# 200 m Backstroke: Race perception and training strategy in elite male swimmers

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## ABSTRACT

The 200m Backstroke event in swimming has a complex structure, composed of various metabolic demands. Establishing performance-determining domains will result in a deeper understanding of the variables influencing performance. The objective of this study was to analyze the differences in split times in the performance of the 200m backstroke event by portuguese and international elite swimmers, as well as to understand the swimmers' perception of their training in relation to their performance in the 200m Backstroke event.

The study was divided into two phases. The first phase involved the analysis and comparison of split times in the 200m event. Significant differences in split time speed were observed among the groups. The second phase entailed a qualitative analysis of responses provided by swimmers from the finals of the Portuguese National Swimming Championship (NC). The qualitative analysis of the swimmers' interviews revealed that a majority of swimmers engage in a base training program for 100m and 200m events. We concluded that the biological maturation of swimmers can be an asset for improving sports performance, along with training focused on mid-distances, which could be significant for enhancing the final performance in the 200m event.

**KEYWORDS:** Sports Performance; Training Perception; Backstroke; Swimming; Race Strategy

## HIGHLIGHTS

- Analysis of the 200m backstroke splits of the various finals revealed trends that are consistent throughout the groups,

- The first 50m of the race seem to be where the biggest difference between the final results.
- Race strategy and experience in the 200m Backstroke might play a bigger part into the final result than initially expected.

## INTRODUCTION

Swimming is one of the most popular sports worldwide. In swimming competitions, there are short-distance events (50m and 100m), mid-distance events (200m and 400m), and long-distance events (800m and 1500m). These different events require swimmers to meet various metabolic demands. Short-distance events primarily involve anaerobic efforts, while long-distance events depend on aerobic metabolism and swimming efficiency.

The 200m events present a challenge for researchers, coaches, and swimmers. The 200m event requires a structured analysis supported by training focused on different metabolic demand zones to achieve optimal performance (Costa et al., 2020). The difference in metabolic demands and energy cost between 50m/100m events and the 200m events may not be as significant as expected, but it has a profound impact on the swimmers' performance. The 200m event, compared to the 100m event, craves a greater aerobic energy contribution due to its longer duration. Consequently, different training strategies are employed for preparing for the 200m event, with the key observation that the first 50m split is typically swum at a faster pace than the subsequent splits (Adrzyk, Staszkiewicz, & Strzala, 2022).

Energy consumption during the 200m Backstroke follows natural laws, as such, the whole event is dependent on how well the usage of nutrients is performed by the athlete. The breakdown of nutrients generates energy in the form of ATP but the amount of ATP generated varies according to the process. In humans, the two main ways of processing glucose are through Oxidative Phosphorylation (aerobic pathway) and Lactate Fermentation (anaerobic pathway, along with the use of Creatinine Phosphate). The most utilized pathway is Oxidative phosphorylation because it yields the most energy, between 30 to 36 ATP (Brand, 2003). However, cells use mostly the anaerobic pathway to breakdown glucose when under stress. Cellular stress can come

from disease, low nutrients and anaerobic conditions, in other words, from situations resembling high intensity sports that require energy fast.

Lactate fermentation is a simpler way of generating ATP since it only requires the enzyme Lactate dehydrogenase to convert pyruvate into lactate. This is also a favourable reaction since it produces a significantly less amount of ATP than Oxidative phosphorylation but at a faster rate (Rabidowitz, 2020).

In sports like track and field that require longer and harder efforts, over the range of 60 to 180 seconds, anaerobic glycolysis is one of the primary sources of ATP during high-intensity short-duration activities, such as 400m and 800m events (Duffield et al, 2013). These activities heavily rely on the creatinine phosphate system for the first moments of physical exertion and anaerobic glycolysis (Machado & Marques, 2013). Lactic acid accumulates to a greater extent in intense efforts lasting from 60 to 180 seconds, such as 100m and 200m swimming events (Kachaunov, 2018).

Troup (1991) notes that in 100m freestyle (crawl) events, energy processes are predominantly anaerobic (approximately 55%) as opposed to aerobic (approximately 45%). In the same distance but in the backstroke style, there is a shift to roughly 58% anaerobic and 42% aerobic. With the increase in distance to the 200m Freestyle, energy processes are mostly aerobic (up to 65%) and involve lower anaerobic demands. However, similar to the the 100m Backstroke, the 200m Backstroke events exhibit different ratios from Freestyle events, exhibiting a bigger aerobic demand (up to 70%).

