COMPARISON OF THE SWIMMING START PERFORMANCE BETWEEN INDIVIDUAL AND RELAY FREESTYLE RACES

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The aim of the present study was to compare the swimming start performances between individual and relay events in freestyle races. Competitors who took part in both the individual 100m freestyle and the 4×100m freestyle relay races during the LEN 2017 European Junior Championships were analysed in the present study. The results indicated that swimmers performed 6.92% faster 15m start time in relay race versus the individual freestyle race and the difference seemed to be due to the longer reaction time from the race beginning. Coaches and swimmers would be suggested to try to optimize their relay starting performance in order to take more benefit on flight, underwater and swimming phases compare to individual start.

KEY WORDS: competition, elite-level, velocity, performance analysis.

INTRODUCTION: Dive start is defined in swimming competitive races as from start signal to swimmers' head reach the 15m mark and it represents a critical part in swimming competitions specially in short events (Cossor & Mason, 2001). It is performed both in individual and relay races: In individual races, swimmers begin their starting movements immediately after the referee's start signal; in contrast, relay swimmers (except the first leg) may initiate their starting movements any time as long as both or one of their feet still is in contact with the start block until the incoming swimmer touches the wall. Literature (Atkison, 2018; Smith, 2018) previous compared the differences between the individual dive and relay changeover starts in laboratory settings indicating that (when controlling for block time) the relay start may not provide any additional advantage in terms to time to 15m. However, no data has been examined in competition. Therefore, this study was aimed to compare the starting performances between individual and relay events in swimming competitions.

METHODS: 4 x 100m freestyle relay and 100m freestyle races footage were obtained from Spideeo system during the 2017 European Junior Swimming Championships (Netanya, Israel). Swimmers (n=12, 5 males and 7 females) who competed both in relay final and individual final or heats were selected for further analysis, only the performances from the second to fourth relay swimmers were recruited owing to the first relay swimmer performs a dive start technique just as in individual event. The high-definition (HD) video (50Hz) of all races were provided by the championship organization, which delivered real-time multi-angle recordings. One fixed camera (AXIS q1635, Lund, Sweden) was positioned at the finishing (starting) side from swimmers' plane of movement, to capture the motions of above-water starting phases (Figure 1); four tracked cameras (AXIS v5915, Lund, Sweden) were used to record swimmer's starting performance to 15m and each camera covered two swimming lines. Time code was synchronized to the official timing system by the starting light signal and was carried out as visible reference to set the time-stamp in the race analysis software. Temporal parameters recruited as flight time was defined as the time from take-off to swimmer's head enter the water, underwater time was defined as the time between head entry to head emersion, emersion time was defined as the time from the race (or relay leg) beginning to head emersion and 15m start time was calculated from the race (or relay leg) beginning to when swimmer's head reached 15m mark. Spatial parameters were evaluated from the starting wall to swimmer's head reach the distances of entry, emersion and 15m. Average velocities were calculated on the grounds of their respective times and distances. Paired t-test was implemented to compare the starting parameters between individual and relay races. Effect sizes were then calculated using

Cohen's d (Cohen, 1992) and interpreted with small, medium and large thresholds for 0.2, 0.5 or 0.8 effect sizes, respectively. All statistical procedures were carried out using the R programming language (Version 3.6.1). Significance was set at p<0.05.

RESULTS: The descriptive results (mean±SD), p value, and effect size (Cohen's d) for the start performances in individual and relay races are shown in Table 1.

Table 1 Parametric characteristics of the starting performance in the individual and relay 100m freestyle of the LEN 2017 European Junior Swimming Championships

