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Nutritional intake of elite football referees

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Abstract
There is a paucity of dietary data in football referees. In this study, 23 elite main and assistant referees (34.4 ± 5.6 years) completed a 7-day dietary record during the competitive season. No nutritional intake differences were observed between main and assistant referees. Referees’ mean daily energy intake (DEI) was 2819 ± 279 kcal. The intake of proteins (1.7 ± 0.2 g · kg⁻¹), carbohydrates (4.1 ± 0.8 g · kg⁻¹) and fats (1.4 ± 0.2 g · kg⁻¹) represented, respectively, 18.4 ± 1.5%, 44.4 ± 4.4% and 34.6 ± 4.1% of the DEI. Carbohydrate intakes before, during and after exercise were 66 ± 42, 7 ± 15 and 120 ± 62 g. Daily carbohydrate, fibre, polyunsaturated fat and water intakes were below recommendations, while fat, saturated fat, cholesterol and sodium intakes were above recommended values. The prevalence of inadequate intake was high for vitamin E (96%), folate (74%), vitamin A (61%), vitamin C (39%), magnesium (26%) and calcium (22%). Carbohydrate intake before, during and after exercise were far from achieving the minimum recommended values. Most referees demonstrated a negligent behaviour of hydration during exercise. Referees would benefit from dietary education in order to optimise performance and health.

Keywords: football, soccer, referees, nutrition, athletes

Introduction
Football has attracted the attention of the scientific community, but researchers focus their interest on the performance-related aspects of players (Stølen, Chamari, Castagna, & Wisløff, 2005), almost neglecting the other human intervenient – the referee – despite its crucial role in the outcome of the game (Da Silva, Fernandes, & Fernandez, 2011). However, football is also physically very demanding to referees who additionally have to perform a significant perceptual-cognitive workload (Helsen & Bultynck, 2004; Weston et al., 2012). Referees have to cover long distances at different speeds to get an optimal position to monitor players’ behaviour and ensure the application of the games’ laws (Reilly & Gregson, 2006). Furthermore, the demands imposed upon referees have greatly augmented in recent decades (Helsen & Bultynck, 2004) due to the trend towards an increase in the distance covered by players (Castagna, Abt, & D’Ottavio, 2007). During a game, the average distance covered varies between 9 and 13 km for main referees and between 5.8 and 7.3 km for assistant referees, according to the competition level (Krstrup et al., 2009; Stølen et al., 2005; Weston et al., 2012). These figures are very close to those reported for midfield players (Rampinini, Coutts, Castagna, Sassi, & Impellizzeri, 2007). There seems to be a relationship between the physical activity profile of referees and players within-match and across-season (Weston, Drust, & Gregson, 2011). These data indicate that referees are able to keep pace with elite players, while being 15–20 years older, less fit, cannot be substituted and often have a non-professional status (Rontoyannis, Stalikas, Sarros, & Vlastaris, 1998; Stølen et al., 2005).

The published literature on football referring has increased steadily in the last decades mainly focusing on matches’ activities profile, physiological parameters, anthropometric assessments and training (Caballero et al., 2011; Krstrup, Mohr, & Bangsbo, 2002). The information available on nutrition-related issues of football referees is scarce, with the exception of few studies about energy expenditure (Da Silva, Fernandes, & Fernandez, 2008), dehydration (Da Silva & Fernandez, 2003) and fluid intake (Da Silva et al., 2011). Given the
increase in the high standard fitness and decision performance required for referees, and the training programmes undertaken to achieve them, every determinant of training and performance, such as nutrition, should be taken into consideration. An optimal nutritional status through adequate dietary intake is critical to sustain daily activities, promote adaptations to training and optimise performance during competition (Rodriguez, Di Marco, & Langley, 2009). As football players benefit from an optimised dietary intake (Bangsbo, Mohr, & Krustrup, 2006), referees would benefit as well. Although an adequate diet is essential for the optimal performance of football players, they fail to consume such a diet. Most published studies described a less than optimal nutrient intake of football players, particularly with respect to energy, carbohydrate and micronutrient intakes (Iglesias-Gutiérrez et al., 2005; Maughan, 1997; Rico-Sanz et al., 1998; Ruiz et al., 2005).

Nowadays, while the physiological aspects of football refereeing have already been extensively studied (Weston et al., 2012), there are no data about the nutritional intake. This led to a lack of knowledge that could otherwise be useful to describe the requirements and contribute to the development of specific recommendations on nutrition for a large number of practitioners worldwide (843,000) (FIFA, 2006). In the absence of specific nutritional guidance on sports nutrition, referees are advised (Reilly & Gregson, 2006) to comply with those designed for players (1.2–1.7 g · kg⁻¹ of proteins, 5–12 g · kg⁻¹ of carbohydrate and 20–35% of DEI from fat) (Burke, Loucks, & Broad, 2006; Rodriguez et al., 2009; Tipton & Wolfe, 2004). However, nutritional strategies should be adapted to the particular physical demands of the referee.