There are no significant differences in the oxygen debt between the 50m, 100m, and 200m events (Almeida et al., 2016). The race is faster in the initial 50m segments of the 200m events, with a decrease in speed over the course of the race (Moser et al., 2020). In elite swimmers, other variables such as speed variability and effort management during different adaptations, are also factors influencing backstroke performance. This effect surpasses the high drag and inertia (Fernandes et al., 2022). These differences may impact the swimmers' performance. Nevertheless, there are several approaches to understanding swimmers' performance, as well as exploratory and confirmatory models to establish relationships between various performance-determining domains, providing a deeper understanding of the interaction between performance-determining variables, reinforcing swimming as a multifactorial phenomenon (Costa et al, 2020). It should be noted that measuring thrust force is a reliable means of monitoring changes in an athlete's functional preparedness. Several

indicators can be determined by recording the force values, such as maximum force and its maintenance over the duration of the race.

Swimming is a sport dominated by short and mid-duration maximum power efforts, with a prevalence of anaerobic exercises. Measuring thrust force during 60 seconds efforts allows us to assess an athlete's performance, their level of strength preparation and to test their endurance at a total racing time close to their specialization (100m and 200m) (Stachowicz & Milde, 2023). Scientific literature reports that the difference between early-season peak performance and the end of the season is evident in significantly different training zones. The initial months primarily focus on aerobic zones, while the latter months of the competitive season emphasize anaerobic zones and technical training (Vasconcelos Raposo, 2000; Navarro & Arsenio, 2002). In a study with Polish swimmers, it was found that swimmers in the 200m events, compared to swimmers in the 50m and 100m events, had less improvement in their performance. The final phase of the competitive season culminates in training specificity, resulting in lower strength gains (Stachowicz & Milde, 2023).

**Training Perception**

Swimming is one of the largest sports globally, with over thirty-two events in the Olympic program, covering distances from 50m to 1500m, with race durations ranging from 20 seconds to just over 14 minutes. Despite the short distances and relatively brief race times, swimming coaches are recognized for emphasizing high-volume, low-intensity training. However, there are various training paradigms beyond high volume versus low intensity, such as low volume/high intensity, which contribute to the long-term development of swimmers (Nugent, Comyns & Warrington, 2017). Throughout a swimmer's career there is a gradual increase in training volume until adolescence. Substantial increases in later ages allow for increased intensity and different athlete development models have been presented (Saavedra et al., 2018; Ehmkea et al., 2023).

Swimmers' perception of their training often aligns with the design and implementation of training by coaches, except during the taper phases in the macrocycle. During the macrocycle coaches tend to overemphasize the intensity of training sessions (De Andrade Nogueira et al., 2015). The subjectivity of effort

perception (intensity) is influenced by various factors such as gender, personality, and individual readiness for training (Leite et al., 2022).

### Objective

The objective of the study was to analyze the differences and relationships among split times in the performance of the 200m Backstroke event by national and international swimmers as well as understanding the swimmers' perception of training in relation to their sports performance in the 200m Backstroke event.

## MATERIALS AND METHODS

### Sample

The study was divided into two phases. The first phase involved an analysis of the 200m Backstroke event. The second phase included a qualitative analysis of responses provided by swimmers from the national finals regarding their training perception. The first phase of the study analyzed the performance of the 200m Backstroke event among the top eight finalists in the Open/Youth National Championship of Portugal (NC) (Lisbon - 2022), XXXII Olympic Games (OG) (Tokyo - 2021), the 19th FINA World Championships (WC) (Budapest - 2022), and the LEN European Championships (EC) (Rome - 2022), involving 32 male swimmers.

Table 1 presents descriptive data from the study groups. The average age in the group of finalists from the National Swimming Championships (NC) is 19.75 years, while the group of Olympic finalists (OG) has an average age of 25.50 years, the group of World Championship finalists (WC) has an average age of 24.00 years, and the group of European Championship finalists (EC) has an average age of 23.12 years. The table also displays the race times for each group, with the OG group being the fastest and the NC group being the slowest. Swimmers in the finals of the NC were informed about the study's purpose and provided their consent. The study adhered to the principles established by the Helsinki Declaration.

