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ORIGINAL SCIENTIFIC ARTICLE

ANALYSIS OF REACTION TIME, SPLIT TIME AND FINAL TIME SWIMMING ATHLETES IN THE OLYMPIC GAMES ON 2008-2021

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Abstract

Study purpose. This research aims to evaluate and analyze the Final Time (FT), Split Time (ST), and Reaction Time (RT) records of 100-meter butterfly swimmers in four Olympic events in order to provide benchmarks and standards for the development of swimming training.

Materials and methods. This research combines quantitative and qualitative approaches. This study utilized a sample of 32 athletes ranked first through eighth who competed in the 100-meter butterfly at four Olympics: the 2008 Beijing Olympics, 2012 London Olympics, 2016 Rio Olympics, and 2021 Tokyo Olympics. It utilizes secondary data in which all time results are obtained from the website (http://www.fina.org). The descriptive statistics of mean and standard deviation were utilized for statistical analysis in this study. The Kolmogorov-Smirnov test was used to determine data normality. For comparing data between Olympiads, a one-way multi-comparison ANOVA was used to verify interactions between RT, ST, and FT across Olympiads. To determine the effect of RT and ST on FT, one-way linear regression was used with a significance level of $p<0.05$ as a standard. SPSS Inc., Chicago, IL, USA, was utilized for all analyses.

Results. ST and RT were found to influence the achievement of FT in the 100-meter butterfly stroke, and RT had an effect of 0,712 (51%), for both male and female swimmers, on the achievement of the time in the first 50 meters.

Conclusions. The conclusion is that both athletes and coaches are required to optimize the achievement of RT and ST in short-distance swimming because these two indicators play a crucial role in achieving the travel time of short-distance swimmers.

Keywords: reaction time, final time, split time, swimming.

Introduction

In every European, world and Olympic swimming championship, there is always a record-breaking swimming time for all events (Marinho et al., 2020). This is inseparable from the ingenuity of the coach in maximising every movement of the swimmers. Swimming movements have high complexity, such as when starting and turning, dolphin and hand pull (Morais, Marinho, et al., 2019; Tourny-Chollet et al., 2010).

Hand drag kinematics is another essential element of the results of butterfly stroke swimming (Strzała et al., 2017). In addition, adjustments to match distances (short, medium and long distances) are also a separate consideration for a coach in determining appropriate movements and techniques as well as pace time for each event (McGibbon et al., 2018; Menting et al., 2019; K. G. Thompson et al., 2000).

In swimming, small motion errors will cause hydrodynamic resistance (Washino et al., 2019), so coaches must pay attention to the movements' details and the energy athletes use. Coaches must use match data such as RT, ST, and FT combined with video recordings to analyse swimmer performance (Gonjo & Olstad, 2021).

A 100-meter butterfly stroke is a fast number or short distance that must be supported by several indicators such as reaction time (RT), force technique, low resistance when

entering the water, underwater glide, and underwater propulsion (Bishop et al., 2013; Potdevin et al., 2011). A coach must pay attention to long jump performance in swimming athletes to positively impact achieving reaction time(Rebutini et al., 2016).

Swimming speed can be defined as the speed at which a swimmer completes a distance and is an important variable to monitor to get better performance (Gordon et al., 2015; G. K. Thompson, 2014). Therefore, proper swimming speed is essential to avoid unwanted sudden onset of fatigue, leading to loss of strength, coordination and stroke speed (Mauger et al., 2012; Taylor et al., 2016; G. K. Thompson, 2014). Competitive and elite swimmers can constantly repeat swimming speeds under different conditions (Skorski et al., 2013, 2014).

This research aims to evaluate and analyse records of final travel time, ST, and reaction time to determine the performance developments of athletes swimming in the 100-meter butterfly at the four Olympics. The urgency in this study is that the evaluation of FT, ST and RT is critical to be applied to swimming training even though. Currently, swimming coaches do not understand the standards of swimmer success as measured by these three indicators.

Materials and methods

Study participants

In this study, the type of research used is a combination of quantitative and qualitative with descriptive methods. There were 32 athletes ranked 1-8 participating in this study. They participated in the 100-meter butterfly swimming competition at four Olympics: the 2008 Beijing Olympics, the 2012 London Olympics, the 2016 Rio Olympics, and the 2021 Tokyo Olympics.

