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ORIGINAL ARTICLE

Allometric scaling and age-related differences in change of direction speed performances of young soccer players



Aptitude à changer rapidement de direction : effet de l'âge et calcul des indices allométriques chez les jeunes footballeurs

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Change of direction speed;
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Summary

Purpose. – The purposes of this study were to compare change of direction speed (CODS) performances between different age categories (i.e., U-10, U-12, U-13, and U-18) and to develop allometric exponents for scaling this quality.

Material and method. – Data were gathered with the participation of 101 male soccer players (mean \pm SD; age = 12.5 ± 2.9 years, mass = 44.4 ± 14.7 kg, height = 149.3 ± 17.7 cm, and leg length = 75.7 ± 13.1 cm). All players performed the Illinois change of direction speed test (ICDST).

Results. – U-18 players achieved significantly better results in ICDST compared with the other groups, whereas U-10 players had the lowest performances ($F = 48.78$, $P < 0.0001$). In regards to U-12 and U-13 soccer players, no significant differences were established between them ($P > 0.05$). The ICDST performances were significantly associated with body mass ($r = -0.58$; $P < 0.0001$), height ($r = -0.75$; $P < 0.0001$) and leg length ($r = -0.75$; $P < 0.0001$). No correlations between allometrically scaled ICDST performance and anthropometric measures were observed (all $P > 0.05$), indicating the effectiveness of allometric exponents in partialing out the effect of anthropometric measures on ICDST's compared to ratio scaling.

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MOTS CLÉS

Changement rapide de direction ;
Anthropométrie ;
Indice allométrique

Conclusion. – Results indicated differences in CODS performance among soccer players of different age categories. These results demonstrated that developing allometric exponents are effective in controlling for anthropometric measures.

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Résumé

Objectifs. – Cette étude a eu pour objectifs (a) l'analyse de l'effet de l'âge sur l'aptitude à changer rapidement de direction, évaluée par le test Illinois, chez des jeunes footballeurs (i.e., U-10, U-12, U-13, et U-18) ; (b) la détermination de l'exposant allométrique de relativisation des performances à ce test.

Matériels et méthodes. – Cent un footballeurs ont participé à cette étude (âge = $12,5 \pm 2,9$ ans, masse corporelle = $44,4 \pm 14,7$ kg, taille = $149,3 \pm 17,7$ cm, longueur des membres inférieurs = $75,7 \pm 13,1$ cm) et ont tous réalisé le test Illinois de changement rapide de direction.

Résultats. – Les joueurs de moins de 18 ans (U-18) ont réalisé la meilleure performance dans le test de changement rapide de direction, par contre les joueurs de moins de 10 ans (U-10) ont enregistré la plus faible performance ($F = 48,78, p < 0,0001$). Aucune différence significative n'a été enregistrée entre les joueurs de moins de 12 ans (U-12) et ceux de moins de 13 ans (U-13) ($p > 0,05$). La performance au test Illinois a été significativement corrélée avec la masse corporelle ($r = -0,58 ; p < 0,0001$), la taille ($r = -0,75 ; p < 0,0001$) et la longueur des membres inférieurs ($r = -0,75 ; p < 0,0001$). Les performances exprimées sous forme allométriques ont perdu leurs corrélations significatives avec leurs indices anthropométriques respectifs révélant la validité des indices allométriques calculés dans cette étude.

Conclusion. – L'aptitude à changer rapidement de direction évaluée par le test Illinois chez les footballeurs diffère selon les catégories d'âge. Nos résultats indiquent l'efficacité de calculer les indices allométriques afin de contrôler l'effet des mesures anthropométriques sur la performance.

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1. Introduction

Apart from the psychology and the tactical intelligence of a soccer player, his or her physiological attributes (e.g. strength, speed, and agility) play an essential role in playing success [1]. Agility, in particular, is an important physical quality for soccer players, in view of the great and/or various number of situations within the game that require high-speed and rapid total body movements in response to the action of team-mates, opponents and/or the ball [2]. Consequently, soccer's training program should incorporate specific exercises directed towards the development of agility with an emphasis on technique, sprint and strength training, and the development of perception and decision making [3]. In this context, several authors have argued that change of direction speed (CODS) is a prerequisite for successful participation in modern-day team sports, particularly soccer, and it would seem extremely beneficial for strength and conditioning practitioners to identify those training techniques that may best optimize CODS performance [4–7].

Actually, sport scientists are in permanent search for effective methods that allow the identification of particular physical characteristics that might contribute to sport performance optimization. To that end, physical testing constitutes the unique and the common effective method that leads to a successful performance by an appropriate talent identification and training program follow-up.

Several number of agility field tests that try to mimic the movement patterns of team sporting performance have been developed. In this context, we can quote the T-test [8], the Illinois agility test [9], the 505 test [10], the L-run test [11], the zigzag test [7], the Hexagon test [12], the hop test, the single hop for distance test, the triple hop for distance test, the 6-m timed hop test and the crossover hop for distance test [13]. Up to now, it seems that the Illinois change of direction speed test (ICDST) is one of the most practiced agility assessment test within team sports practitioners [14,15]. It has been suggested recently that ICDST is a valid and reliable test in assessing the CODS ability in team sport athletes [15]. Moreover, ICDST has been often considered as a standard protocol for the assessment of change of direction speed test [10]. Apart from a high overall validity [15], the test could have an advantage of ecological validity since it includes generic cues that closely mimic the majority of movement patterns of soccer [15]. It is well recognized that the involvement of young athletes in soccer training at an early age is increasing substantially all over the world. In order to achieve high-level soccer performance, young athletes must develop a variety of fundamental motor skills during childhood. However, each physical attribute requires special attention in a particular age-related period. The pattern of improvement is not uniform for all the tasks. In this context, it has been argued that running speed performance improves from 5 to 18 years and acceleration after 13 years. In regards to agility performance, it has been revealed

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