In the second phase of the study, the swimmers in the finals of the NC responded to a questionnaire. A qualitative analysis of the main questions answered was conducted. The group of eight swimmers (NC) was asked the following questions:

1) Do you consider yourself a swimmer of 50/100m, 200m, mid-distance, or long distance?

2) Did you train for 50/100m, 200m, mid-distance, or long distance this season?
3) Did you train for 50/100m, 200m, mid-distance, or long distance in the previous season?

From the semi-open interviews, three categories were defined: training perception, training structure, and race strategy. After analyzing the responses from the group of swimmers in the NC finals, both qualitative and quantitative data analysis was performed. A Spearman correlation test was used to examine whether the observed results were in line with expected values. The normality and homogeneity of the sample distribution was tested using the Kolmogorov-Smirnov and Levene tests, respectively. Basic statistical descriptions (mean and standard deviation) were used to characterize the sample. One-way ANOVA with Bonferroni post-hoc analysis was used to compare differences between the observed variables. Correlations were conducted between race splits and the final race time. Qualitative analysis of interviews with national swimmers regarding their training perception according to their performance in the 200m Backstroke event was also performed. Data with a p-value of ≤0.05 was considered statistically significant. All statistical data were analyzed using the Statistical Package for Social Sciences software. All data were obtained from digital platforms and databases, including Swimrankings, FINA, and LEN.

**RESULTS**

According to the data from the study's swimmers, the group of swimmers in the NC finals had a younger average age (19 years) than the other groups (OG - 25.50 years; WC - 24.00 years; EC - 23.12 years). This suggests that they have less experience than their counterparts in other championships, which may influence race strategies and performance.

In Table 2 it can be seen that the speeds of each 50m split show significant differences between the groups, particularly between the national group and the other groups (OG, WC, and EC). However, when comparing the speed variations of the splits in each 50m segment, there are no significant differences, indicating that swimmers generally approach the race in the same way and with the same strategy. In all groups, the first 50m is swum faster than the subsequent 50m segments, as mentioned by earlier researcher (Adrzyk, Staszkiewicz, & Strzala, 2022).

Table 3 shows the degree of relationship between the variables and how they interfere with each other's results, with statistically significant results in all variables (final race time, 1st split, 2nd split, 3rd split, and 4th split of the race) and their relationship with each other. The data reveals that all swimmers from the various groups approach their race in the same way but with varying speeds due to the different levels of the various championships (NC, OG, WC, and EC).

In the correlation analysis between the final race times and the respective race splits (1st split, 2nd split, 3rd split, and 4th split), positive correlations were observed in all swimmers, with statistically significant correlation values in the parameters from Table 3. A mixed-method study was conducted, incorporating both quantitative closed-ended questions and qualitative aspects (categories: training perception, training structure, and race strategies) with the group of swimmers from NC. The data was obtained from a semi-structured interview regarding swimmers' perceptions and training structures in the last two competitive years, in line with their performance in the 200m Backstroke event.

Regarding swimmers' understanding of training perception in relation to their sports performance, it was found that there is homogeneity in the responses, with a prevailing perception of training for 100m and 200m, and an understanding that the 200m Backstroke event is highly demanding. The self-image of the swimmers seemed to correlate more with their past training ($p= 0.0179$) than with the training from their current season ($p=0.1143$).

After defining and analyzing the categories, regarding training perception (understanding of training as perceived by the swimmer, including their understanding of the tasks they perform and the purpose of each training session), it was observed that most swimmers have an understanding of what they are doing and the types of tasks they are performing.

In the category of "Training Structure," swimmers have an understanding of the specific training for the event, understanding whether their training is focused on speed (50/100), 200m, mid-distance, or long-distance. According to the swimmers' responses, individuals were oriented towards short-distance and speed training. They knew the type of training they were undergoing and whether it aligned with the 200m Backstroke event. Regarding race strategy, swimmers successfully defined how to approach the 200m Backstroke event. Swimmers prepared their race strategy based on the training they had completed throughout the season.

## DISCUSSION

In this study, the 200m Backstroke event was analyzed by comparing each 50m split of the event and its relationship with the best time in the 50m Backstroke event for swimmers in the finals of the Olympic Games, World Championships, European Championships, and the top 8 times from the National Youth and Absolute/Open Championships of Portugal. It was observed (Table 2) that there were no differences between the various groups (NC, OG, WC and EC) in the progression of the 200m Backstroke event.

