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ORIGINAL ARTICLE

Physical fitness and physiological characteristics of soccer referees

Condition physique et caractéristiques physiologiques des arbitres de football selon leur statut compétitif, niveau et âge

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Summary
Aims. — The purpose of our research was primarily to investigate the physical fitness and physiological characteristics of soccer referees according to their competitive status, level and age, and secondly, to analyze the relationship among sprint, change of direction ability and endurance capacity.
Material and methods. — Forty-five Spanish referees were grouped according to status: field (FR, $n = 23$) and assistant (AR, $n = 22$), competitive level: national (NR, $n = 28$) and provincial (PR, $n = 17$), and age: > 35 yr ($n = 10$) and ≤ 35 yr ($n = 35$). The main focuses of our study were acceleration, change of direction ability and endurance capacity, which were measured by 20 and 30 m linear straight sprinting tests (LSST), the modified agility T-test free (MATF) and the Yo-Yo intermittent recovery level 1 test (YYIR1), respectively.
Results. — The results showed no significant differences between FR and AR, or between NR and PR groups. However, > 35 yr were significantly slower ($P \leq 0.01$) than the ≤ 35 yr in the 20 m sprint, 30 m sprint and the MATF. Moreover, the > 35 yr covered significantly ($P \leq 0.01$) less distance in the YYIR1 than the ≤ 35 yr group and HR_{max} was significantly ($P \leq 0.05$) lower in the > 35 yr group. MATF was strongly related to the 20 m ($r = 0.762$) and 30 m ($r = 0.757$) sprints.
Conclusion. — Our findings suggest the necessity of implementing specific training programs focused on maintaining change of direction ability, acceleration and aerobic capacity in referees older than 35 years.

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Résumé
But. — Cette étude a eu pour but principalement d'examiner la condition physique et les caractéristiques physiologiques des arbitres de football selon leur statut compétitif, niveau et âge, et en second lieu d'analyser la relation entre le sprint, l'habileté a changer de direction et la capacité d'endurance.
Méthodes. — Quarante-cinq arbitres espagnols ont été répartis en groupes selon leur statut : arbitre central (FR, $n = 23$) ou arbitre assistant (AR, $n = 2$), niveau compétitif : national (NR, $n = 28$) ou provincial (PR, $n = 17$), et âge : > 35 ans ($n = 10$) ou ≤ 35 ans ($n = 35$). Les principaux objets de notre étude étaient accélération, agilité et capacité d'endurance, que l'on a mesurées avec deux épreuves de sprint de 20 et 30 m linéaires (LSST), l'épreuve T libre d'agilité modifié (MATF) et le Yo-Yo test de la récupération intermittente de niveau 1 (YY1R1), respectivement.
Résultat. — On n'a pas trouvé de différences significatives entre les FR et les AR, ou entre les groupes NR ou PR. Cependant, les > 35 ans étaient significativement plus lents ($p \leq 0{,}01$) que les ≤ 35 ans dans le sprint de 20 m, le sprint de 30 m et le MATF. En outre, les > 35 ans ont fait significativement moins de distance ($p \leq 0{,}05$) dans le YY1R1 que le groupe des ≤ 35 ans et la fréquence cardiaque maximale (HR_{max}) était significativement plus basse ($p \leq 0{,}05$) dans le groupe des > 35 ans. Le MATF était fortement lié aux sprints de 20 m ($r = 0{,}762$) et de 30 m ($r = 0{,}757$).
Conclusion. — Nos résultats suggèrent la nécessité de réaliser des programmes spécifiques d'entraînement concentrés sur maintenir l'agilité, l'accélération et la capacité aérobie des arbitres de plus de 35 ans.

1. Introduction

Field referees (FR) in cooperation with two assistant referees (AR) have full authority to control and regulate the behavior of players and coaches [1]. Considering that referees are responsible for making key decisions to ensure the game is played correctly [2], they are required to keep up with the play [3]. Therefore, refereeing is a very physically and physiologically demanding activity [4].

Researchers have shown that during the English Premier League, FR covered 889 ± 327 m at high-speed running (> 19.8 km·h^{-1}) of a total distance of 11,770 ± 808 m and undertook 21.3—30.5 sprints at a speed above 25.2 km·h^{-1} [3]. In the two top Danish leagues, FR performed 1269 activity changes each match [5] and in the first division of the Italian championship, FR were involved in backward and sideways running during 13.2% of the match time [6]. Even though assistant refereeing has also been characterized by brief intense bouts of forward and sideways running interspersed with long low-activity periods [7], FR spend more time walking, jogging, cruising and sprinting than AR. These results are in line with the requirements of the Fédération Internationale de Football Association (FIFA) which establishes different physical requirements for AR and FR [8]. Due to the high demands of the soccer match, a high level of physical fitness could help referees to ensure optimal positioning in making key decisions [3]. Moreover, the higher accumulated fatigue during the match might have consequence in the sense of increasing the possibility of injury. Therefore, although physical fitness is not a unique and essential factor in refereeing activity, it is very relevant for the referees.

The referees officiating at higher categories have shown to be fitter than those at lower categories [9,10]. The top levels FR in the Italian championship were better in the Yo-Yo intermittent recovery test than the low level FR [11]. Since the competitive level seems to play a major role in the fitness level of the referees [9], the assessment of their physical performance would help determine fitness standards for both elite and lower level referees, and assist in the designing of training programs [11].

Refereeing experience has also shown to influence refereeing performance [11] and it is considered by the international refereeing governing bodies (FIFA and Union of European Football Associations, UEFA) as a fundamental prerequisite to officiate at the elite level [12]. Casajus and Castagna [13] reported that referees reach their better career level at the age of 40, when most soccer players have retired from competition. Castagna et al. [12] also reported that soccer referees may give their best performances in an age range that is commonly thought to be associated with a decline in fitness. Castagna and Abt [14] reported that experienced referees may moderate their competitive behavior during a match and that this 'sparing behavior' may be adopted by the referees to avoid fatigue. Therefore, it seems that a better physical performance is not related to a better refereeing level. Nevertheless, no studies have analyzed the age-related effects on speed in short distances and change of direction ability (CODA).

The relationships between different physical field tests have already been investigated in soccer, however, the results are contradictory [15,16]. Some researchers [16,17] reported that sprinting in a straight line and CODA, are independent abilities. However, Ingebrigtsen et al. [18] obtained high significant correlations between the results in 20 and 35 m acceleration tests and repeated sprint ability tests (RSA) with two intermittent endurance tests. In soccer, referees Casajus and Castagna [13] observed a high correlation