大学競泳選手の近代四泳法の主観的努力度と泳速度の関係

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【目的】

競泳ではクロール(Fr)、背泳ぎ(Ba)、平泳ぎ(Br)、バタフライ(Bu)の四泳法ごとに推進力メカニズムが異なる。主観的努力度による泳速度の制御は競泳競技でのペーシング戦略や、日々のトレーニングでのワークアウト負荷設定に重要となる。そこで本研究では主観的努力度と泳速度の関係が四泳法で異なるという仮説を立て、これらの関係を四泳法で明らかにすることを目的とした。

【方法】

19 人の大学競泳選手が研究に参加し、ランダムに決定された6つの異なる主観的努力度（50~100%）で25mを泳いだ。この試技は四泳法全てで実施され、主観的努力度は最大努力を 100% とする百分率で表された。各泳法の最大努力(100%) に対する速度の相対値を統計分析に使用した。統計分析には EZR (Kanda, 2013) を用い、主観的努力度を説明変数、泳速度を従属変数とした単回帰分析を実施した。主観的努力度と泳法を要因とする二要因分散分析が実行され、さらに各主観的努力度においてボンフェローニの多重比較事後検定も実行された。すべての統計分析の有意水準はp <0.05に設定した。

【結果】

主観的努力度と泳速度の有意な回帰式は、四泳法すべてで得られた。これらの回帰式はクロールでは y = 0.5499x + 0.4612、背泳ぎでは y = 0.4934x + 0.5152、平泳ぎでは y = 0.3543x + 0.6411、バタフライでは y = 0.3959x + 0.6079 であった (p <0.001)。二要因分散分析の結果では、主観的努力度と泳法について、有意な主効果と相互作用が明らかになった(p<0.001)。相対速度の多重比較においては、主観的努力度50%においてFr 対 Br、Fr 対 Bu、Ba 対 Br 、主観的努力度の60% でFr 対 Br、Fr 対 Buで泳速度に有意差が認められた (p<0.05)。

【結論】

回帰分析の結果から、主観的努力と泳速度の関係はすべての泳法で異なり、クロールと背泳ぎ、平泳ぎとバタフライは類似するの関係性を示した。本研究の結果は仮説を支持している解釈でき、仮説が採択された。また前述の泳法の類似点は推進力を生成するための上肢の動きが左右対称かあるいは非対称かに関連していると考えられた。

Relationships between subjective effort and swimming velocity of four strokes in college competive swimmers

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[Purpose]

Every four strokes which are front crawl(Fr), backstroke(Ba) , breaststroke(Br), and butterfly(Bu) in competitive swimming has a different propulsion mechanism. Control of swimming velocity by subjective effort is important for pacing strategy in competitive races and workout load setting during daily training. We hypothesized that the relationships between subjective effort and swimming velocity in the four strokes are different. The purpose of this study was to clarify these relationships in the four strokes.

[Methods]

Nineteen college swimmers participated in this study. They swam 25m by the four strokes at six different subjective efforts which were randomly determined. The subjective effort was expressed as percentages for swimming velocity when the maximum effort was 100%. The relative swimming velocity to maximum effort (100%) for each stroke was calculated as a percentage and used for statistical analysis. EZR (Kanda, 2013) was used for the analysis, and simple regression analysis was performed with subjective effort as the independent variable and swimming velocity as the dependent variable. A two-factor analysis of variance was performed at the swimming velocities, and Bonferroni's multiple-comparison post hoc test was also performed after an analysis of variance variable at each subjective effort. The significance level of significance for all statistical analyses was set at $p<0.05$.

[Results]

Significant regression equations of subjective effort and swimming velocity were obtained for all four strokes. These regression equations were $y = 0.5499x + 0.4612$ in front crawl, $y = 0.4934x + 0.5152$ in backstroke , $y = 0.3543x + 0.6411$ in breaststroke, $y = 0.3959x + 0.6079$ in butterfly ($p<0.001$). A two-factor analysis of variance revealed significant main effects and interactions for both subjective effort and swimming stroke. There were significant differences in the swimming velocities of Fr vs Br, Fr vs Bu, Ba vs Br at 50% of the subjective effort, in Fr vs Br, Fr vs Bu at 60% of subjective effort($p<0.05$).

[Conclusion]

Regression analysis revealed that the relationships between subjective effort and swimming speed differed among all strokes, and that front crawl and backstroke, breaststroke and butterfly showed similar relationships. These similarities were thought to be related to the symmetrical or alternating left-right limb movements for generating thrust force.