The data also reveals that there are no differences among the various groups (NC, OG, WC and EC) in terms of race strategies and race progress. However, in the 200m Backstroke race, the time variation in the first 50m split is higher in the NC group, although there are no significant differences among the groups. The NC group has a much lower average age (19.75 years) compared to the other groups ((NC, OG, WC and EC), which are close to an average of 25 years, indicating that individuals' experience and maturation may have an influence on sports performance and the final race outcome (Table 2). Metabolic demands throughout the 200m Backstroke race are primarily anaerobic, and this contribution increases over time, along with the accumulation of the lactate effect and fatigue, leading to a decrease in performance over the course of the race.

In the variables of speed in different 50m splits over the course of the race, the final performance results in the 200m Backstroke race show significant differences among the groups of swimmers from OG, WC and EC compared to the NC group (Table 2). The average swimming speed within a race is significant and occurs continuously throughout the race, irrespective of the stroke, gender, and distance. The change in swimming speed occurs differently between specific segments of the race, regardless of the stroke, gender, and distance (Torsten, 2016).

The metabolic demands throughout the race change as the race unfolds. The shorter the race, the greater the dependence on the anaerobic system, while the longer the race, the greater the dependence on the aerobic system. The 100m races depend more on the anaerobic systems that create energy quickly, whereas the 200m races depend more on phosphorilative oxidation. As muscle acidosis increases due to the cumulative effect of lactate, sports performance will decrease over time. A reduction in the lactate threshold, in which the exercise and intensity at which blood

lactate concentration significantly increases above the baseline, also contributes to reduced endurance performance with aging, although this may be secondary to decreases in VO2max (Moser, 2020).

Swimmer performance improves with both aerobic and endurance strength training. Both methods can be combined in training methodology to improve sports performance (Yufeng, 2023). It can be asserted that the race will naturally be faster in the first part of the race and slower in the subsequent splits. There is a greater aerobic contribution in the second part of the race, while the first part of the race relies mainly on the anaerobic system. An analysis of a competitive 100m Freestyle race in elite male swimmers showed that the relative lactate contribution decreased. The aerobic contribution increased up to a distance of 100m. The anaerobic contribution remained stable with a higher VO2 (maximal oxygen consumption (VO2max)) as well as concentrations of blood lactate (Moser, 2020).

Sports performance produces a large amount of information based on perceived self-efficacy and satisfaction of the experience, depending on the success or failure of the performance (Leite et al., 2022). The correlations reveal significant positive relationships, underlining the importance that dictates the unfolding of the race. The analysis of the performance of the 200m Backstroke swimming race can be observed in the split times. Split times are measured based on the pool length and represent an average speed over the distance covered (Torsten, 2016). A swimmer's performance cannot be explained by a single factor. Elite swimmers optimize the efficiency of their stroke to maximize swimming speed, emphasizing the importance of individual strategies in the course of the sporting event (Gonjo, Olstad & Race, 2021). As Fernandes et al. (2022) mention, the best swimmers demonstrate strategies to control their variations and maintain high performance. These strategies are possibly related to stroke technique efficiency, resulting in smoother backstroke, which leads to less drag force at higher speeds.

Greater swimming performance can be achieved if training is based on the monitoring of motor, mental, and biophysical indicators, training planning (effort volume and effort zones), individual perception of effort assessment, and control (Mihailescu et al., 2021). There is the need to have a holistic perspective on athlete performance development. Understanding the moments of athlete development will be beneficial in applying or not applying certain training methodologies for performance efficiency (Santos, 2018).

A strong aerobic base in younger age groups will be beneficial and will lead to improvements for swimmers in the future, enhancing training and competition recovery and being a vital training component (Nugent, Comyns & Warrington, 2017). Bob Bowman suggests that a 200m Freestyle swimmer should train for the 400m Freestyle to be prepared for the 200m race and be strong in the second 100m split. As we mentioned, swimmers have the perception that the 200m race is extremely challenging due to the race's contingencies. We also noted that swimmers with a perception of training for middle-distance and long-distance races felt more prepared for such races, aligning with swimmers' perception that training corresponds to the training they receive (De Andrade Nogueira et al., 2023).