Study design

The data source in this study uses secondary data where all travel time results, such as speed of 100 meters, every 50 meters, and RT, is taken from the website (www.fina.org, 2022) This study did not use the consent form as a sample because the data taken is secondary data validated through the official website for every Olympics.

Statistical analysis

Descriptive statistics are presented as mean and standard deviation. Data normality was performed using the Kolmogorov-Smirnov test. For comparing data between Olympiads, one-way multi-comparison ANOVA was used to verify the interaction between the different Olympiads' reaction time (RT) and final time (FT). To see the effect of RT with FT using one-way linear regression. The adopted significance level is p <0,05. All analyzes were performed using statistics for the Social Sciences software (SPSS Inc., Chicago, IL, USA).

Results

Fig. 1 describes the two normally distributed data with a probability value of more than 0.05. Furthermore, the respective averages of the reaction time for each Olympic event for both male and female athletes were stated to be different from the sig. < than 0.05 (Table 1).

Table 2 describes the average first and second ST achievements of swimmers at the Olympics in the 100-meter butterfly for both men and women. It can be seen in table 3 that the best first and second splits were during the Tokyo Olympics (men's 23.763/26.882 seconds and women's 26.255/29.886 seconds)

Table 1. Profile of the 8 Best Swimmers at Each Olympic Event

Rank	Sex	Beijing 2008	age (Years)	Height (cm)	London 2012	age (Years)	Height (cm)	Rio 2016	age (Years)	Height (cm)	Tokyo 2021	age (Years)	Height (cm)
1	Pa	MP	23	193	MP	27	193	JS	21	184	CD	24	191
	Pi	LT	23	167	DV	24	185	SS	22	182	MM	21	169
2	Pa	MC	24	197	CLC	20	189	MP	31	193	KM	21	190
	Pi	CM	22	185	LY	23	175	PO	16	186	YZ	23	176
3	Pa	AL	21	186	YK	29	197	C£	24	189	NP	20	192
	Pi	JS	21	170	AC	24	176	DV	28	185	EM	27	180
4	Pa	1C	25	193	MC	28	197	LC	30	188	AM	19	187
	Pi	ZY	24		SS	18	182	YL	27	175	TH	18	173
5	Pa	JD	21	183	SD	25	186	ZL	17	183	JM	20	
	Pi	TL	18	160	IB	22	170	RK	16	170	LH	24	187
6	Pa	TF	23	184	JV	24	ISO	MM	24	191	MT	22	
	Pi	JL	18	171	JO	24	178	EM	22	180	MW	24	180
7	Pa	AS	25	188	TM	24	180	TS	25	193	LCM	25	183
	Pi	GS	19	166	CD	23	170	JO	28	178	SS	27	182
8	Pa	RP	26	196	KC	23	195	AS	19		JM	18	
	Pi	ID	22	183	EG	20	170	XC	18	178	AS	18	182

Fig. 1. Average RT 100 meters butterfly at each Olympics

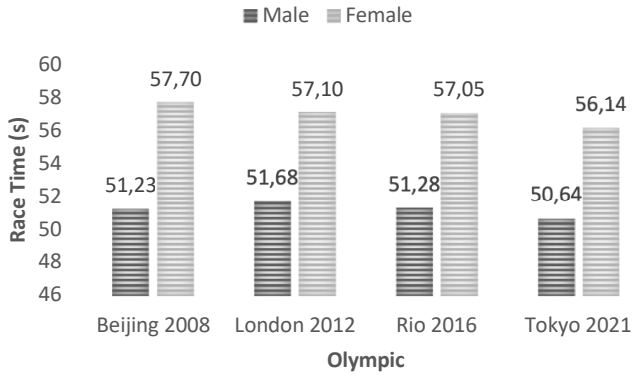

Fig. 2. The average travel time of 100 meters butterfly at each Olympics

Table 2. Details of Mean ST Records in the Four Olympics Men's and Women's Athletes