Therefore, this study was designed to investigate the dietary intake for the duration of 1 week of football referees, while living in their own environment and at a time when they were in full training in mid-season of regular competition, and to evaluate its overall nutritional adequacy as well as before, during and after exercise.

Methods

Participants

All referees credited by the Portuguese Professional Football League (n = 83) who participated in a training campus were invited to take part in this cross-sectional study. Participants were considered elite as they had refereed at least at the national level. Twenty-three adult Caucasian men volunteered to participate, eight of whom were main referees and fifteen were assistant referees. Athletes gave written informed consent after having been explained verbally and in writing the purpose and demands associated with the study, in accordance with the Helsinki Declaration. They were told that they could withdraw from the study at any time without having to give any elucidation. The protocol for this study was approved by the Scientific Council of the Faculty of Nutrition and Food Sciences at the University of Porto.

Anthropometry

Referees were asked to record their height (cm) and weight (kg, lightly dressed and barefooted). Afterwards, body mass index (BMI) was calculated as weight/height² (kg/m²).

Dietary intake

Referees were asked to accurately record everything they ate and drank in a dietary record for seven consecutive days. A 7-day recording was chosen because it is believed to represent the time frame associated with a good balance between a reasonably accurate estimation of habitual nutritional intake and the effort required for its completion (Magkos & Yannakoulia, 2003). A full description of foods and fluids consumed was requested, including the commercial brand names of packaged food, cooking or processing methods, the time of day and place of meals, and food items and ingredients added in the preparation whenever possible. Quantification of the portion of foods and fluids consumed was carried out by referring to the weight or volume provided on food packages, number of items of predetermined size, or by using standardised household measures, later converted into grams using adequate bibliographic support. Referees were required to record the use of any supplements that were taken. A trained nutritionist gave detailed oral and written instructions about proper recording during a group seminar. The referees in this study had never before received specific dietary advice and were instructed to continue their habitual dietary intake and training routines during the experiment. Common issues leading to the alteration of usual eating patterns were discussed, and athletes were persuaded to avoid the omission and replacement of foods that are hard to record or that they feel that shouldn’t be eating. Referees were advised of the benefits of keeping accurate and reliable records to ensure valuable personal feedback. Upon return, each food record was carefully scrutinised for accuracy, and any ambiguous information was clarified by telephone conversation with the referee.

To alleviate the influence of under-reporting, the basal metabolic rate (BMR) of all participants was
calculated using the Harris–Benedict equations, and an energy intake of $1.1 \times BMR$ was used as a threshold to identify and eliminate under-reporters (Goldberg et al., 1991).

**Nutritional analysis**

Dietary records’ information was converted to energy and nutrients using ESHA Food Processor® 8.0 for Windows (Salem, OR, USA). This software was added with information for recipes, commercial foods and sports foods, whenever reliable nutritional composition data could be obtained. All the analyses were performed by the same trained person so that the potential variation in the interpretation of dietary data was minimised.

Macronutrient intakes were compared with sports nutrition recommendations (Rodriguez et al., 2009). Since data are not sufficient to define the specific reference values for athletes, the Dietary Reference Intakes (DRI) published by the Food and Nutrition Board were used to evaluate the adequacy of fibre, vitamins and minerals intake (Otten, Hellwig, & Meyers, 2006). For micronutrients with established Estimated Average Requirement (EAR), the prevalence of inadequacy was calculated by the cut-point method, i.e. the proportion of athletes whose intakes were below EAR (Food and Nutrition Board & Institute of Medicine, 2000). For those nutrients without EAR, we compared the average intake of the group with Adequate Intake (AI); if it was at or above the AI, we concluded that there is a low prevalence of inadequacy, while if it was below the AI, nothing can be inferred about the probability of inadequacy (Food and Nutrition Board & Institute of Medicine, 2000).

The dietary periods which occurred 4 h before, during and 4 h after exercise (training session and match) were analysed to assess the adequacy of nutritional intake, and were categorised as preparation, during and recovery periods, respectively.

**Statistical analysis**

All statistical analysis was carried out using Statistical Package for Social Sciences version 17.0 (Chicago, IL, USA). The data are presented as mean ± standard deviation (SD). The normality of distribution was assessed by Kolmogorov–Smirnov Z test. When normality was confirmed, t-Student test was used to compare two independent means; otherwise Mann–Whitney U test was used. In all cases, significance was accepted at $P < 0.05$.

**Results**

As there were no significant differences between main referees and assistant referees, both on anthropometric parameters and nutritional intake, they were analysed as a single sample. Participants’ characteristics are presented in Table I. The BMI was as adequate for only 57% of the referees with the other being classified as pre-obese, according to the WHO categories.

