SHORT COURSE 50M MALE FREESTYLE PERFORMANCE COMPARISON BETWEEN NATIONAL AND REGIONAL SPANISH SWIMMERS

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We aimed to analyse and compare the race components of national (47) and regional (158) male swimmers taking part in 50 m freestyle short course event. The relative contribution of each component, the split differences and relative splits were considered. A swimming race analysis system and an automatic swimming performance analysis (ASPA) were applied in the study. National male swimmers obtained significantly shorter times than regional: T10, 3.65 ± 0.14 s vs 4.56 ± 0.43 s; T15, 6.11 ± 0.18 s vs 7.47 ± 0.62 s; TTV15m, 6.99 ± 0.22 s vs 8.42 ± 0.71 s; T50, 23.25 ± 0.57 s vs 27.70 ± 2.16 s; higher SR ($cyc•min^{-1}$) 60.2 ± 4.13 vs 57.6 ± 5.51; longer SL(m) 1.97 ± 0.15 vs 1.78 ± 0.15; and higher SI($m^2•s^{-1}$) 3.89 ± 0.36 vs 3.011 ± 0.37. Differences in performances between national and regional Spanish groups were explained by the absolute split times, stroke length and stroke index. These differences were not found analysing the relative splits and indicates a similar race strategy regardless of the swimmers level.

KEYWORDS: Swimming competition analysis, race components, start time, turning time.

INTRODUCTION: Performance analysis has become an essential tool for coaches, athletes. sports organizations and academic researchers, intending to improve the training program (O'Donoghue. 2015). This kind of data have been collected from international competitions and their results have been distributed by different means as report publications, web pages as www.swim.ee (R. Haljand) and international publications as Arellano. R. Brown. P. Cappaert. J. & Nelson. R. C. (1994), that analysed the Barcelona 92 Olympic Games and more recently Morais. J. E. Marinho. D. A. Arellano. R. & Barbosa. T. M. (2018) the European Swimming Championships 2016.
The swim race can be splitted-up into several components: the start, the clean swimming (or swim stroke), the turn(s) and the finish. The swimming speed is determined by the stroke length and stroke rate (Craig & Pendergast. 1979). Recently the start distance has changed from 10m to 15m and the turning time is composed by a distance of turn-in (5m) and turn-out (15m) or 10m in short course events. At any case, both distances were collected in this study. Previous studies found that successful freestylers were characterized by longer stroke lengths, shorter time values over each race component, higher average swimming velocity and greater stature, when the study measure it (Arellano et al. 1994). Comparing to the similar event on long course swimming pool: the 100 m freestyle that includes similarly one turn and the start, accounted up one third of the final race time (Morais et al. 2018).
Little attention has been paid to the analysis of race components during short course (25m) events. We aimed to analyse the race components between national and regional male swimmers taking part in 50m freestyle short course event, considering the relative contribution of each component, the split differences and relative proportions.

METHODS: Performances by 47 national level (Spanish Short Course Nationals, December 2016) and 158 regional (local competitions developed at our University swimming pool. season 2016/17) swimmers were compared. No swimmers repeated in both competitions. National level swimmers had a mean age (± SD) of 20.96 (± 4.5) years and regional swimmers had a mean age (± SD) 17.30 (± 3.45) years.
Instruments: A system of 3 cameras (HD 50 Hz) located at the poolside (7.5 m from the ends and in the middle of the swimming pool) and connected to a video switcher were used during Spanish Short Course Nationals. The swimmer's data were obtained after detailed observations of HD videos recorded. A new system installed on the ceiling of the Faculty of

Sport Science swimming pool allowed the collection of the performance data at regional level (Automatic Swimming Performance Analysis, ASPA) The system is composed by 8 cameras (Basler Aviator: 83.33 Hz 1080 x 1080 pixels) and is located on the ceiling of the swimming pool and connected through Ethernet (1Gb) to a PC Work Station. The 8 cameras video information was added in a frame using the video stitching technique. Video was collected in real time to analyse the swimmers activity in every lane (8 simultaneously). Algorithms of image recognition allowed the event split time collection, when the head crosses every 5 m section, and the arm stroke count. The system processes the full event in a very short time compared to the manual collection. Both methods were applied in this study. Variables analysed at the Spanish Championships were studied in Regionals. Both methods showed high values of concurrent validity when used to measure the same sample.