Olympic	n	Split Time 1st		Split Time 2nd	
		Mean (second)	S.Dev	Mean (second)	S.Dev
Male					
Beijing 2008	8	23.911	0.340	27.319	0.456
London 2012	8	24.077	0.299	27.545	0.517
Rio 2016	8	24.058	0.199	27.218	0.344
Tokyo 2021	8	23.763	0.377	26.882	0.444
Female					
Beijing 2008	8	27.123	0.428	30.661	0.366
London 2012	8	26.602	0.250	30.402	0.518
Rio 2016	8	26.421	0.319	30.208	0.496
Tokyo 2021	8	26.255	0.384	29.886	0.437

Table 3. Details of ST Records in the Four Men's Athlete Olympiads

No	Split Time	N	Normality	F	Sig
Male					
1	Split Time 1st	32	0.536	1.764	0.177
2	Split Time 2nd		0.547	3.061	0.044
Female					
1	Split Time 1st	32	0.007	1.190	0.331
2	Split Time 2nd		0.007	1.080	0.374

Table 3 describes only ST in male athletes normally distributed with a probability value of more than 0.05. Furthermore, only the second ST of the male athlete was stated to be different from sig. < than 0.05.

Fig. 2 explains that both data are normally distributed with a probability value of more than 0.05. Furthermore, the average travel time for each Olympic event in the 100-meter butterfly for both male and female athletes is stated to be different from the sig. < than 0.05.

Table 4 explains that in the 4 Olympics held in the 100-meter butterfly event, only the London and Tokyo Olympics had different average travel times for male athletes. In comparison, the female athletes at the Beijing 2008 and Tokyo 2021 Olympics had other has an average travel time of 100 meters in different butterfly strokes. These two groups show that the Tokyo 2021 Olympics is the best organizer on the average travel time indicator for the 100-meter butterfly.

Table 4. The results Olympics on the 100-meter butterfly event

Uji statistic	Olympiad	N	Subset for alpha = 0,05	
			1 (second)	2 (second)
Male				
	Tokyo 2021	8	50.65	
	Beijing 2008	8	51.23	51.23
Tukey HSD	Rio 2016	8	51.28	51.28
	London 2012	8		51.68
	Sig.		0.078	
Female				
	Tokyo 2021	8	56.14	
	Rio 2016	8	57.05	57.05
Tukey HSD	London 2012	8	57.10	57.10
	Beijing 2008	8		57.70
	Sig.		0.111	

Table 5. The similarity of Average Reaction Time in the Swimming Olympics Number 100 Butterfly Stroke

Uji statistic	Kejuaraan	N	Subset for alpha = 0,05	
			1 (m/s)	2 (m/s)
Male				
	Tokyo 2021	8	0.632	
	Rio 2016	8	0.68	0.68
Tukey HSD	London 2012	8		0.70
	Beijing 2008	8		0.73
	Sig.		0.128	0.069
Female				
	Tokyo 2021	8	0.67	
	London 2012	8	0.71	0.71
Tukey HSD	Rio 2016	8	0.73	0.73
	Beijing 2008	8		0.76
	Sig.		0.135	

Table 6. The effect of ST, RT on FT in all Olympic events

	R Square	F	Sig.
Male			
ST 1st vs FT Male	0.328	14.657	0.001
ST 2nd vs FT Male	0.713	74.565	0.000
RT vs FT (Male)	0.160	2.389	0.023
Female			
ST 1st vs FT Female	0.996	7806.906	0.000
ST 2nd vs FT Female	0.997	10973.351	0.000
RT vs FT (Female)	0.876	2.215	0.000

Table 7. Effect of RT on First ST

	R Square	F	Sig.
Male and Female			
RT vs Split 1st	0.712	153.013	0.000

Table 5 explains that the reaction time for the men's swimmers in the 2008 Beijing 2008, London 2012 and Tokyo 2021 Olympics was significantly different. The reaction time for the 2021 Tokyo Olympics is the fastest reaction time from the 2 previous Olympics. For female athletes, the difference in reaction time only occurred in the 2008 Beijing and 2021 Tokyo Olympics.

Table 6 explains that the two indicators, ST and RT, influence the achievement of FT in the 100-meter butterfly stroke.

Table 7 explains that the RT ability of male and female swimmers has an effect of 0.712 (51%) on achieving the first 50 meters in the 100 meters butterfly event.

