Physical education and sport through the centuries
2022, 9(2), 122-129
ISSN 2335-0598

Original research article

DOI: 10.5937/spes2202123D

DIFFERENCES IN THE DROP-OFF PARAMETER BETWEENELITE SWIMMERS IN THE 100M BUTTERFLY

Marko Đurović[1], Miomir Danev[1], Miloš Paunović[1], Irfan Gračanin[1], Dejan Madić[1] and Tomislav Okičić[1]

[1]Faculty of Sport and Physical Education, University of Nis, Serbia

UDK 797.212.3

SUMMARY

This research aimed to determine differences in pace strategies between the two groups of elite swimmers at the 2019 World Championships in the 100m butterfly. The overall sample included in this study consisted of 16 maleparticipants of the World Swimming Championships in South Korea, who were divided into two groups. The first group consisted of finalists (22.88 ± 3.83 years; n = 8), and the second group of semifinalists (24.63 ± 4.93 years; n = 8). The results are taken from the official results from the omegatiming website. A T-test was used to determine the differences between groups. Finalist were faster than semifinalists for first lap (23.82 ± .45 vs. 24.26 ± .30 s, p= .035), second lap (27.34 ± .31 vs. 27.78 ± .34 s, p= .018) as well as final time (51.16 ± .74 vs. 52.04 ± .26 s, p= .007) but not in drop off (3.53 ± .22 vs. 3.51 ± .59 s, p= .946). Finalists of the 100-m butterfly event at international competitions swam a faster first and second lap compared to their competitors inthe semifinal group. Both groups are elite swimmers and showed abilities to maintain swimming velocity in first and second laps, therefore minimizing the drop-off from the start to the end of the race.The pacing strategies of elite swimmers remain relatively stable. The obtained results can be a good starting point in the learning process and education of teachers who coach young swimmers.

Key words: Pace strategies, World Swimming Championships, Swimming, Learning Process.

Corresponding author
Marko Đurović
djura86@yahoo.com

INTRODUCTION

Swimming is one cyclic sport. The main characteristic of cyclic sports is that motor activities involve repetitive movements. Each movement is a complex kinetic unit in itself, which implies an alternating and harmonious connection into one appropriate coordinated rhythm[1]. The swimmers perform them with the same success during the cyclic motion of the swimming stroke[2]. The stroke is the basic unit of movement in swimming. Each stroke contains the amplitude, power, rhythm, and frequency of the stroke[3].Also, the stroke has a propulsive part (hand movement through the water) and a retropulsive part (hand movement through the air), when the stroke surfaces are returned and prepared for a new stroke. Propulsion refers to the force that enables the body to move forward. The retropulsion of the stroke is the period in which the arms and legs return to the initial position, beginning with the exit and ending with the entry of the arm into the water. All the listed characteristics of the stroke directly affect the efficiency of the race[4].

The main goal in competitions is to complete the event distance in the fastest possible time.To achieve this goal, the swimmer's contractile abilities must be efficiently deployed during the race to make the best use of all available physiological abilities while limiting premature fatigue[5]. The best way to expend the limited energetic sources which are available to the athletes is known as pacing or the pacing strategy. Even small differences in pacing determine the outcome of the race, indicating that pace is playing an increasingly important role[6].Pacing strategy in swimming is characterized by monitoring split times over each lap of the race. The difference between the first and second lap times is called drop-off. The drop-off in time between the first and second laps is typically 1–2 s

[1] K. E. McGibbon et al., "Pacing in swimming: a systematic review",*Sports Medicine* 48, no.7, (2018): 1621-1633.

[2] Tomislav Okičić i dr., Plivanje-*praktikum*(Niš: FSFV, 2007).

[3] Marko Đurović et al., „A comparison of kinematic variables between european elite, national elite and regional elite male 100m freestyle swimmers", *Facta Universitatis, Series: Physical Education and Sport* 10, no. 4 (2012): 339-346.

[4] E. W. Maglischo, *Swimming fastest* (Human kinetics., 2003).