	Individual		Relay		*p* value	Cohen's d
	mean	SD	mean	SD		
Reaction Time (s)	0.69	0.06	0.29	0.14	0.000	3.76
Flight Time (s)	0.32	0.07	0.36	0.09	0.035	0.46
Entry Distance (m)	2.95	0.38	2.99	0.32	0.561	0.14
Underwater Time (s)	3.25	0.84	2.92	0.70	0.275	0.44
Underwater Distance (m)	7.83	1.61	7.43	1.58	0.522	0.25
Underwater Velocity (m/s)	2.45	0.27	2.57	0.23	0.131	0.49
Emersion Time (s)	4.26	0.82	3.56	0.74	0.040	0.90
Emersion Distance (m)	10.77	1.50	10.42	1.57	0.565	0.23
Emersion Velocity (m/s)	2.56	0.27	2.98	0.35	0.001	1.33
Swim Time (s)	2.24	0.63	2.49	0.75	0.411	0.37
Swim Distance (m)	4.23	1.50	4.58	1.57	0.565	0.23
Swim Velocity (m/s)	1.87	0.30	1.81	0.20	0.442	0.24
15m Start Time (s)	6.50	0.46	6.05	0.50	0.000	0.93
15m Average Velocity (m/s)	2.32	0.17	2.50	0.21	0.000	0.92

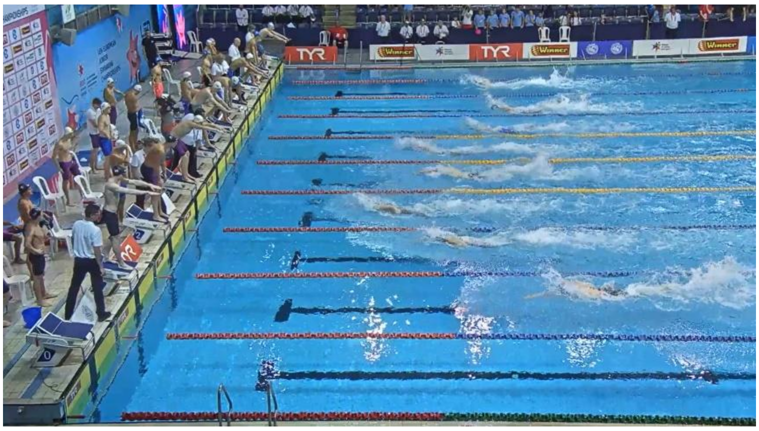

Figure 1 Filming set-up position of fixed camera

DISCUSSION: The present study compared the starting performances of individual and relay events in the freestyle event of the same competition. The results revealed that the same swimmers performed 6.92% faster 15m times in the relay versus the individual freestyle events, difference seemed to be due to the longer reaction time from the race beginning. There were no other differences on temporal or spatial parameters except emersion time which also affected by the reaction time.
Reaction time was significant shorter when competing in relay race, this is not surprising due to no start signal in relay race, allowing competitors are able to gain the anticipate benefit (Mellifont, 2009) before take-off. Similarly, the advantages of the reduced reaction time also resulted in the reduction of start time, 15m start time and relevant average velocity were observed greater in relay performance. This conclusion is in line with the previous investigation of individual and relay race profiles (Smith, 2014).

There was a small difference in flight time between individual and relay races. Present results in this parameter were shown longer than reported in previous research (Atkison, 2018) in both performance conditions (0.24±0.04s in individual and 0.27±0.03s in relay, respectively). The reason for this difference might be caused by the competitive level of swimmers, the competitors included in the present study were junior category while all participants in the previous study were the members in 2016 Olympic relay team, thus, the proficiencies of swimmer might help to obtain shorter flight time.
After the underwater segment, competitors emerged to water surface earlier in relay when compared to their individual performance, this could be explained as the result of the differences on reaction time since no significant differences were detected during underwater phase between two race types. Emersion time was revealed longer than in the previous race investigation by Veiga et al. (2013) in individual race (3.44±0.64s), while shorter than in the previous results in relay race (3.91±0.89s) by Atkison (2018) who excluded the relay changeover time from this parameter. In addition, there were no meaningful effects detected in the swim phase despite the significances occurred in the moment of emersion.

CONCLUSION: The starting characteristics of individual and relay races in swimming competition were compared in present study. The main differences between race types were detected in the reaction time, emersion time, 15m start time, and the relevant velocities. Swimmers were able to take benefit from the anticipation in relay race and, consequently, to obtain greater performances in 15m start time and 15m average velocity. Coaches and swimmers should try to optimize their relay starting performance in order to take more benefit on flight, underwater and swimming phases compare to individual start.

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