Discussion

This study aims to provide benchmarks and standards in the development of swimming sports training, especially in the 100-meter butterfly stroke. This analysis is based on the two categories of ST and RT in swimmers who entered the final round at the Olympics from 2008 to 2021.

The findings in this study are that the ST travel time in the last 50 meters has differences in each Olympics. This is in accordance with the results of research (Robertson et al., 2009), which found that ST management will affect the achievement of travel time at the end of the race. The last ST 50 meters is a critical travel time for swimmers. In all Olympic events, there is a slowdown in the stroke. This causes a delay in the ST travel time due to physiological limitations of the body in supporting performance to increase speed in the last 50 meters (Morais, Barbosa, et al., 2019; Tucker et al., 2006).

The first ST speed is caused by optimal starting support, where starting ability is also supported by high leg muscle strength (Keiner et al., 2021; Thng et al., 2020). Furthermore, the body's physiological ability to maximize the energy released will also help optimize performance in maximizing all swimming movements (Barbosa et al., 2008; Nordsborg et al., 2014). Breaststroke and butterfly stroke have a higher energy expenditure value than freestyle and backstroke (Barbosa et al., 2006; Strzała et al., 2012, 2017).

This study also found that RT (RT) in every Olympics, both male and female, had different travel times. This difference indicates that every coach and athlete has set the same strategy for improving their performance when starting a swimming competition. RT achievements also relate to the final performance of swimming athletes (Everett, 2015; Lima, 2016; Seifert et al., 2011).

Previous research stated that final travel time was strongly influenced by net swimming speed, shot reaction time at the start, stroke frequency and stroke length (Markovic et al., 2014). This speed of reaction is also supported by the athlete's ability to start (Cuenca-Fernández et al., 2015; Marinho et al., 2021). Support for the quality of athletic starts is also an indicator of promoting an athlete's swimming performance (Garcia-Hermoso et al., 2013). These facts suggest that coaches should apply all the kinematic elements of the training season and try to identify optimal swimming speed (ratio of stroke speed to long stroke) for swimmers (Vasic et al., 2021).

This study also found that RT influenced the target travel time at the first ST. This study found that RT can affect the first ST by 50%. This is the same as several studies which state that optimal RT will provide a path to the swimmer's shot timing policy (da Silva et al., 2019). However, other variables also affect it, such as the force applied to the block, low resistance when entering the water, underwater slides and underwater propulsion (Bishop et al., 2013; Potdevin et al., 2011; Rebutini et al., 2016).

Viewed in this study, it can be interpreted that from the Beijing Olympics (2008) to the Tokyo Olympics, there has been a change in the reaction time performance policy strategy. The findings from this study show RT affects the attack time of the 100-meter butterfly stroke, so RT here will positively impact swimmer speed (Draheim et al., 2019).

RT itself is influenced by the athlete's ability to capture start instructions in audiovisual form. In sports, an athlete's swimming ability in receiving stimuli from the committee's instructions also determines how fast the RT gets; most of these stimuli are in the form of audiovisual. Like runners, swimmers are very good at capturing audiovisual stimuli, which will later be continued in the form of RT (Nuri et al., 2013).

Conclusions

This study concludes that the implementation of each Olympics in swimming in the 100-meter butterfly event has a different average of FT and RT in each event. Every performance of FT and RT shows changes that are getting faster in both. Furthermore, there is the influence of RT on the desire for FT; although this effect is minimal, it strongly impacts the willingness of the first ST.

Conflict of interest

Authors state no conflict of interest.

References

Marinho, D. A., Barbosa, T. M., Neiva, H. P., Silva, A. J., & Morais, J. E. (2020). Comparison of the start, turn and finish performance of elite swimmers in 100 m and 200 m

races. *Journal of Sports Science and Medicine, 19*(2), 397-407.