[5] C. Foster et al., "Pattern of energy expenditure during simulated competition",*Medicine and science in sports and exercise* 35, no. 5, (2003): 826-831.

[6] C. R. Abbiss & Laursen P. B., "Describing and understanding pacing strategies during athletic competition". *Sports medicine* 38, no. 3, (2008): 239-252.

longer in butterfly and breaststroke than in 100m freestyle events due to the different ways of turning[7].

Professional athletes who participate in major competitions such as the Olympic Games or the World Championship strengthen their educational personality profile and social responsibility through the training process[8].

Therefore, this research aimed to evaluate the pacing strategies adopted by elite male swimmers at high levels of competition. The purpose of this paper is to provide practical information regarding the pacing strategies in the learning process and education for teachers who coach young swimmers.

THE METHODS

The sample of participants

The sample of participants numbered 16 swimmers, participants in the Semifinals and Finals of the 100m butterfly at the 2019 World Championships. All participants swam the 100 m butterfly race and based on the results were ranked into two semifinal groups and later in one final group. The first group of participants in this study consisted of finalists (22.88 ± 3.83 years; n = 8), and the second group consisted of the last eight semifinalists (24.63 ± 4.93 years; n = 8).All methods and procedures of this investigation were approved by the ethical committee of the University of Nis, Faculty of Sport and Physical Education, Serbia, and they conformed to the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Procedures

The World Swimming Championships were held in 2019 in South Korea, the city of Gwangju in a 50 m long pool. All results are taken from the official website (https://www.omegatiming.com). The following variables were used to evaluate the pacing strategies in the 100 m butterfly:

- the first 50m of the finalists – **Lap1_F** (s);
- the second 50m of the finalists – **Lap2_F** (s);
- differences between the first and second laps – **Drop-off_F** (s);
- total time of the finalists - **T100_F**(s);

[7] Navedeno delo: 4

[8] Sergii Ivashchenko & Kovalchuk Nataliya & Živanović Nenad, "Development of olympic education in the historical aspect" *Physical education and sport through the centuries*, 9, no. 1, (2022): 43-54

- the first 50m of the semifinalists – **Lap1_SF** (s);
- the second 50m of the semifinalists – **Lap2_SF** (s);
- differences between the first and second laps – **Drop-off_SF** (s);
- total time of the semifinalists - **T100_SF** (s).

Statistical analyses

For all the variables, the basic parameters of descriptive statistics were calculated. To calculate the statistically significant difference for each variable between the groups, the T-test was used. Statistical calculation was done using the Statistics software SPSS 19.0.

RESULTS

Tables

Table 1 Basic descriptive statistical parameters and the results of the T-test of the applied variables in the 100m butterfly

Variables	Groups	N	Mean	SD	Min	Max	CV	F	t	Sig.
Yr	Finalist	8	22.88	3.83	17	27	17%	0.14	-0.79	0.441
	Semifinalist	8	24.63	4.93	19	34	20%			
Lap1 (s)	Finalist	8	23.82	0.45	22.83	24.24	2%	0.71	-2.33	**0.035**
	Semifinalist	8	24.26	0.30	23.82	24.83	1%			
Lap2 (s)	Finalist	8	27.35	0.31	26.67	27.65	1%	0.82	-2.68	**0.018**
	Semifinalist	8	27.78	0.34	27.36	28.23	1%			
Drop-off (s)	Finalist	8	3.53	0.22	3.22	3.84	6%	9.37	0.07	0.946
	Semifinalist	8	3.51	0.58	2.54	4.28	17%			
T100 (s)	Finalist	8	51.16	0.74	49.50	51.70	1%	3.40	-3.17	**0.007**
	Semifinalist	8	52.04	0.26	51.71	52.55	0%			

Legend: Groups – groups of swimmers, **N** – number of participants, **Mean** – means,**SD** – standard deviation, **Min** – minimal results, **Max** – maximal results, **CV** – coefficient of variation, **T-test F** – F statistic, **T-test t** – t statistic, **Sig.** – level of significance,**Yr**– the age of the respondents, **Lap1 (s)**–the first 50m of the 100m butterfly,**Lap2 (s) –** the second 50m of the 100m butterfly,**Drop-off (s)**– differences between the first and second laps,**T100 (s)**– achieved time in the 100m butterfly.

