turn can be broken down into the surface and underwater profile (Veiga and Roig, 2016; Lyttle and Mason, 1997). In this research a non-significant race effect was verified on the underwater variables. By contrast, a significant and moderate-strong race effect was noted on the surface profile. Thus, one might point out that variations between race distances in the turn were mainly related to the surface profile used. This occurrence might be easily understood as being mainly due to fatigue, as the 200 m swimmers spent a larger amount of time turning, and hence performing the surface variables (related to the swim itself) (Veiga and Roig, 2016). Therefore, it could be argued that 200 m swimmers should increase their underwater distance to save themselves energy for the surface phase, and consequently for the clean swim. Hence, swimmers should be advised to increase their forces on the turning wall leading to an increase in momentum during wall contact and consequently in their gliding speed (Garcia-Hermoso et al., 2013). This will allow swimmers to break the water farther from the turning wall and thus save energy.

The same reasoning can be used for the finish. However, significant effects were only verified in butterfly (males and females) and, in breaststroke (females). It was possible to note that 100 m swimmers slightly slowed down in the last lap, between the intermediate 30 m and the last 5 m finish. On the other hand, 200 m swimmers increased the clean swim speed between these same race splits. Nevertheless, this was not enough to deliver the same swim speed as that shown by the 100 m swimmers. Despite a swim speed increase, fatigue may play a major role in this difficulty for the 200 m swimmers (Simbanã et al., 2018a).

Regarding the start, fatigue cannot be responsible for the race effect verified between events. This significant and moderate-strong race effect shown in the 15 m time was mainly related to the underwater profile, where the 100 m swimmers presented a faster underwater speed. Hence, one might claim that 200 m swimmers may substantially excel their start performance if they adopt a similar profile as their 100 m counterparts (Morais et al., 2018). That is, swimmers could improve their forces at the block phase (increasing the lower-limb power), which could lead to a higher underwater speed. Moreover, they should be advised to understand the critical moment when the underwater speed is lower than the swim speed that they should achieve in the surface phase (Nicol et al., 2019). Nevertheless, it should be pointed out that 200 m swimmers should only adopt such a start profile until the 15 m mark (and not for the entire first lap). If they prolong this start profile, the swimmers may be compromising the rest of the race, and hence negatively affect the total race time (Fardel and Zapponi, 2016).

Conclusion

Overall, a race effect was verified in the start, turn and finish in both sexes. The 100 m sprinters delivered faster starts, turns and finishes in comparison to their 200 m counterparts. The underwater profile was the main determinant in starting, whereas the surface profile was the main determinant in turning. The finish yielded mixed findings depending on the swim stroke (which was determinant in butterfly events and to some extent in breaststroke).

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Key points

- A significant and moderate race effect was observed in the main start and turn outcomes between 100m and 200m races in both sexes.
- The 15m start time was mainly related to the underwater strategy.
- Non-significant differences were observed between races in the turn underwater strategy, so surface strategies (5m-in and 15m-out) were the main contributors.
- Swimmers should only be underwater while they are able to maintain a high velocity displacement.

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