Morais, J. E., Marinho, D. A., Arellano, R., & Barbosa, T. M. (2019). Start and turn performances of elite sprinters at the 2016 European Championships in swimming. *Sports Biomechanics, 18*(1). https://doi.org/10.1080/14763141.2018.1435713

Tourny-Chollet, C., Chollet, D., Hogie, S., & Papparodopoulos, C. (2002). Kinematic analysis of butterfly turns of international and national swimmers. *Journal of Sports Sciences, 20*(5), 383-390. https://doi.org/10.1080/026404102317366636

Strzała, M., Stanula, A., Krężałek, P., Ostrowski, A., Kaca, M., & Głąb, G. (2017). Butterfly Sprint Swimming Technique, Analysis of Somatic and Spatial-Temporal Coordination Variables. *Journal of Human Kinetics, 60*(1), 51-62. https://doi.org/10.1515/hukin-2017-0089

McGibbon, K. E., Pyne, D. B., Shephard, M. E., & Thompson, K. G. (2018). Pacing in Swimming: A Systematic Review. *Sports Medicine, 48*(7). https://doi.org/10.1007/s40279-018-0901-9

Menting, S. G. P., Elferink-Gemser, M. T., Huijgen, B. C., & Hettinga, F. J. (2019). Pacing in lane-based head-to-head competitions: A systematic review on swimming. *Journal of Sports Sciences, 37*(20), 2287-2299. https://doi.org/10.1080/02640414.2019.1627989

Thompson, K. G., Haljand, R., & MacLaren, D. P. (2000). An analysis of selected kinematic variables in national and elite male and female 100-m and 200-m breaststroke swimmers. *Journal of Sports Sciences, 18*(6), 421-431. https://doi.org/10.1080/02640410050074359

Washino, S., Mayfield, D. L., Lichtwark, G. A., Mankyu, H., & Yoshitake, Y. (2019). Swimming performance is reduced by reflective markers intended for the analysis of swimming kinematics. *Journal of Biomechanics,* 91, 109-113. https://doi.org/10.1016/j.jbiomech.2019.05.017

Gonjo, T., & Olstad, B. H. (2021). Race analysis in competitive swimming: A narrative review. *International Journal of Environmental Research and Public Health, 18*(1), 1-16. https://doi.org/10.3390/ijerph18010069

Bishop, C., Cree, J., Read, P., Chavda, S., Edwards, M., & Turner, A. (2013). Strength and conditioning for sprint swimming. *Strength and Conditioning Journal, 35*(6), 1-6. https://doi.org/10.1519/SSC.0000000000000019

Potdevin, F., Alberty, M., Chevutschi, A., & Pelayo, P. (2011). Effects of a 6-Week Plyometric Training Program on Performances in Pubescent Swimmers. *The Journal of Strength and Conditioning Research, 25*(1), 80-86. https://doi.org/10.1519/JSC.0b013e3181fef720

Gordon, D., Baker, J., Roberts, J., Basevitch, I., Merzbach, V., & Scruton, A. (2015). Pacing accuracy during an incremental step test in adolescent swimmers. *Open Access Journal of Sports Medicine,* 249. https://doi.org/10.2147/oajsm.s84906

Thompson, G. K. (2014). *Pacing: Individual Strategies for Optimal Performance.* http://books.google.com/books?hl=en&lr=lang_en&id=ur47BAAAQBAJ&pgis=1

Mauger, A. R., Neuloh, J., & Castle, P. C. (2012). Analysis of pacing strategy selection in elite 400-m freestyle swimming. *Medicine and Science in Sports and Exercise, 44*(11), 2205-2212. https://doi.org/10.1249/MSS.0B013E3182604B84

Taylor, J. B., Santi, G., & Mellalieu, S. D. (2016). Freestyle race pacing strategies (400 m) of elite able-bodied swimmers and swimmers with disability at major international championships. *Journal of Sports Sciences, 34*(20), 1913–1920. https://doi.org/10.1080/02640414.2016.1142108

Skorski, S., Faude, O., Caviezel, S., & Meyer, T. (2014). Reproducibility of pacing profiles in elite swimmers. *International Journal of Sports Physiology and Performance, 9*(2), 217-225. https://doi.org/10.1123/IJSPP.2012-0258

Skorski, S., Faude, O., Rausch, K., & Meyer, T. (2013). Reproducibility of pacing profiles in competitive swimmers. *International Journal of Sports Medicine, 34*(2), 152-157. https://doi.org/10.1055/s-0032-1316357

FINA (2022). World Aquatics. www.fina.org.

