ANALYSIS OF THE FREQUENCY AND BACKSTROKE LENGTH IN 50, 100 AND 200M TESTS IN SWIMMING

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ABSTRACT
Introduction: This study aimed to analyze and compare the stroke efficiency indicators: average velocity (Av), stroke rate (SR) and stroke length (SL) on 50m, 100m and 200m backstroke events. Materials and Methods: Fourteen swimmers (seven men and seven women) were intentionally selected, mean age 20±4 years old among the 16 finalists of the 50m, 100m and 200m backstroke in XXXVI Brazilian Absolute Swimming Championship - José Finkel Trophy 2007, held in the Greater Florianópolis, SC, Brazil. The variables were described by average, standard deviation and coefficient of variation, as all different distances were compared through ANOVA one-way (Tukey Post-Hoc) and correlated through Pearson correlation test (p<0.05). Results: The results are in accordance to the literature: the smaller distances have a higher SR and a lesser SL with a higher Av. The values are reversed for larger distances, where it has a lesser SR and a higher SL, but Av decreases. Discussion: For coaches and swimmers, it is suggested to develop the technical aspects for a better combination of SR and SL, aiming at an ideal balance to maintain higher speed independently on the distance.

KEYWORDS
Swimming; Athletic Performance; Biomechanics.

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ANÁLISE DA FREQUÊNCIA E DO COMPRIMENTO DE BRAÇADA EM PROVAS DE 50, 100 E 200M COSTAS NA NATAÇÃO

RESUMO

Introdução: Este estudo objetivou analisar e comparar os indicadores de eficiência de nado: velocidade média (Vm), frequência de braçada (FB) e o comprimento de braçada (CB) nas provas de 50, 100 e 200m nado costas.

Materiais e Métodos: Foram selecionados intencionalmente 14 nadadores (sete homens e sete mulheres), com média de idade de 20±4 anos dentre os 16 finalistas das provas no XXXVI Campeonato Brasileiro Absoluto de Natação (Troféu José Finkel). Para determinação das variáveis, as provas foram filmadas (30Hz) e as imagens, posteriormente analisadas. Descreveram-se as variáveis por média, desvio padrão e coeficiente de variação, comparadas nas diferentes distâncias por ANOVA one-way (pós-test de Tukey) e correlacionadas através do teste de correlação de Pearson, adotando-se um nível de significância de 5% (p<0,05).

Resultados: Os resultados obtidos vão ao encontro dos achados na literatura: menores distâncias apresentam maior FB e menor CB, com uma maior Vm. O comportamento se inverte em maiores distâncias de prova, com menor FB, maior CB e menor Vm.

Discussão: Para treinadores e nadadores, sugere-se que sejam desenvolvidos os aspectos técnicos para uma melhor combinação entre a FB e o CB, objetivando um equilíbrio ideal, a fim de manter maior velocidade independentemente da distância.

PALAVRAS-CHAVE
Natação; Desempenho Atlético; Biomecânica.

ANÁLISIS DE LA FRECUENCIA Y LARGURA DEL BRAZADA EN LAS PRUEBAS DE 50, 100 Y 200M ESPALDA EN LA NATAción

RESUMEN

Introducción: Este estudio tuvo como objetivo analizar y comparar los indicadores de eficiencia de la natación: la velocidad media (Vm), frecuencia (FB) y largura del brazada (CB) en las pruebas de 50, 100 y 200m espalda.

Materiales y Métodos: Fueron escogidos, de forma intencionada, 14 nadadores (siete hombres y siete mujeres), con una media de edad de 20±4 años entre los 16 finalistas de las pruebas en el XXXVI Campeonato Brasileño Absoluto de Natación (Trofeo José Finkel 2007). Para determinar las variables, las pruebas fueron filmadas (30Hz) y, posteriormente, las imágenes fueron analizadas. Las variables fueron descriptas por la media, desvió estándar, coeficiente de variación, comparadas en las diferentes distancias por ANOVA one-way (pós-test de Tukey) y correlacionadas a través de los testes de correlación de Pearson, en la cuales el nivel de significancia fijado fue de 5% (p<0,05).