Variables: Each swimmer's mean stroke rate (SR), stroke length (SL) and stroke index (SI) were collected from both sources of digital video. Event time was obtained from official results (T50). The starting phase is from the starting signal until swimmer's head crosses the 10 m (10T) mark. The turning phase commences when the swimmer's head passes through a distance of 5 m coming into the wall until swimmer's head crosses the 35 m reference (TTV15m) movinging away from the wall.

Statistics: Normality assumption was analysed by the Kolmogorov-Smirnov test. The mean ± one standard deviation (sd), were selected as descriptive statistics. T-test for independent samples, Pearson correlation coefficient and effect size were applied.

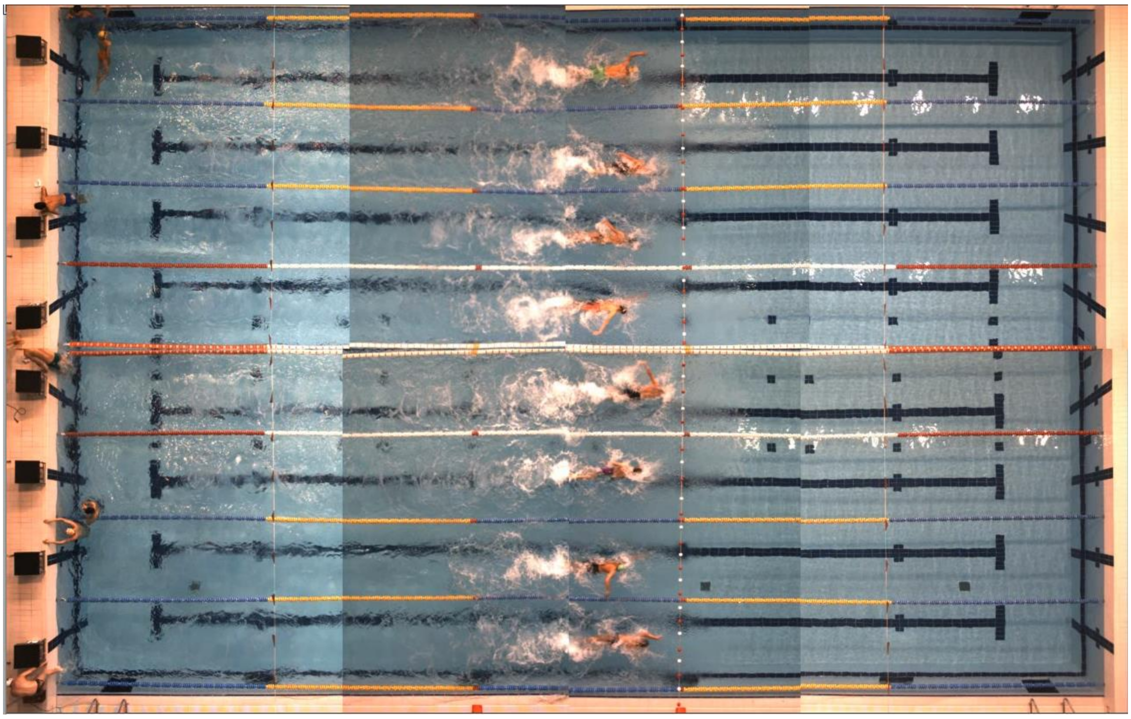

Figure 1: Example of one image frame analysed by ASPA of the 50m freestyle event.

