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ORIGINAL ARTICLE

The influence of maximal strength performance of upper and lower extremities and trunk muscles on different sprint swim performances in adolescent swimmers



Influence de la force maximale des muscles des membres supérieurs et inférieurs et du tronc sur la performance en natation de sprint chez les nageurs adolescents

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Summary

Objectives. – Strength and speed are 2 major factors that determine a swimmer's sprint performance, especially swim sprint performance and swim starts. This study identified and examined variables that determine the influence of maximal strength performance on different swim performance styles and distances in trained adolescent swimmers.

Equipment and methods. – Twenty-one regional swimmers (12 males and 9 females, 17.5 ± 2 years; mass: 69.5 ± 11.4 kg; height: 177.3 ± 10.1 cm) volunteered to take part in the present study. One-repetition-maximum (1RM) in the back squat, dead lift, bent-over row and sit-up were used to determine maximum strength. Squat jump (SJ) and countermovement jump (CMJ) were evaluated to determine speed-strength performance. Swim performances of 15 to 100 meters in freestyle, breaststroke and backstroke were measured in a 25-m indoor

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MOTS CLÉS

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pool. Pearson correlation analysis was used to assess the relationships between strength and power variables and swim variables.

Results. – Strong negative correlations between leg strength (1RM squat), speed-strength (SJ and CMJ) and swim performance were found in this investigation, especially for short distances (up to 25 m, $r = -0.75$ to -0.94 , $P < 0.05$). Additionally, moderate to mostly strong correlations ($r = -0.37$ to -0.85 , $P < 0.05$) were found between the strength tests of the upper extremities, and non-uniform correlations were found for the trunk strength test ($r = -0.05$ to -0.68) and swim performance.

Conclusion. – The maximal strength parameters of the upper and lower extremities and maximal trunk strength are good predictors of performance in sprint swimming in trained adolescent swimmers in different disciplines.

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Résumé

Objectifs. – La force et la vitesse sont les deux facteurs principaux qui déterminent les performances d'un nageur en sprint, ainsi que les départs en natation. Cette étude a pour but d'identifier les variables qui déterminent l'influence des performances maximales dans différents styles de nage et distances de natation chez les nageurs adolescents entraînés.

Équipement et méthodes. – Vingt et un nageurs de niveau régional (12 masculins et 9 féminins, âgés de $17,5 \pm 2$ ans ; poids : $69,5 \pm 11,4$ kg ; taille : $177,3 \pm 10,1$ cm) se sont portés volontaires pour participer à la présente étude. La performance sur un test d'une répétition maximum (1RM) en squat, en tirage en position assise a été utilisée pour déterminer la force maximale. Un «squat jump» (SJ) et «countermovement jump» (CMJ) ont été utilisés pour évaluer les performances de type force-vitesse. Les performances de natation sur des distances de 15 m à 100 m en nage libre, brasse et dos ont été évaluées dans un bassin de 25 m. Une analyse de corrélation de type Pearson a été utilisée pour évaluer la relation entre les variables de force et de puissance et les variables de performance en natation.

Résultats. – Des corrélations négatives significatives ont été observées entre la force des membres inférieurs, la performance en SJ et CMJ et les performances en natation, notamment pour les courtes distances (jusqu'à 25 m, $r = -0,75$ à $-0,94$, $p < 0,05$). Des corrélations modérées à fortes ($r = -0,37$ à $-0,85$, $p < 0,05$) ont également été constatées entre les valeurs de force des membres supérieurs et les performances en natation alors que ces corrélations sont non significatives ou faiblement significatives pour la force des muscles du tronc ($r = -0,05$ à $-0,68$).

Conclusion. – Les paramètres de force maximale des membres supérieurs et inférieurs, ainsi que la force maximale des muscles du tronc constituent de bons indicateurs des performances de natation en sprint chez des nageurs adolescents entraînés.

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1. Abbreviations

1RM	one-repetition-maximum
SJ	squat jump
CMJ	countermovement jump
s	seconds
kg	kilogram
m	meter
FS	freestyle
BS	breaststroke
BackS	backstroke

2. Introduction

A small range between winning and losing was shown during the 2014 European Swimming Championships, especially in short distances. These tight margins in achieving success

emphasize that each athlete must optimize every aspect of the race. Start performance in swimming requires a combination of reaction time, vertical and horizontal force off the block, and low resistance during underwater gliding. Ruschel et al. [1] reported that flight distance is one variable that determine start performance ($r = -0.48$). Therefore, swimmers need to jump as far as possible during a block start and travel the maximum distance at the highest velocity to influence this important factor [2]. It is not surprising that Breed and Young [3] identified countermovement jump (CMJ) performance as significantly related to flight distance ($r = 0.69-0.84$). Some investigations demonstrated a strong relationship between maximal strength in squat and jump performances [4,5]. West et al. [6] also showed that lower body strength and power are significantly related to swim time of 15 m in international male swimmers ($r = -0.66$ to -0.74). Therefore, there may be an advantage of high maximum strength level in turning (pushes of the wall). Strength training or vertical jump training programs seem appealing because of their high correlation with start performance

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