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ORIGINAL ARTICLE

Determinants of acceleration and maximum speed phase of repeated sprint ability in soccer players: A cross-sectional study

Facteurs déterminants de la phase d'accélération et de la vitesse maximale de la capacité à répéter des sprints chez les footballeurs : étude transversale

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Summary
Objectives. — The aim of this study was to examine the anthropometric and physiological factors that influence the acceleration (0—10 m) and maximum speed phases (10—20 m) of a repeated sprint ability (RSA) test.
Equipment and methods. — Thirty-six soccer players were tested for height, body mass, body fat percentage, sit-and-reach test, squat and countermovement jump, Wingate test, maximal aerobic running speed, 20 m sprint time (with 0—10 m and 10—20 m splits) and a 10 × 20 m RSA test.
Results. — The comparison between groups with different levels of RSA revealed that players with higher RSA had better scores in physical fitness than their counterparts with lower RSA (maximal aerobic speed +1.1 $km.h^{-1}$, +7.1%; squat jump +4.5 cm, +14.2%; mean power in the Wingate test +0.4 $W.kg^{-1}$, +4.6%; 20 m sprint −0.13 s, −4.1%; $P < 0.05$). The split 0—10 m and

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10—20 m of the 20 m sprint test had similar correlations with the mean time of the RSA test ($0.57 \leq r \leq 0.59$, $P < 0.001$), but they had phase-dependent correlations with the mean time in the acceleration phase ($r = 0.63$, $P < 0.001$, vs. $r = 0.32$ ns) and maximum speed phase of the RSA test ($r = 0.38$, $P < 0.05$, vs. $r = 0.74$, $P < 0.001$). In conclusion, this study showed the existence of different physical fitness components that are related with each phase of RSA, suggesting that an analysis of separate phases of a RSA test can provide additional information for the training design. Therefore, players should focus on the physical fitness components associated with the specific phase in order to improve the performance in a targeted phase of RSA.

MOTS CLÉS
Intermittent ;
Haute-intensité ;
Test de répétition ;
Football ;
Puissance

Résumé
Objectifs. — Le but de cette étude était d'examiner les facteurs anthropométriques et physiologiques qui influencent les phases d'accélération (0—10 m) et de vitesse maximale (10—20 m) d'un test de répétitions de sprints (RSA).
Matériels et méthodes. — Trente-six footballeurs ont été soumis aux différents tests suivants : la taille, la masse corporelle, le pourcentage de masse grasse, un test de souplesse en position assise, le *countermovement jump* (CMJ) et squat jump (SJ), le Wingate test, le test aérobie déterminant une vitesse maximale aérobie (VMA), le sprint sur 20 m (avec des temps intermédiaires de 0—10 m et 10—20 m), et le test RSA de 10×20 m.
Résultats. — La comparaison entre les groupes avec différents niveaux de performance au RSA prouve que ceux ayant une haute performance au test RSA avaient également de meilleures performances aux tests physiques par rapport à ceux ayant une faible performance au test RSA (VMA +1,1 km.h^{-1}, +7,1 % ; squat jump +4,5 cm, +14,2 % ; puissance moyenne au Wingate test +0,4 W.kg^{-1}, +4,6 % ; sprint sur 20 m −0,13 s, −4,1 % ; $p < 0{,}05$). Les temps sur 0—10 m et 10—20 m lors d'un sprint chronométré sur 20 m avaient la même corrélation avec le temps moyen au test de RSA ($0{,}57 \leq r \leq 0{,}59$, $p < 0{,}001$), ils avaient en revanche une corrélation avec le temps moyen, dépendante des phases, durant la phase d'accélération ($r = 0{,}63$, $p < 0{,}001$, vs $r = 0{,}32$, ns) et la phase de vitesse maximale, lors du test RSA ($r = 0{,}38$, $p < 0{,}05$, vs $r = 0{,}74$, $p < 0{,}001$). En conclusion, cette étude montre l'existence de différentes composantes déterminant la condition physique, qui sont liées avec les phases de course lors d'un test RSA, suggérant que des analyses distinctes des différentes phases de sprint lors d'un test RSA apporteraient des informations supplémentaires importantes pour l'organisation et la mise en place de l'entraînement. De ce fait, les joueurs doivent se concentrer sur leur condition physique, associée aux phases distinctes de la course de sprint, afin d'améliorer la performance dans les phases ciblées lors d'un test de RSA.

1. Introduction

Soccer is a team sport taxing both aerobic and anaerobic energy transfer systems [1,2] and including short high-intensity activities interspersed with longer low-to-moderate activities, e.g. short sprints interspersed with walking or low-intensity running, in a ratio one to nine [3]. To develop optimal physical fitness training programs, it is important to know which parameters of physical fitness, and to what extent, are associated with performance. Compared with other parameters (e.g., anthropometrics, aerobic power, flexibility, muscle strength and power) that have been well studied since the 1970s [4], repeated-sprint ability (RSA) in soccer relatively recently has attracted scientific interest [5]. Findings support that repeated-sprint ability (RSA) significantly correlates with the distance covered at a high intensity during a game (> 19.8 km.h^{-1}) [6] and has been shown to discriminate soccer players according to competitive level [7], suggesting that RSA is related to soccer performance.

Defined as the ''ability to produce the best possible average sprint performance over a series of sprints, separated by short ($\leq$ 60 s) recovery periods'' [8], RSA is linked with both anaerobic and aerobic power. In accordance with this definition, many studies have been conducted on the associations of RSA with measures of anaerobic (e.g., Wingate anaerobic test) [9,10] and aerobic power (e.g., maximal oxygen uptake, 20-m shuttle run endurance test, Yo-Yo IRT1) [2,9,11,12] revealing moderate to very large correlations. However, in the aforementioned studies, the distance covered during RSA protocol was considered as a whole and was not divided in separate phases. In track-and-field's 100 m, the sprint performance typically includes three phases, an initial acceleration phase (0—10 m), a transition (10—36 m) and a maximum speed phase (36—100 m) [13]. Compared with track-and-field's 100 m, a typical sprint in soccer is much shorter; it has distance 10—20 m and lasts 2—3 s [14,15]. Thus, it is reasonable to consider the 20 m sprint as representative of soccer's sprint ability and to distinguish it further into acceleration (0—10 m) and maximum speed