Resultados: Los resultados obtenidos en este estudio son iguales a los hallados en la literatura: menores distancias presentan mayor FB e menor CB, así como una Vm mayor. Los valores se van invirtiendo para distancias mayores con una FB menor y mayor CB, pero la Vm disminuye.

Discusión: Para los entrenadores y nadadores, se sugiere que desarrollen los aspectos técnicos para mejor combinación entre la frecuencia y largura de brazada, con el objetivo de un equilibrio óptimo, a fin de que se mantenga la mayor velocidad independiente de la distancia nadada.

PALABRAS CLAVE
Natación; Rendimiento Atlético; Biomecánica.

INTRODUCTION

Technique is understood as the set of procedures and knowledge capable of propitiating the execution of a specific activity, of variable complexity, with the least wastage and the maximum success; and technique preparation as the set of activities and teaching that the athlete absorbs, aiming at the execution of a sportive movement with the maximum of efficacy and the least effort.

In swimming, the aim of a swimmer is to go through the complete distance of a test (according to its regulation) in the smallest possible time. Aiming at the best performance, several studies about swimmer’s techniques components have been carried out. Some of the technique elements verified and studied by trainers and researchers are the efficacy indicators of swimming, described by Hay as the backstroke frequency (BF, defined by the number of backstroke per minute) and the backstroke length (BL, defined by the distance traversed by the swimmer in a backstroke cycle). These indicators have been studied since the 1970’s. It is important to determine the BF and BL and an ideal combination of these elements, letting the tests rhythmical and efficient, by means of the control and maintenance learning of this combination during all test’s distance. Depending on how are the coordinates, Alberty et al. presume that the BF and BL interfere in the swimming velocity (mean
velocity, mV), creating propulsive and resistible impulses in backstrokes.

In order to find the perfect combination between BF and BL, analyses are done through swimming competitions shooting, like the Olympic Games and the Worldwide Championship, providing details about the performance. Despite the great number of studies that consider these indicators, most of them are focused on analyses of the crawl style, but few were carried out concerning the other styles, an area that is still needs further studies for affirmations and comparisons.

In this context, this study aimed at analyzing and comparing BF, BL and the mV of swimmers in 50, 100 and 200m backstroke tests.

MATERIALS AND METHODS

This study was approved by the Ethics and Research Committee with Human Beings of Universidade do Estado de Santa Catarina (Udesc), protocol n. 48/2008. All subjects agreed to take part in the research by means of assigning the Informed Consent Form, as established by Resolution 96/96 from the National Health Counsel (NHS), which treats of the ethical requests for the realization of human beings researches.

Fourteen swimmers participated (seven men and seven women) from this descriptive and correlation study, with a mean age of 20±4 years old, intentionally selected among the finalists of 50, 100 and 200m tests from backstroke style of the XXXVI Campeonato Brasileiro Absoluto de Natação (Troleu José Finkel 2007), carried out in the Great Florianópolis, state of Santa Catarina.

As inclusion criteria, the following were adopted: male and female swimmers who participated in the 50, 100 and 200m tests of backstroke style and that were classified for the final “A” (8 greatest times) or “B” (9th to 16th better times) of all the three tests of this style. The swimmers that could not be classified for the final “A” or “B” for all the mentioned tests were excluded.

The following variables were defined and verified:

1. mean Velocity of swimming (mV), expressed in meters per second (m.s⁻¹): obtained by dividing the distance by the obtained time in seconds by the charts counting, since the swimmer’s head passed through the initial 15m up to the instant that the swimmer’s head surpassed the final 15m demarcation, totaling 20m swimming;

2. BF, in backstroke cycles per minute (cycles.min⁻¹): each cycle represented by two complete backstrokes was obtained considering the interval since the first complete backstroke accomplished after the initial 15m demarcation, up to the last complete backstroke before the final 15m demarcation;

3. BL, expressed in meters per cycle (m.cycle⁻¹): distance ran during one backstroke cycle, obtained by dividing mV by BF.

The variables were verified from acquired video images; a video camera, MiniDV type, with a 30Hz acquisition frequency, positioned 25m from the departure edge (middle of the pool), in a 15m-height and perpendicular to the event, was used. The images of the A and B finals from the 50, 100 and 200m male and female backstroke were recorded, completing 12 tests. Each test was filed separately and the images, analyzed using the images edition software Intervideo WinProducer 3.0.

