87 - INFLUENCE OF CRAWL STROKE FREQUENCY AND AMPLITUDE ON 50-M SWIMMING PERFORMANCE.

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Introduction

Competitive swimming has evolved in the last three decades with consistent and significant improvement of results. The advanced training processes, sophisticated selection methods, and mechanical improvement of swimming are among the reasons of such improvement (ARELLANO et al., 1994).

Swimming speed (S) is determined by the stroke amplitude (SA) and frequency (SF) (COLWIN, 1992; CRAIG et al., 1985; PELAYO et al., 1996; SYDNEY et al., 1998). The relations between SA, SF, and S have been studied by several researchers (CHOLLET et al., 1997; CRAIG and PENDERGAST, 1979; CRAIG et al., 1985; EAST, 1970; KESKINEN and PAAVO, 1993; PELAYO et al., 1996; PELAYO et al., 1997; SYDNEY et al., 1998). The average speed (AS) and SF are significantly higher in short distance competitions and there are no significant differences in SA values (SYDNEY et al. 1998).

The relations between these parameters can vary during competition (KESKINEN and PAAVO, 1993; CHOLLET et al., 1997; SYDNEY et al., 1998). KESKINEN and PAAVO (1993) found that SF and S generally decrease during competition, but that the SA ratio does not.

Similar performances are characterized by high SF and SA variability (ARELLANO et al., 1994; PELAYO et al., 1996, CHOLLET, et al., 1997). However, in several cases, this variability is due mainly to SA rather than to SF (COLWIN, 1992; ARELLANO et al., 1994; CHOLLET, et al 1997). SA is extremely important to determine the swimmer's speed (CRAIG et al., 1985; CHOLLET, et al., 1997). The improvement of S between 1976 and 1984 is attributed to the increase in SA and the decrease in SF of almost 82% in swimming events (CRAIG et al., 1985).

Currently, high-level swimmers tend to use long and fast strokes (COLWIN, 1992). According to CHOLLET et al. (1997) and SYDNEY et al. (1998), these swimmers are characterized by their capacity to keep more constant and higher S, SA, and SF during competition events.

CRAIG and PENDERGAST (1979), CRAIG et al. (1985) and KESKINEN and PAAVO (1993) reported that excluding jump entry and flip-turning, swimming speed is affected by SF and the length swum at each stroke cycle. This combination is highly individual (KESKINEN & PAAVO, 1993; PELAYO et al., 1996; SYDNEY et al., 1998). However, CHATARD et al. (1990) reported that the variability in swimming performance is largely a result of SF, being this variable is a better indicator of swimming technique than SA is. For CRAIG and PENDERGAST (1979), the increase in S in all styles results from the combined increase in SF and decrease in SA.

Methodology

Sample

The subjects of this study were 11 male swimming athletes aged 15.09 ± 0.71 on average in the national young category. All volunteers signed an informed and free consent statement.

Procedures

The volunteers swam 50 m in Crawl style at three different moments. All three performances were carried out in Olympic swimming pool with in-water start and at the highest speed possible.

In one of the performances, the athletes swam with competition-like stroke amplitude and frequency. The performance, FREQUENCY, was carried out with frequency strokes as high as possible. The AMPLITUDE performance was carried out with higher stroke amplitude with as few strokes as possible. It was respected the 10-min recovery interval between performances.

All performances were filmed with a video camera. Based on the images recorded, swimming time and number of strokes (two strokes per cycle) were measured, and later, it was calculated the average speed of each performance.

The distance swum per cycle or average stroke amplitude (SA) in $m.cycle^{-1}$ was calculated by dividing the distance swum (50 m) by the number of complete cycles. The stroke frequency (SF) expressed in $cycles.s^{-1}$ was calculated by dividing the number of stroke cycles by the time.

Statistical analysis

Data normality was verified with the Kolmogorov-Smirnov test. The averages were compared by ANOVA with Tukey post-hoc. Besides inferential statistics, the data were also submitted to descriptive statistical analysis. The significance level adopted was 5% (< 0.05).

Results

The anthropometric measures of the volunteers are presented in Table 1.

Table 1 - Anthropometric characteristics

Parameters	Mean
Age(years)	15.1 ± 0.7
Body Mass (kg)	66.95 ± 1.56
Percent Fat (%)	15.66 ± 2.47
Height (cm)	179.45 ± 1.06
Arm span (cm)	191.14 ± 2.12
Right foot length (cm)	27.64 ± 1.06
Left foot length (cm)	28.03 ± 0.85

The average swimming times for the NORMAL, FREQUENCY, and AMPLITUDE treatments, 29.48 0.77; 29.30 0.95, and 31.30 1.38 s, respectively, were significantly different (p < 0.05).The average number of strokes (NS) for the NORMAL, FREQUENCY, and AMPLITUDE performances, 42.55 6.17, 51.92 3.32, 36.09 2.84, respectively, were significantly different ($p < 0.05$).