The psychological profile of swimmers reflects their biological adaptation to training and competitive effort, aiding in improving their competitive performance. Performance in swimming can be increased by young swimmers' adaptation to the physical and mental stressors in training and competitions (Mihailescu et al., 2021). Individuals in certain sports have greater resilience and possess specific psychological characteristics that allow them to adapt to the demands of specific sports (Reigal et al., 2018). In the case of the 200m Backstroke and middle-distance or long-distance events, we can point out that these swimmers are resilient and emotionally trained, defining a certain athlete profile with significant resilience (Santos, 2018).

## LIMITATIONS

Our study has several limitations. In addition to the perception of training by swimmers in the NC final, there should be a comparison with the training sessions of their coaches, as well as the perception of training by groups of swimmers in the finals of the other championships under study. This study strengthens the evidence that swimmers are aware of the work they do and what they are oriented for.

## CONCLUSION

The 200m race is undoubtedly a complex race that requires a specific race and training strategy. The aim of the study was to analyze the differences and relationships between the splits in the performance of the 200m Backstroke race for national and international swimmers. We found statistically significant differences in comparing the splits of the 200m Backstroke race with the final race time among swimmers from NC, OG, WC and EC. From the conclusions drawn from this study, it can be asserted that

the 200m Backstroke race is a difficult race in which it is necessary to find a balance between speed and endurance. It was also noted that older swimmers have better performance, indicating that the biological maturation of swimmers and their experience will be an asset for improving sports performance. Training focused on middle distances such as the 400m could also be an asset for improving the final performance of the 200m race.

The study aimed to understand swimmers' perception of training in their sports performance. Swimmers in general have a perception of their training and understand that their training is not always suitable for the races they will participate in. The efficiency of middle-distance races results from a combination of factors from short and long-distance races, as well as the complexity of other physiological, psychological, and technical factors. It was concluded that more studies are needed to better clarify the similarities and differences in achieving better performance.

## DECLARATION OF INTEREST

The authors declare no conflict of interest.


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## BIBLIOGRAPHY


Adrzyk, L., Staszkiewicz, R., & Strzala, M. (2022). Evaluating the Usefulness of the Modified Swimming Anaerobic Sprint Test (SAST) Based on the Relationship with the 100- and 200-m Freestyle. *Applied Sciences, 12,* 7566. https://doi.org/10.3390/app12157566

Almeida, T., Pessoa Filho, D., Simonato, A., Silva, J., Pestana, D., Espada, M., Reis, J. & Alves, F. (2016). Oxigen uptake response at supramaximal swimming intensities – Study of 50, 100 and 200 meters time trials. Edited by Baca, A., Wessner, B., Diketmuller, R., Tschan, H., Hofmann, M., Kornfeind, P. & Tsolakidis, E. *Book of abstracts 21th Annual congress of the European Coleege of sport Science (Crossing Borders through sport science. Vienna, Austria.*

Brand, M. (2003), Approximate yield of ATP from glucose, designed by donald nicholson: Commentary. Biochem. Mol. Biol. Educ., 31: 2-
4. https://doi.org/10.1002/bmb.2003.494031010178

Costa, M., Santos, C., Marinho, D., Silva, A. & Barbosa, T. (2020). Modelling the 200 m Front-Crawl Performance Predictors at the Winter Season Peak. *International Journal of Environmental Research and Public Health, 17,* 2126. doi:10.3390/ijerph17062126

De Andrade Nogueira, F., Nogueira, R., Miloski, B., Cordeiro, A, Werneck, F., & Bara Filho, M. (2015). Comparison of the training load intensity planned by the coach with the training perceptions of the swimming athletes. *Gazzetta Medica Italiana – Archivio per le Scienze Mediche, 174*(1), 174:1-2.

Duffield R, Dawson B, Goodman C. Energy system contribution to 400-metre and 800-metre track running. J Sports Sci. 2005 Mar;23(3):299-307. doi: 10.1080/02640410410001730043. PMID: 15966348.

Ehmkea, A., Binhardia. P., Zecchinb, A., Aquinoc, R., Pugginaa, E. (2023). The effects of high-intensity functional training on muscle damage and recovery capacity in trained individuals. *Revista Andaluza Medicina del Deporte, 16*(1-2): 1-7. https://doi.org/10.33155/j.ramd.XXXX.XX.XXX

Fernandes, A.; Goethel, M.; Marinho, D.A.; Mezêncio, B.; Vilas-Boas, J.P.; Fernandes, R.J. (2022). Velocity Variability and Performance in Backstroke in Elite and Good-Level Swimmers. *International Journal of Environmental Research and Public Health, 19*, 6744. https://doi.org/10.3390/ ijerph19116744

Gonjo, T.; Olstad, B.H. Race (2021). Race Analysis in competitive swimming: A narrative review. *International Journal of Environmental Research and Public Health, 18, 69.* DOI: 10.3390/ijerph18010069

Kachaunov, M. (2018). Post-competition blood lactate concentration in swimmers. *Journal of Applied Sports Sciences, 1*, 30-36.