RESULTS: All the study' results are summarized in the Table 1. Significant differences between both levels of swimmers were found in all the analysed variables with the exception of the percentage of duration of each lap. National male swimmers obtained significantly shorter times than regional: National male swimmers obtained significantly shorter times than regional: T10, 3.65 ± 0.14 s vs 4.56 ± 0.43 s; T15, 6.11 ± 0.18 s vs 7.47 ± 0.62 s; TTV15m, 6.99 ± 0.22 s vs 8.42 ± 0.71 s; T50, 23.25 ± 0.57 s vs 27.70 ± 2.16 s; higher SR (cyc•min^{-1}) 60.2 ± 4.13 vs 57.6 ± 5.51; longer SL(m) 1.97 ± 0.15 vs 1.78 ± 0.15; and higher SI(m^2•s^{-1}) 3.89 ± 0.36 vs 3.011 ± 0.37.

Table 1: Descriptive statistics (Mean and standard deviation), coefficient of correlation between the variable and final time, mean differences and effect size of variables

	REGIONAL				NATIONAL					
	n	Mean	sd	**r**	n	Mean	sd	**r**	Mean dif.	Eff. size
Age (years)	158	17.30	3.45	**-0.38**	47	20.96	4.53	**-0.28**	3.65**	0.98
T10 (s)	158	4.56	0.43	**0.89**	47	3.65	0.14	**0.58**	-0.92**	-2.37
T15 (s)	158	7.47	0.62	**0.95**	47	6.11	0.18	**0.85**	-1.36**	-2.46
T20 (s)	158	10.37	0.78	**0.97**	47	8.61	0.22	**0.89**	-1.76**	-2.53
T25 (s)	158	13.49	1.03	**0.98**	47	11.32	0.29	**0.91**	-2.17**	-2.36
T35 (s)	158	18.79	1.46	**0.99**	47	15.60	0.41	**0.95**	-3.19**	-2.45
T45 (s)	158	24.87	1.94	**1.00**	47	20.81	0.54	**0.97**	-4.06**	-2.35
T50 (s)	158	27.70	2.16	**0.99**	47	23.25	0.57	**1.00**	-4.45**	-2.31
TTV15m (s)	158	8.42	0.71	**0.98**	47	6.99	0.22	**0.86**	-1.43*	-2.25
V0_10 (m/s)	158	2.21	0.20	**-0.88**	47	2.75	0.11	**-0.59**	0.54**	2.94
V10_15 (m/s)	158	1.73	0.13	**-0.90**	47	2.03	0.08	**-0.75**	0.30**	2.49
V15_20 (m/s)	158	1.73	0.10	**-0.90**	47	2.00	0.07	**-0.51**	0.27**	2.87
V20_25 (m/s)	158	1.61	0.14	**-0.88**	47	1.85	0.09	**-0.52**	0.24**	1.84
V25_35 (m/s)	158	1.90	0.16	**-0.93**	47	2.34	0.09	**-0.77**	0.44**	2.99
V35_45 (m/s)	158	1.65	0.13	**-0.96**	47	1.92	0.08	**-0.70**	0.27**	2.24
V45_50 (m/s)	158	1.61	0.16	**-0.71**	47	1.85	0.10	**-0.34**	0.24**	1.61
SF1 (cyc/min)	156	59.52	6.30	**-0.47**	47	61.78	4.52	**0.13**	2.26*	0.38
SF2 (cyc•min^{-1})	158	55.65	6.05	**-0.42**	47	58.61	3.92	**0.03**	2.96**	0.52
SFx (cyc•min^{-1})	158	57.58	5.51	**-0.50**	47	60.20	4.13	**0.08**	2.62**	0.5
SL1 (m)	156	1.76	0.17	**-0.12**	47	1.97	0.15	**-0.43**	0.21**	1.26
SL2 (m)	158	1.80	0.19	**-0.29**	47	1.98	0.15	**-0.36**	0.18**	0.99
SLx (m)	158	1.78	0.15	**-0.24**	47	1.97	0.15	**-0.42**	0.19**	1.26
SI1 (m^2•s^{-1})	156	3.05	0.38	**-0.57**	47	3.97	0.38	**-0.61**	0.92**	2.42
SI2 (m^2•s^{-1})	158	2.98	0.45	**-0.70**	47	3.81	0.39	**-0.55**	0.82**	1.89
SIx (m^2•s^{-1})	158	3.01	0.37	**-0.72**	47	3.89	0.36	**-0.62**	0.88**	2.39
Clean ST (s)	158	14.94	1.17	**0.96**	47	12.87	0.33	**0.88**	-2.08**	-1.98
Clean ST (%)	158	53.94	0.94	**-0.14**	47	55.34	0.68	**-0.18**	1.40**	1.57
Start 15m (%)	158	26.96	0.70	**0.08**	47	26.26	0.42	**0.05**	-0.70**	-1.08
Turn 15m (%)	158	19.10	0.61	**0.12**	47	18.39	0.47	**0.21**	-0.70**	-1.22
T2nd 25m (s)	158	14.21	1.17	**0.97**	47	11.93	0.33	**0.94**	-2.28**	-2.19
Split dif. (s)	158	0.71	0.45	**0.26**	47	0.61	0.24	**0.19**	-0.11*	-0.24
1st Split (%)	158	48.72	0.79	**-0.12**	47	48.70	0.51	**-0.13**	-0.02ns	-0.02
2nd Split (%)	158	51.28	0.79	**0.12**	47	51.30	0.51	**0.13**	0.02ns	0.02