Table 1. shows the results of the descriptive statistical parameters for the used variables as well as the results of the T-test. By analyzing the values of the coefficient of variation (CV) we can see that they were below 30%, which indicates

that the results were confident and can be used for further analysis[9]). The T-test results indicate that there is a statistically significant difference between finalists and semifinalists in the following variables: Lap1 (F = 0.71; p = 0.035); Lap2 (F = 0.82; p = 0.018) and T100 (F = 3.40; p = 0.007), but not in variable Drop-off (F = 9.37; p = 0.946). Furthermore, if we look at the minimum and maximum results of the Semifinalists in the Drop-off variable, we can see that there are large deviations (Min = 2.54 s, Max = 4.28 s; CV = 17%), while these deviations for the Finalists are very small (Min= 3.22 s, Max = 3.84; CV = 6%).

DISCUSSION

This research aimed to determine differences in pace strategies between the two groups of elite swimmers at the 2019 World Championships in the 100m butterfly and evaluate the pacing strategies adopted by elite male swimmers at high levels of competition.The findings from the present study suggest that there is a statistically significant difference in the first and second lap between elite male swimmers, but there is no statistically significant difference in the Drop-off parameter. However, there is a positive pacing strategy whereby the mean 50m lap time increased by 12.9% from the first to the second lap at the finalists while it is in the case of semifinalists that increase amounted to 12.6% which is consistent with the results of previous research[10]. The obtained results indicate that the finalists were faster than the semifinalists in the first lap (23.82 ± .45 vs. 24.26 ± .30 s, p= .035), but also in the second lap (27.34 ± .31 vs. 27.78 ± .34 s, p= .018) as well as final time (51.16 ± .74 vs. 52.04 ± .26 s, p= .007) which confirms the claim of Dopsaj[11] (2009) who investigated the tactics models of elite male and female swimmers and concluded that the male swimmer who is faster in the first lap will win the race with a probability of 43.45%, while with female swimmers this probability is significantly higher and amounts to 77.18%.On the other hand, research by Robertson, Pyne, Hopkins & Anson[12] that dealt with the same topic

[9] Milivoj Dopsaj i Zoran Bratuša, "Matematički model za procenu nivoa generalne plivačke pripremljenosti vaterpolista mlađeg uzrasta od 12 do 14 godina", Nova sportska praksa 3, no. 1-2,(2003): 47-55.

[10] P. T. Nikolaidis & B. Knechtle, "Pacing in age-group freestyle swimmers at The XV FINA World Masters Championships in Montreal 2014", Journal of Sports Sciences 35, no. 12, (2017): 1165-1172.

[11] Milovoj Dopsaj,"Analysis of competitive activity in the function of defining model indicators of swimming tactics on the section" (Analiza takmičarske aktivnosti u funkciji definisanja modelskih pokazatelja taktike plivanja na deonici od 100m.) (Rad predstavljen na: International Scientific Conference Theoretical, Methodological and Methodical Aspects of Competitions and Athletes' Preparation / Conference Proccedings Belgrade, Serbia, 23-28, 2009)

[12]E. Y Robertson & D. B.Pyne& W. G Hopkins & J. M. Anson, "Analysis of lap times in international swimming competitions",*Journal of Sports Sciences* 27, no. 4, (2009): 387-395.

showed that elite male swimmers who can swim the second lap faster than their opponents will win the 100m butterfly (finalists vs. semifinalists; r= 0.88 vs. 0.58). However, research that investigated pacing parameters on less successful swimmers reported that nonelite swimmers had a larger differential between first and second lap speeds, which indicates a higher drop-off parameter[13]. Finally, although we did not examine the appearance of fatigue, it is certainly a very important parameter that affects the pacing strategy, which must be monitored and developed throughout the training process.