Leite, L., Soares, L., Pussieldi, A., Claudino, J., Da Silva, S., & Pussieldi, G. (2022). Swimming Training Load Control: an integrated approach. *REBESDE, 3* (2), 1-15. DOI: 10.33872/rebesde.v3n2.e021

Machado, M., & Marques, A. (2013). *Fisiologia do exercício (Cadernos de referência do esporte; 2)*. Ed. Homrich, L. Brasília: Fundação Vale, UNESCO.

Mihailescu, L., Dubiţ, N., Mihailescu, L., & Potop, V. (2021). Particularities of the changes in young swimmers' body adaptation to the stimuli of physical and mental stress in sports training process. *PeerJ 9*:e11659. http://doi.org/10.7717/peerj.11659

Moser, C., Sousa, C., Olher, R., Theodoros, P., Nikolaidis, P., & Knechtle, B. (2020). Pacing in World-Class Age Group Swimmers in 100 and 200 m Freestyle, Backstroke, Breaststroke, and Butterfly. *International Journal Environmental Research Public Health, 17*, 3875. doi:10.3390/ijerph17113875

Navarro, F., & Arsenio, O. (2002). *Natación II – La natación y su entrenamiento. Técnica, planificación y análisis pedagógico.* Gymnos. Madrid, Espanha.

Nugent, F., Comyns, T., & Warrington, G. (2017). Quality Versus Quantity Debate in Swimming: Perceptions and Training Practices of Expert Swimming Coaches. *Journal of Human Kinetics, 57,* 147-158 DOI: 10.1515/hukin-2017-0056

Rabinowitz JD, Enerbäck S. Lactate: the ugly duckling of energy metabolism. Nat Metab. 2020 Jul;2(7):566-571. doi: 10.1038/s42255-020-0243-4. Epub 2020 Jul 20. PMID: 32694798; PMCID: PMC7983055.

Reigal DR, Delgado-Girart JE, Raimundi MJ, Hernández-Mendo A. (2018). Perfil psicológico en una muestra de triatletas amateurs y diferencias con otros deportes. *Cuadernos de Psicología de Deporte, 18*(1), 55-62

Saavedra, J., Þorgeirsson, S., Kristjansdottir, H., Halldorsson, K., Margret L. Guðmundsdottir, M., & Einarsson, I. (2018). Comparison of Training Volumes in Different Elite Sportspersons According to Sex, Age, and Sport Practised. *Montenegrin Journal of Sports Science and Medicine, 7* (2), 37-42. DOI 10.26773/mjssm.180906

Santos, S. (2018). Estudo exploratório do perfil psicológico de participação desportiva em atletas de longa distância. *Motricidade, 14*(2-3), 145-146.

Santos, S. (2018). The sports evolution of the swimmer in the perspective of the coach. *Global Scientific Journals, 6*(8), 484-490.

Stachowicz, M., & Milde, K. (2023). Changes in thrust force in swimmers in the annual training cycle. *Biomedical Human Kinetics, 15*, 159–171. DOI: 10.2478/bhk-2023-0019

Torsten, B. (2016). Difference in speed at fixed reference points and changes in speed between fixed reference points during 100 meter swimming races at the European Championships, 2010. *Jornal Swimming Research, 24(1), 22-31*.

Troup, J., (1991). Studies by the international center for aquatic research 1990-1991, USA. Press Colorado Springs, USA-Swimming.

Vasconcelos Raposo, A. (2000). *A carga no treino desportivo.* Editorial Caminho. Lisboa, Portugal.