Robertson, E., Pyne, D., Hopkins, W., & Anson, J. (2009). Analysis of lap times in international swimming competitions. *Journal of Sports Sciences, 27*(4), 387-395. https://doi.org/10.1080/02640410802641400

Morais, J. E., Barbosa, T. M., Neiva, H. P., & Marinho, D. A. (2019). Stability of pace and turn parameters of elite long-distance swimmers. *Human Movement Science,* 63, 108-119. https://doi.org/10.1016/j.humov.2018.11.013

Tucker, R., Lambert, M. I., & Noakes, T. D. (2006). An analysis of pacing strategies during men's world-record performances in track athletics. *International Journal of Sports Physiology and Performance, 1*(3), 233-245. https://doi.org/10.1123/ijspp.1.3.233

Keiner, M., Wirth, K., Fuhrmann, S., Kunz, M., Hartmann, H., & Haff, G. G. (2021). The Influence of Upper- and Lower-Body Maximum Strength on Swim Block Start, Turn, and Overall Swim Performance in Sprint Swimming. *Journal of Strength and Conditioning Research, 35*(10), 2839-2845. https://doi.org/10.1519/JSC.0000000000003229

Thng, S., Pearson, S., Rathbone, E., & Keogh, J. W. L. (2020). The prediction of swim start performance based on squat jump force-time characteristics. *PeerJ, 2020*(6), 1-18. https://doi.org/10.7717/peerj.9208

Barbosa, Tiago M., Fernandes, R. J., Keskinen, K. L., & Vilas-Boas, J. P. (2008). The influence of stroke mechanics into energy cost of elite swimmers. *European Journal of Applied Physiology, 103*(2), 139-149. https://doi.org/10.1007/s00421-008-0676-z

Nordsborg, N. B., Espinosa, H. G., & Thiel, D. V. (2014). Estimating energy expenditure during front crawl swimming using accelerometers. *Procedia Engineering,* 72, 132-137. https://doi.org/10.1016/j.proeng.2014.06.024

Barbosa, T. M., Fernandes, R., Keskinen, K. L., Colaço, P., Cardoso, C., Silva, J., & Vilas-Boas, J. P. (2006). Evaluation of the Energy Expenditure in Competitive Swimming Strokes. *Int J Sports Med, 27*(11), 894-899.

Strzała, M., Krezałek, P., Kaca, M., Głab, G., Ostrowski, A., Stanula, A., & Tyka, A. (2012). Swimming speed of the breaststroke kick. *Journal of Human Kinetics, 35*(1), 133-139. https://doi.org/10.2478/v10078-012-0087-4

Everett, M. (2015). Swimming Starts : a Comparison of Relay and Individual Racing Dive Reaction Time , Speed , and Distance. *Go Forth and Measure - Cambridge,* 1, 1-7.

Lima, M. A. de B. (2016). Método de análise biomecânica da saída tipo atletismo na natação competitiva. *Faculdade de Engenharia Biomédica, 1*(1), 81.

Seifert, L., Didier, C., & Mujika, I. (2011). *World book of swimming: From science to performance.*

Markovic, V., Pasic, G., & Kulundzic, D. (2014). Analysis of a swimming stroke in the 100m breaststroke swimming event in Athens in 2004. *Sport and Health, 9*(1), 58-64.

Cuenca-Fernández, F., López-Contreras, G., & Arellano, R. (2015). Effect on Swimming Start Performance of Two Types of Activation Protocols: Lunge and YoYo Squat. *The Journal of Strength & Conditioning Research, 29*(3). https://journals.lww.com/nsca-jscr/Fulltext/2015/03000/Effect_on_Swimming_Start_Performance_of_Two_Types.10.aspx

Marinho, D. A., Barbosa, T. M., Neiva, H. P., Moriyama, S. I., Silva, A. J., & Morais, J. E. (2021). The effect of the start and finish in the 50 m and 100 m freestyle performance in elite male swimmers. *International Journal of Performance Analysis in Sport, 21*(6), 1041–1054. https://doi.org/10.1080/24748668.2021.1969514

Garcia-Hermoso, A., Escalante, Y., Arellano, R., Navarro, F., Domínguez, A. M., & Saavedra, J. M. (2013). Relationship between final performance and block times with the traditional and the new starting platforms with a back plate in international swimming championship 50-m and 100-m freestyle events. *Journal of Sports Science and Medicine, 12*(4), 698-706.