The average speed for the NORMAL, FREQUENCY, and AMPLITUDE performances, 1.70 0.04, 1.71 0.05, and 1.60 0.07 $m.s^{-1}$, respectively, were significantly different ($p < 0.05$).

The average stroke amplitude for the NORMAL, FREQUENCY, and AMPLITUDE performances, 2.40 0.36, 2.11 0.22, and 2.79 0.23 m/cycle, respectively, were significantly different ($p < 0.05$).

The stroke frequency values for the NORMAL, FREQUENCY, and AMPLITUDE performances, 0.72 0.11, 0.82 0.07, and 0.58 0.05 $cycles.s^{-1}$, respectively, were significantly different ($p < 0.05$).

The swimming time (ST), the number of strokes (NS), the average speed (AS), and the stroke parameters (SF and SA) measured during the three performances are presented in table 2.

Table 2 - Characteristics of the three difference performances

Performance	ST (s)	NS	AS (m/s)	SA (m/cycle)	SF (cycle/s)
NORMAL	29.48 ± 0.77	42.55 ± 6.17	1.70 ± 0.04	2.40 ± 0.36	0.72 ± 0.11
FREQUENCY	29.30 ± 0.95	47.82 ± 4.79*	1.71 ± 0.05	2.11 ± 0.22*	0.82 ± 0.07*
AMPLITUDE	31.30 ± 1.38*	36.09 ± 2.84*	1.60 ± 0.07*	2.79 ± 0.23*	0.58 ± 0.05*

* Significant difference ($p < 0.05$)

Discussion

According to COLWIN (1992), CRAIG et al. (1985), PELAYO et al. (1996), and SYDNEY et al. (1998), swimming speed is determined by both stroke amplitude and frequency. The results obtained in this study corroborate this statement since changes in amplitude and frequency affected swimming speed significantly.

The correlation between these parameters may vary during competition events (KESKINEN & PAAVO, 1993; CHOLLET et al., 1997; SYDNEY et al., 1998). As we used average values obtained in different performances in this study, it was not possible to identify such variations.

SA is absolutely important to determine swimming speed (CRAIG et al., 1985; CHOLLET, et al., 1997). However, its increase led to a significant reduction in swimming speed.

Higher swimming speeds were observed with the increase in stroke frequency comparatively to the increase in amplitude. Furthermore, the increase in frequency did not change swimming speed significantly comparatively to that of the NORMAL performance (competition-like performance). These results suggest the greater importance of stroke frequency for performance in short duration competition events. Likewise, CHATARD et al. (1990) report that SF is a better indicator of swimming technique that SA is.

For CRAIG and PENDERGAST (1979), the increase in speed in all swimming styles results from the combined increase in SF and decrease in SA. In the present study, the best results were those of the FREQUENCY performance, which also presented the highest stroke frequency and the lowest stroke amplitude.

Conclusion

Based on the results obtained in this study, it is possible to conclude that the increase in stroke frequency leads to a decrease in stroke amplitude and significant increases in crawl swimming speed. These results suggest the greater importance of stroke frequency comparatively to that of stroke amplitude in crawl swimming.

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INFLUENCE OF CRAWL STROKE FREQUENCY AND AMPLITUDE ON 50-M SWIMMING PERFORMANCE.

The objective of this study was to analyze the influence of stroke frequency and amplitude on 50-m swimming performance. The subjects of this study were 11 male swimming athletes aged 15.09 ± 0.71 on average in the national young category. Swimming time and number of strokes were measured by filming and later the average speed (AS), the average stroke amplitude (SA) and the stroke frequency (SF) were calculated. Data of three performance modes were compared: NORMAL - the athletes swam with competition-like amplitude and frequency, FREQUENCY - increased stroke frequency, AMPLITUDE - swimming with the largest amplitude and the lowest stroke frequency possible. The average speeds found for the three modes were 1.70 ± 0.04 m/s, 1.71 ± 0.05 m/s, and 1.60 ± 0.07 m/s, respectively. These results indicate the importance of stroke frequency for Crawl swimming speed comparatively to that of stroke amplitude.