The backstrokes counting was carried out by the researchers, one athlete each 50m, resulting in a partial in the 50m test, two partials in the 100m tests and four partials for the 200m and, then, the mean for each test distance was determined. The measurement in the central 20m of the pool happens in order to avoid events related to the departure of the turns, since in these moments the athletes can remain during most of time totally submergence.

For organization and data analysis, the descriptive statistics, with mean, standard deviation and variation coefficient, was used. It was opted to present data divided by genre, due to considerable differences presented between men and women. After being verified the normality of data by the Shapiro-Wilk’s test (p=0.128 for mV; p=0.859 for BL; and p=0.291 for BF), two forms of analysis were opted: a) comparison between the variables mV, BL and BF, in the different distances, by the ANOVA one-way test and complemented by the Tukey’s post-test; b) correlation between BF, BL and mV in the different distances, carried out through the Person’s correlation test. A 5% significance level was adopted (p<0.05).

RESULTS

In Table 1, the results concerning BF, BL and mV in 50, 100 and 200m tests, from male and female were presented.

According to Pestana and Gageiro, the results from this study have a low variation coefficient (lower than 15%), which allows a comparison between the means found.

In Table 2, the results concerning the correlation value between BF, BL and mV in the 50, 100 and 200m backstroke distances, for the male, female and general groups, are presented.

The correlations between BL and the BF for the 50, 100 and 200m distances were inversely proportionally and presented significant values for all the classes.
Table 1 - Results from BF, BL and mV in 50, 100 and 200m backstroke tests

<table>
<thead>
<tr>
<th></th>
<th>50m</th>
<th>100m</th>
<th>200m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BF</td>
<td>52.1±2.7</td>
<td>45.0±1.9</td>
<td>37.8±3.2</td>
</tr>
<tr>
<td>[cycle.min⁻¹]</td>
<td>-0.052*</td>
<td>-0.042*</td>
<td>-0.055*</td>
</tr>
<tr>
<td>BL</td>
<td>2.04±0.10</td>
<td>2.22±0.10</td>
<td>1.95±0.11</td>
</tr>
<tr>
<td>[m.ciclo⁻¹]</td>
<td>-4.90*</td>
<td>-4.50*</td>
<td>-5.90*</td>
</tr>
<tr>
<td>mV</td>
<td>1.77±0.03</td>
<td>1.66±0.03</td>
<td>1.43±0.02</td>
</tr>
<tr>
<td>[m.s⁻¹]</td>
<td>-1.80*</td>
<td>-1.80*</td>
<td>-1.60*</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BF</td>
<td>45.0±2.4</td>
<td>44.0±2.4</td>
<td>38.3±1.1</td>
</tr>
<tr>
<td>[cycle.min⁻¹]</td>
<td>-0.077*</td>
<td>-0.055*</td>
<td>-0.084*</td>
</tr>
<tr>
<td>BL</td>
<td>1.79±0.14</td>
<td>1.95±0.11</td>
<td>2.41±0.15</td>
</tr>
<tr>
<td>[m.ciclo⁻¹]</td>
<td>-8.20*</td>
<td>-5.90*</td>
<td>-6.20*</td>
</tr>
<tr>
<td>mV</td>
<td>1.53±0.02</td>
<td>1.43±0.02</td>
<td>1.51±0.04</td>
</tr>
<tr>
<td>[m.s⁻¹]</td>
<td>-1.90*</td>
<td>-1.80*</td>
<td>-2.90*</td>
</tr>
</tbody>
</table>

Mean±standard deviation (*variation coefficient).
*p=0.00, ANOVA one-way, between: 50x100m p=0.00; 50x200m p=0.00; 100x200m p=0.00 (Tukey’s post-test); **p=0.00, ANOVA one-way, between: 50x100m p=0.07; 50x200m p=0.00; 100x200m p=0.01 (Tukey’s post-test).