*p<0.05. **p<0.01

High and significant correlation coefficients were obtained analysing each group separately: Between 50 m time and 10mT (0.58 vs 0.89); 15mT (0.85 vs 0.95); TTV15m (0.86 vs 0.98). Low correlations were found between 50 m time and relative race components: Clean ST% (-018. vs -0.14); Start 15m% (0.05 vs 0.08); Turn 15m% (0.21 vs 0.12); split difference (s)

(0.19 vs 0.26); split percentage difference 1st Split% (-0.13 vs -0.12); 2nd Split % (0.13 vs 0.12).

DISCUSSION: There seem to be few published studies of short course events. Some analysis has been reported by Haljand (www.swim.ee). Our 50 m time results were faster than the mean data taken at the 1992 Olympics in Barcelona (23.25 s and 24.30 s respectively). However, the influence of the pool dimension, short course vs long course, and the changes in the equipment since1992 have contributed to the difference. The start time in 10 m was similar for National and 92 Olympic (3.65s and 3.78s), even though the swim start data collected on the present study was performed in the new starting blocks. Comparing our data to obtained at the European Championships in 2016, the start mean time (15 m) in 100 m Freestyle was 5.82 s while our national swimmers mean was 6.11 s during the 50 m short course event. Fifty meters long course events are characterized by an all-out strategy with a gradual decline in swimming velocity through the race, as was described by McGibbon, Pyne, Shephard and Thompson (2018). The current study showed an increase of mean velocity after the turn-out phase and a small decrease of the clean swimming velocity in the second lap. Adding the two factors, a split difference was found between laps of 0.71 and 0.61 respectively, with both groups significantly different. The difference was small compared with the long course event when the percentage of each lap duration was considered, no differences were found. Demonstrating a similar relative strategy independent of the swimmer's level. The start and turn times collected in this study contributed about 45% to the final race time, while the start and turn times collected at the 100 m Freestyle at the European Championships accounted for up to 33% of the final race time (Morais et al. 2018). The differences in total race time between both events were explained by the difference in the event distance. The correlation values between the variables and the final 50 m race time were similar to those obtained by Arellano et al. (1994) regardless of the pool length. Split times and average velocities were strongly related to final race time, while cyclic variables (SR. SL and SI), showed lower correlations. All the relative values expressed in percentages were not related to the final race time.

CONCLUSIONS: Differences in performances between national and regional Spanish groups were explained by the absolute split times, stroke length and stroke index. These differences were not found analysing the relative splits. Similar proportions of lap duration were used regardless of the swimmers level indicating a similar race strategies.

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