Key-words: swimming, crawl stroke, frequency, amplitude.

INFLUENCE DE LA FRÉQUENCE ET DE L'AMPLITUDE DE LA BRASSE DANS LA PERFORMANCE SUR 50 MÈTRES DE LA NAGE EN CRAWL

Le but de cette étude est d'analyser l'influence de la fréquence et de l'amplitude de la brasse dans la performance sur 50 mètres de la nage du crawl. A cette étude ont participé 11 individus du sexe masculin, à l'âge moyenne de 15,09±0,71 ans, des athlètes de la natation de niveau national dans la catégorie jeunes. Des filmages ont permis de mesurer le temps de nage, le nombre de brasses et, ultérieurement, ont été calculées la vitesse moyenne (Vm), l'amplitude moyenne de brasses (AB) et la fréquence de brasses (FB). Toutes les données ont été comparées au cours de trois exécutions : NORMALE, où les athlètes ont réalisé la nage en situation simulant la compétition, c'est-à-dire, avec les caractéristiques d'amplitude et de fréquence de brasse et un nombre minimum de brasses. FRÉQUENCE: réalisée avec la plus grande fréquence de brasses; AMPLITUDE: exécution réalisée avec la plus grande amplitude de brasses et le moins grand nombre de brasses possible. Les vitesses moyennes trouvées ont été les suivantes: 1,70 ± 0,04 m/s; 1,71 ± 0,05 m/s et 1,60 ± 0,07, respectivement. Ces résultats indiquent une importance plus grande de la fréquence en brasse pour la vitesse de nage en crawl, quand l'on compare avec l'amplitude de brasses.

Mots-clés: nage, crawl, fréquence, amplitude.

INFLUENCIA DE LA FRECUENCIA Y AMPLITUD DE BRAZADA EN LA ACTUACIÓN EN LOS 50 METROS NADO CRAWL.

Este estudio tuvo como objetivo el análisis de la influencia de la frecuencia y de la amplitud de la brazada en la actuación en los 50 metros nado crawl. Participaron en este estudio 11 personas del sexo masculino teniendo la edad mediana de 15,09 y aproximadamente 0,71 años,nadadores de nivel nacional de la clase juvenil.A través de rodajes fueron medidos el tiempo de nado,el número de brazadas y , despúes calculadas la velocidad média (VM) , la amplitud media de brazadas (AB) y la frecuencia de brazadas (FB). Todos los datos fueron comparados en 3 ejecuciones: NORMAL - donde los deportistas realizaron el nado con características de amplitud y frecuencia de brazada como en situación de competición; FRECUENCIA - fue hecha con la mayor frecuencia de brazadas; AMPLITUD - ejecución hecha con la mayor amplitud de brazadas y el menor número de brazadas posible.Las velocidades medias encontradas fueron de 1,70 y aproximadamente 0,04m/s; 1,71 y aproximadamente 0,05 m/s y 1,60 y aproximadamente 0,07 m/s respectivamente.Estos resultados senãlan una mayor importancia de la frecuencia de brazadas en la velocidad del nado crawl,cuando comparado con la amplitud de la brazada.

Palabras clave: nado crawl, brazada, frecuencia, amplitud.

INFLUÊNCIA DA FREQUÊNCIA E AMPLITUDE DE BRAÇADA NO DESEMPENHO NOS 50 METROS NADO CRAWL

O objetivo deste estudo foi analisar a influência da frequência e da amplitude da braçada no desempenho nos 50 metros nado crawl. Participaram deste estudo 11 indivíduos do gênero masculino, com idade média de 15,09 ± 0,71 anos, atletas de natação de nível nacional da categoria juvenil. Através de filmagem foram medidos o tempo de nado, o número de braçadas e, posteriormente, foram calculadas a velocidade média (Vm), a amplitude média de braçadas (AB) e a freqüência de braçadas (FB). Todos os dados foram comparados em três execuções: NORMAL - onde os atletas realizaram o nado com características de amplitude e freqüência de braçada como em situação de competição; FREQUÊNCIA - foi realizada com a maior freqüência de braçadas; AMPLITUDE - execução realizada com a maior amplitude de braçadas e o menor número de braçadas possível. As velocidades médias encontradas foram 1,70 ± 0,04 m/s; 1,71 ± 0,05 m/s e 1,60 ± 0,07 m/s respectivamente. Estes resultados apontam uma maior importância da freqüência de braça na velocidade do nado crawl, quando comparado com a amplitude de braçada.

Unitermos: nado crawl, braçada, frequência, amplitude.