CONCLUSION

Based on the results, we can conclude that butterfly swimmers must have a fast first lap to stay competitive and maintain second lap speed for success in 100m events. The elite swimmers were faster throughout each lap and in the final time, which indicates that their physiological abilities are highly developed, so swimmers who are less successful need to develop their general conditions and technique and after that their pacing strategy.

REFERENCES

1. Abbiss, C. R. & P. B. Laursen."Describing and understanding pacing strategies during athletic competition". *Sports medicine,* 38, no. 3, (2008), 239-252.
2. Chollet, D .& C. Delaplace & P. Pelayo & C.Tourny & M. Sidney. "Stroking characteristic variations in the 100-m freestyle for male swimmers of differing skill". *Perceptual and motor skills*85, no. 1,(1997): 167-177.
3. Dopsaj, Milovoj. "Analysis of competitive activity in the function of defining model indicators of swimming tactics on the section" (Analiza takmičarske aktivnosti u funkciji definisanja modelskih pokazatelja taktike plivanja na deonici od 100m.) Rad predstavljen na: *International Scientific Conference Theoretical, Methodological and Methodical Aspects of Competitions and Athletes' Preparation / Conference Proccedings* Belgrade, Serbia, 23-28, 2009.
4. Dopsaj, Milivoj i Zoran Bratuša."Matematički model za procenu nivoa generalne plivačke pripremljenosti vaterpolista mlađeg uzrasta od 12 do 14 godina". *Nova sportska praksa* 3, no. 1-2, (2003): 47-55.

[13] Navedeno delo: 1; D. Chollet, et al., "Stroking characteristic variations in the 100-m freestyle for male swimmers of differing skill". *Perceptual and motor skills* 85, no. 1, (1997): 167-177; J Senefeld & Joyner M. J. & Stevens, A. & Hunter, S. K. "Sex differences in elite swimming with advanced age are less than marathon running". *Scandinavian journal of medicine & science in sports* 26, no. 1, (2016): 17-28.

5. Đurović, Marko i Igor Beretić i Milovoj Dopsaj i Milan Pešić i Tomislav Okičić."A comparison of kinematic variables between european elite, national elite and regional elite male 100m freestyle swimmers". *Facta Universitatis, Series: Physical Education and Sport* 10, no. 4,(2012), 339-346.
6. Foster, C. & J. J De Koning & F. Hettinga & J. Lampen & K. L.La Clair, & C. Dodge, & J. P. Porcari. "Pattern of energy expenditure during simulated competition". *Medicine and science in sports and exercise,* 35, no. 5, (2003), 826-831.
7. Ivashchenko, Sergii & Nataliya Kovalchuk & Živanović Nenad. "Development of olympic education in the historical aspect" *Physical education and sport through the centuries*, 9, no. 1, (2022): 43-54
8. Maglischo, E. W. *Swimming fastest.* Human kinetics, 2003.
9. McGibbon, K. E.&D. B.Pyne, &M. E. Shephard, &K. G. Thompson."Pacing in swimming: a systematic review". *Sports Medicine,* 48, no. 7, 2018., 1621-1633.
10. Nikolaidis, P. T. & B. Knechtle."Pacing in age-group freestyle swimmers at The XV FINA World Masters Championships in Montreal 2014". *Journal of Sports Sciences* 35, no. 12, (2017): 1165-1172.
11. Okičić, Tomislav, Zlatko Ahmetović, Dejan Madić, Milovoj Dopsaj i Marko Aleksandrović. *Plivanje-praktikum*. Niš: FSFV, 2007.
12. Robertson, E. Y., & D. B. Pyne & W. G. Hopkins & J. M. Anson."Analysis of lap times in international swimming competitions". *Journal of Sports Sciences* 27, no. 4, (2009): 387-395.
13. J Senefeld & Joyner, M. J.& Stevens, A.& Hunter, S. K.. Sex differences in elite swimming with advanced age are less than marathon running. *Scandinavian journal of medicine & science in sports* 26, no. 1, (2016): 17-28.