Table 2 - Correlation between the variables in different distances test

<table>
<thead>
<tr>
<th></th>
<th>BLxBF</th>
<th>BLxmV</th>
<th>BFxmV</th>
</tr>
</thead>
<tbody>
<tr>
<td>50m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>-0.96*</td>
<td>0.28</td>
<td>-0.03</td>
</tr>
<tr>
<td>Male</td>
<td>-0.93*</td>
<td>-0.04</td>
<td>0.39</td>
</tr>
<tr>
<td>100m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>-0.97*</td>
<td>-0.37</td>
<td>0.53</td>
</tr>
<tr>
<td>Male</td>
<td>-0.9*</td>
<td>0.4</td>
<td>0.02</td>
</tr>
<tr>
<td>200m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>-0.85**</td>
<td>0.22</td>
<td>0.28</td>
</tr>
<tr>
<td>Male</td>
<td>-0.96*</td>
<td>-0.69</td>
<td>0.85**</td>
</tr>
</tbody>
</table>

*Significant correlation to 0.01 value; **significant correlation to 0.05 value.

For the mV and BL, no significant correlations were obtained in all the distances. A significant correlation between the BF and the mV was also found between men in 200m distance.

**DISCUSSION**

The values found in this study for BF and BL are similar to the findings of Arrelano et al., who analyzed the backstroke’s characteristics in the 100m back test during a juniors competition. Authors observed the mean values of BF of 46.0 cycles.min⁻¹ in male and 44.9 cycles.min⁻¹ in female; and for BL, 2.10m for men and 1.91m for women.

It can be seen that BF was lower in the largest distances, for both sexes, agreeing with the reports from Pai, Hay and Wilson, who analyzed 15 athletes from both sexes in 100 and 200m tests freestyle, backstroke, breaststroke and butterfly stroke. These results were also found for Craig and Pendergast for the 100 and 200m backstroke tests, as well as in different studies of distances in crawl swimming.

As for BL, the highest values were observed for the longest tests both for men, and women. Pai, Hay and Wilson when analyzing backstroke swimming tests found similar results for women, but not in the same tendency for men. Different results were found in Craig and Pendergast study, when analyzing 100 and 200m backstroke tests, observing a higher value of BL for both sexes in bigger swim distances.

In another point of view, Camargo, who compared the mean BF of the free 50m test with mean BF of the free 10m test first partial from 1996 Atlanta Olympic Games finalists, observed a mean decrease of 6.7 cycles.min⁻¹ for the free 100m partial related to the free 50m test. In this study, when carrying out this analysis option, a mean decrease of 6.2 cycles.min⁻¹ was observed, when compared to the backstroke 50m test with the first partial backstroke 100m. It is a similar result to the one found for the backstroke 100m test and the first 100m partial test of 200m backstroke, with a mean decrease of 6.0 cycles.min⁻¹.

By observing the mV, it was verified that, for all the tests, higher mV values corresponded to higher BF values and lower BL values. These results encounter the findings of Craig and Pendergast, who analyzed the four types in small meters and described that the increase of swim speed resulted in the combination of BF increase and BL decrease. Gatti et al. obtained similar results when analyzing BF and BL for the 200m freestyle distance in different swimming intensities, in which the BF had an increase of 52.63% and BL, a decrease of 19.48% between the intensities of 80 and 100% with a mV increase.

Maglischo incites the use of BF as an easier learning instrument of test rhythm implementation searching an ideal BL, in order to maintain a higher mV during the swim distance.

For the female group, the correlations between BF and BL are close to the values found by Perez, (-0.85) for the 100 and 200m backstroke distances, differently from the male group (-0.45) for the same distances.

Caputo et al., when correlating BF and mV between 16 male subjects for the free 50, 100 and 200m distances, found r-values: -0.05; -0.01; 0.28, respectively. Different results found in this study were found: r=-0.39; 0.024; 0.85 for the male group in the 50, 100 and 200m backstroke distances, respectively.
The results discovered in this study encounter with the literature findings: in the lower swimming distances, we have a higher frequency and a lower BL, as well as a higher mean speed of swim. Values invert for higher distances, in which the BF decreases and the BL increases, however the swim speed decreases. For athletes and trainers, it is suggested to develop technical aspects combining increase frequency to a great BL, in order to maintain swim speed independently from swim distance.

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