Vasic, A., Djurovic, M., Madic, D., & Okicic, T. (2021). Differences in Split Times between the Elite Breaststroke Swimmers. *Journal of Anthropology of Sport and Physical Education, 5*(2), 9-11. https://doi.org/10.26773/jaspe.210402

da Silva, J. K. F., dos Santos, P. S., Favaro, S. O. V. B., Lirani, L. da S., & Osiecki, R. (2019). Reaction time on swimming block start in competitors swimmers on world swimming championship. *Journal of Physical Education and Sport, 19*(s2), 376-380. https://doi.org/10.7752/jpes.2019.s2056

Rebutini, V. Z., Pereira, G., Bohrer, R. C. D., Ugrinowitsch, C., & Rodacki, A. L. F. (2016). Plyometric long jump training with progressive loading improves kinetic and kinematic swimming start parameters. *Journal of Strength and Conditioning Research, 30*(9). https://doi.org/10.1519/JSC.0000000000000360

Draheim, C., Mashburn, C. A., Martin, J. D., & Engle, R. W. (2019). Reaction time in differential and developmental research: A review and commentary on the problems and alternatives. *Psychological Bulletin, 145*(5), 508-535. https://doi.org/10.1037/bul0000192

Nuri, L., Shadmehr, A., Ghotbi, N., & Attarbashi Moghadam, B. (2013). Reaction time and anticipatory skill of athletes in open and closed skill-dominated sport. *European Journal of Sport Science, 13*(5), 431-436. https://doi.org/10.1080/17461391.2012.738712

АНАЛІЗ ЗАРЕЄСТРОВАНИХ ПОКАЗНИКІВ ЧАСУ РЕАКЦІЇ, ПРОМІЖНОГО ЧАСУ ТА КІНЦЕВОГО ЧАСУ СПОРТСМЕНІВ-ПЛАВЦІВ НА ОЛІМПІЙСЬКИХ ІГРАХ 2008-2021 РР.

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 7 с., 7 табл., 2 рис., 39 джерел.

Мета дослідження. Метою цього дослідження є оцінка та аналіз зареєстрованих показників кінцевого часу (КЧ), проміжного часу (ПЧ) та часу реакції (ЧР) плавців батерфляєм на дистанції 100 метрів у чотирьох олімпійських змаганнях із метою забезпечення контрольних показників і стандартів для розвитку навчання плавання.

Матеріали та методи. Це дослідження поєднує в собі кількісний і якісний підходи. У цьому дослідженні використовували вибірку з 32 спортсменів з першої по восьму категорії, які змагалися на дистанції 100 метрів батерфляєм на чотирьох Олімпійських іграх: Олімпіаді 2008 року в Пекіні, Олімпіаді 2012 року в Лондоні, Олімпіаді 2016 року в Ріо-де-Жанейро та Олімпіаді 2021 року в Токіо. У дослідженні використовують вторинні дані, у яких усі часові результати одержані з вебсайту (http://www.fina.org). У цьому дослідженні для статистичного аналізу використовували описову статистику середнього та стандартного відхилення. Для визначення нормальності даних використовували тест Колмогорова-Смирнова. Для порівняння даних між олімпіадами використовували однофакторний дисперсійний аналіз із критерієм множинного порівняння, щоб перевірити взаємодію між ЧР, ПЧ та КЧ на олімпіадах. Для визначення впливу ЧР та ПЧ на КЧ використовували однофакторну лінійну регресію з рівнем значущості $p<0,05$ як стандартом. Для всіх аналізів використовували ПЗ SPSS Inc., Чикаго, Іллінойс, США.

Результати. Було встановлено, що ПЧ та ЧР впливають на досягнення КЧ на 100-метровій дистанції батерфляєм, а ЧР має вплив на рівні 0,712 (51%), для плавців і чоловічої, і жіночої статі, на досягнення цього часу за перші 50 метрів.

Висновки. Висновок полягає в тому, що як спортсмени, так і тренери повинні оптимізувати досягнення показників ЧР та ПЧ у плаванні на короткі дистанції, оскільки ці два показники відіграють вирішальну роль у досягненні часу загального руху плавців на короткі дистанції.

Ключові слова: час реакції, кінцевий час, проміжний час, плавання.

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