Xinhua, L. & Wang, H. (2023). Improvement of swimmer´s physical coordination based on anaerobic endurance trainning. *Revista Brasileira de Medicina do Esporte, 29,* 1-4. DOI: http://dx.doi.org/10.1590/1517-8692202329012022_0311

Yufeng Z, (2023). Impacts of resistance exercise on performance in swimmers. *Revista Brasileira Medicina Esporte, 29,* 1-4. DOI: http://dx.doi.org/10.1590/1517-8692202329012023_0083

## TABLES

| | NC final | OG final | WC final | EC final |
|---|---|---|---|---|
| Age | 19.75 | 25.50 | 24.00 | 23.12 |
| Total time (in seconds) | 127.07 | 115.81 | 116.30 | 116.81 |

Table 1 - Descriptive data for the study groups in the 200m Backstroke event

| | NC | | OG | | WC | | EC | | p≤0,05 |
|---|---|---|---|---|---|---|---|---|---|
| | | SD | | SD | | SD | | SD | |
| Age | 19.75 | *.1.09 | 25.50 | *1.34 | 24.00 | *.77 | 23.12 | *.97 | |
| Time (200m) | 127.07 | *2.81 | 115.81 | *1.84 | 116.30 | *1.38 | 116.81 | *.85 | .000 |
| 1st lap | 29.66 | *.35 | 27.34 | *.12 | 27.21 | *.12 | 27.33 | *.16 | .000 |
| 2nd lap | 32.21 | *.23 | 29.07 | *.18 | 29.41 | *.19 | 29.45 | *.07 | .000 |
| 3rd lap | 32.62 | *.21 | 29.49 | *.21 | 30.00 | *.19 | 30.00 | *.16 | .000 |
| 4th lap | 32.56 | *.32 | 29.90 | *.10 | 29.67 | *.25 | 30.01 | *.22 | .000 |
| | | | | | | | | | |
| Total time (%) | | | | | | | | | |
| 1st lap | 23.33 | *.16 | 23.60 | *. 09 | 23.40 | *.07 | 23.39 | *.12 | .558 |
| 2nd lap | 25.35 | *.10 | 25.10 | *.08 | 25.28 | *.08 | 25.21 | *.06 | .430 |
| 3rd lap | 25.72 | *.10 | 25.46 | *.07 | 25.79 | *.07 | 25.69 | *.13 | .135 |
| 4th lap | 25.62 | *.11 | 25.82 | *.12 | 25.52 | *.09 | 25.69 | *.16 | .422 |
| | | | | | | | | | |
| Best time in the 50 m Backstroke | 27.71 | *.45 | 25.18 | *.21 | 25.00 | *.29 | 25.36 | *.19 | .000 |
| Best time in the 50m Backstroke/ First lap (%) | 93.43 | *.72 | 92.13 | *.70 | 92.23 | *.85 | 92.65 | *.35 | .558 |

Table 2 – Analysis of the split averages during the 200m Backstroke event between the different study groups.

| | 1st split | 2nd split | 3rd split | 4th split |
|---|---|---|---|---|
| Final Time | .892<br>.000 | .954<br>.000 | .936<br>.000 | .917<br>.000 |
| 1º split | | .892<br>.000 | .741<br>.000 | .753<br>.000 |
| 2º split | | | .896<br>.000 | .804<br>.000 |
| 3º split | | | | .808<br>.000 |

Table 3 - Correlations of race splits and the final race time in the 200m Backstroke event among swimmers in the finals of NC, OG, WC, and EC.

## FIGURES

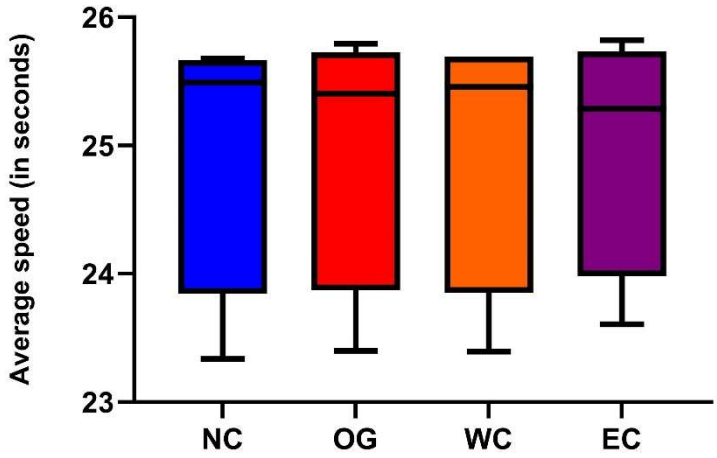


Figure 1 – Box plot analysis of the lap splits in the 200m Backstroke race across different groups