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ESTIMATED HAND'S PALM AND FOOT AREAS ARE NOT CORRELATED TO PERFORMANCE IN FRONT CRAWL SWIMMING

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SUMMARY

The objective of this study was to check the correlations among the hand's palm area (HPA) and performance (PER), averages stroke length (SL), stroke rate (SR) and swimming velocity (SV) and among the foot area (FA) and PER, SV and average kick rate (KR) in 50 m front crawl. **Methods:** Eleven masters male swimmers (age: 25.8 ± 5.5 years, mass: 75.2 ± 5.5 kg, height: 177 ± 6.5 cm; HPA: $149 \text{ cm} \pm 10.9 \text{ cm}^2$ and FA: $388 \pm 28.6 \text{ cm}^2$) performed 50 m front crawl at maximum intensity. The HPA and FA were estimated using the DuBois and DuBois equation to calculate the total body area and, after, applied constants for HPA and FA. To obtain PER, SL, SR and SV three chronometers were used; for KR, underwater images from two camcorders operating at 60 Hz were analyzed. Pearson correlation test was applied among the variables. **Results:** No correlations between the areas and performance variables were found. **Discussion:** Parameters such as attack angles, length chord and vortices must contribute to propulsion performance. HPA and FA, alone, do not seem to contribute to understand performance in front crawl swimming. **Conclusion:** There was no significant correlation between HPA and FA with PER, SL, SR, SV and KR.

INTRODUCTION

When the front crawl stroke mechanics is analyzed, it is observed that upper and lower limbs are the primarily responsible for the body displacement of the swimmer. The produced propulsion is mainly explained by two forces: drag and lift, and by the vortices phenomenon¹. As hands and feet are the body segments which directly apply force against the water mass, the objective of this study was to check the correlations among the hand's palm area (HPA) and performance (PER), averages stroke length (SL), stroke rate (SR) and swimming velocity (SV) and among the foot area (FA) and PER, SV and average kick rate (KR) in 50 m front crawl.

METHODS

Eleven master swimmers, highly experienced in swimming training (age: 25.8 ± 5.5 years, mass: 75.2 ± 5.5 kg, height: 177 ± 6.5 cm; HPA: $149 \text{ cm} \pm 10.9 \text{ cm}^2$ and FA: $388 \pm 28.6 \text{ cm}^2$) performed 50 m all-out front crawl stroke in a 25 m

length swimming pool. Body mass and height were measured. Hand's palm area (HPA) and hand's palm area (HPA) were estimated with the proposed equation by DuBois and DuBois² (Equation 1), where body mass (x) and height (y) are used. Then, two constants (k) related, respectively, to the hand's palm area (0.78%)³ and foot area (2.03%)⁴, were applied.

Equation 1

$$\text{Hand's palm or foot area} = (0.007184 * x^{0.425} * y^{0.725}) * k$$

All the swimmers performed 800 m in front crawl as warm up, then the 50 m all-out and more 300 m in front crawl to warm down. Spatio-temporal parameters performance (PER, in sec), stroke length (SL, in m), stroke rate (SR in Hz), swimming velocity (SV, in $\text{m}\cdot\text{s}^{-1}$) and kick rate (KR, in Hz) were measured from the 50 m trial. Two markers were placed in the lateral of the pool: in the 10 and in the 20 m, which demarcated 10 m, from the 25 to the 50 m, where SL, SR, SV and KR were obtained. It was observed that SL, SR, SV, and KR data were obtained from the pure swimming (10 to 20 m), with no contribution from the push in the wall^{5,6}. PER was the time do cover the 50 m, performed with start from inside the pool and Olympic turning. The time to cover the 10 m in pure swimming, from 10 to 20 m markers, (swimmer's head as the reference) was used to measure the SV. When the swimmer was in this area, the time to perform three complete strokes was used to calculate SR. SL was calculated by the quotient between SV and SR.

KR was quantified by underwater video analysis. Images were obtained from two camcorders (one 30 cm under the water surface and other 10 cm above the water surface), both operating at 60 Hz and fixed in an arm which was displaced in a chariot over trails along the swimming pool. Both cameras allowed images from the swimmers sagittal plane. Frames were chosen when the swimmer was inside the 10 m and the amount of kick movements was quantified per stroke cycle. The software Virtual Dub 1.9.9 was used in video analysis.

Statistic analysis was performed by the application of Shapiro-Wilk Test, descriptive analysis and the Pearson Correlation Coefficient test. Alpha was determined as 0.05 and SPSS 17.0 was the software used for the calculations.