РАЗЛИКЕ У ОПАДАЊУ ТЕМПА ПЛИВАЊА ИЗМЕЂУ ЕЛИТНИХ ПЛИВАЧА У ДИСЦИПЛИНИ 100М ДЕЛФИН СТИЛОМ

САЖЕТАК

Ово истраживање је имало за циљ да утврди разлике у стратегијама темпа пливања између две групе елитних пливача на Светском првенству 2019. у дисциплини 100 метара делфин стилом. Укупан узорак укључен у ову студију чинило је 16 мушких учесника Светског првенства у пливању у Јужној Кореји, који су били подељени у две групе. Прву групу чинили су финалисти (22,88 ± 3,83 године; н = 8), а другу групу полуфиналисти (24,63 ± 4,93 године; н = 8). Подацикоји су коришћени преузети су из званичних резултата са омега тајминг веб странице. За утврђивање разлика између група коришћен је Т-тест. Резултати показују да су финалисти били бржи од полуфиналиста у првом пролазу (23.82 ± .45 вс. 24.26 ± .30 с, п= .035), другом пролазу (27.34 ± .31 вс. 27.78 ± .34 с, п= .018), као и у укупном времену трке (51.16 ± .74 вс. 52.04 ± .26 с, п= .007) али не и у опадању темпа пливања (3.53 ± .22 вс. 3.51 ± .59 с, п= .946). Финалисти дисциплине 100 м делфин стилом на Светском првенству 2019 пливали су брже у првом и другом пролазу у односу на такмичаре у

полуфиналној групи. Обе групе су елитни пливачи и показали су способност да одрже брзину пливања у првом и другом пролазу, чиме су минимизирали пад темпа пливања од почетка до краја трке. Може се закључити да је стратегија ритма пливања код елитних пливача релативно стабилна. Добијени резултати могу бити добра полазна основа у процесу учења и едукације наставника који тренирају младе пливаче.

Кључне речи: Стратегије темпа пливања, Светско првенство у пливању, Пливање, Процес учења

РАЗЛИЧИЯ В СНИЖЕНИИ ТЕМПА МЕЖДУ ЭЛИТНЫМИ ПЛОВЦАМИ НА ДИСТАНЦИИ 100 М БАТТЕРФЛЯЕМ

АННОТАЦИЯ

Цель данного исследования – определить различия в стратегиях темпа между двумя группами элитных пловцов на дистанции 100 м баттерфляем на чемпионате мира 2019 года. Общая выборка, включенная в данное исследование, состоит из 16 пловцов-участников Чемпионата мира по плаванию в Южной Корее, которые разделены на две группы. Первая группа – финалисты (22,88 ± 3,83 года; n = 8), а вторая – полуфиналисты (24,63 ± 4,93 года; n = 8). Результаты взяты из официальных данных сайта omegatiming. Для определения различий между группами использовался Т-тест. Финалисты были быстрее полуфиналистов на первом круге (23,82 ± .45 против 24,26 ± .30 с, p = .035), втором круге (27,34 ± .31 против 27,78 ± .34 с, p = .018), а также в финале (51,16 ± .74 против 52,04 ± .26 с, p = .007), но не в отрыве (3,53 ± .22 против 3,51 ± .59 с, p = .946). Финалисты международных соревнований на дистанции 100 м баттерфляем проплыли первый и второй круг быстрее, чем их соперники из полуфинальной группы. Представители обеих групп, являясь элитными пловцами, показали способность поддерживать скорость плавания на первом и втором кругах, таким образом, минимизируя спад скорости на протяжении всей дистанции. Стратегии темпа элитных пловцов остаются относительно стабильными. Полученные результаты могут стать хорошей отправной точкой в процессе обучения и воспитания педагогов, тренирующих юных пловцов.

Ключевые слова: стратегии темпа, чемпионат мира по плаванию, плавание, процесс обучения

Reccived on 09.11.2022.
Accepted on 18.12.2022.