Table II describes the mean nutritional intake of the participants. Nutritional supplements were not considered for the calculation as they were not consumed, with the exception of sport drinks. Referees’ mean daily energy intake (DEI) was $2819 \pm 279$ kcal or $36.5 \pm 4.9$ kcal · kg$^{-1}$. The proportions of macronutrients were not optimal. The intake of carbohydrates relative to body weight ($4.1 \pm 0.8$ g · kg$^{-1}$) was below the recommendations, with almost all the referees (20) reporting an intake below the minimum value recommended (5 g · kg$^{-1}$). On the other hand, their mean protein intake equals the upper value of the recommendations (1.2–1.7 g · kg$^{-1}$), with 10 referees exceeding this interval. Fat, saturated fat and cholesterol intakes were excessive. On the other hand, fibre, polyunsaturated fats and water intakes remained below of what is recommended.

### Table I. Referees’ characteristics.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean ± SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>34.4 ± 5.6</td>
<td>24.0–45.0</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>77.8 ± 6.7</td>
<td>64.0–87.0</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.78 ± 0.06</td>
<td>1.60–1.92</td>
</tr>
<tr>
<td>BMI (kg · m$^{-2}$)</td>
<td>24.5 ± 1.3</td>
<td>22.4–26.8</td>
</tr>
<tr>
<td>BMR (kcal)</td>
<td>1794 ± 109</td>
<td>1582–1969</td>
</tr>
</tbody>
</table>

*Note: BMI = Body mass index; BMR = Basal metabolic rate; SD = Standard deviation.*

### Table II. Referees’ daily energy and nutrient intakes.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Mean ± SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy kcal</td>
<td>2819 ± 279</td>
<td>2209–3259</td>
</tr>
<tr>
<td>kcal · kg$^{-1}$</td>
<td>36.5 ± 4.9</td>
<td>28.2–46.4</td>
</tr>
<tr>
<td>Carbohydrate (g · kg$^{-1}$)</td>
<td>4.1 ± 0.8</td>
<td>2.6–5.6</td>
</tr>
<tr>
<td>Protein (g · kg$^{-1}$)</td>
<td>1.7 ± 0.2</td>
<td>1.3–2.1</td>
</tr>
<tr>
<td>Fat (% DEI)</td>
<td>34.6 ± 4.1</td>
<td>27.1–44.9</td>
</tr>
<tr>
<td>SFA (% DEI)</td>
<td>11.6 ± 2.4</td>
<td>7.2–18.0</td>
</tr>
<tr>
<td>PUFA (% DEI)</td>
<td>5.3 ± 0.8</td>
<td>4.1–7.7</td>
</tr>
<tr>
<td>MUF (% DEI)</td>
<td>14.2 ± 1.9</td>
<td>11.0–18.3</td>
</tr>
<tr>
<td>Cholesterol (mg)</td>
<td>449 ± 92</td>
<td>333–673</td>
</tr>
<tr>
<td>Dietary Fibre (g)</td>
<td>21.8 ± 5.4</td>
<td>14.6–30.5</td>
</tr>
<tr>
<td>Water (mL)</td>
<td>2336 ± 560</td>
<td>1435–3445</td>
</tr>
</tbody>
</table>

*Note: SD = Standard deviation; DEI = daily energy intake; SFA = saturated fatty acids; PUFA = polyunsaturated fatty acids; MUF = monounsaturated fatty acids.*
Table III. Referees’ daily intakes of vitamins and minerals and prevalence of inadequacy.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Mean ± SD</th>
<th>% below EAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A (μg RAE)</td>
<td>691 ± 560</td>
<td>61</td>
</tr>
<tr>
<td>Vitamin E (mg α-tocoferol)</td>
<td>6.0 ± 2.5</td>
<td>96</td>
</tr>
<tr>
<td>Vitamin C (mg)</td>
<td>104 ± 40</td>
<td>39</td>
</tr>
<tr>
<td>Thiamin (mg)</td>
<td>2.2 ± 0.4</td>
<td>0</td>
</tr>
<tr>
<td>Riboflavin (mg)</td>
<td>2.5 ± 0.5</td>
<td>0</td>
</tr>
<tr>
<td>Nicacin (mg NE)</td>
<td>48.7 ± 8.7</td>
<td>0</td>
</tr>
<tr>
<td>Vitamin B6 (mg)</td>
<td>2.8 ± 0.8</td>
<td>0</td>
</tr>
<tr>
<td>Vitamin B12 (μg)</td>
<td>11.6 ± 6.7</td>
<td>0</td>
</tr>
<tr>
<td>Folate (μg DFE)</td>
<td>286 ± 170</td>
<td>74</td>
</tr>
<tr>
<td>Calcium (mg)</td>
<td>965 ± 216</td>
<td>22</td>
</tr>
<tr>
<td>Iron (mg)</td>
<td>18.9 ± 4.4</td>
<td>0</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>396 ± 68</td>
<td>26</td>
</tr>
<tr>
<td>Phosphorus (mg)</td>
<td>1650 ± 219</td>
<td>0</td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>16.1 ± 3.3</td>
<td>0</td>
</tr>
<tr>
<td>Selenium (μg)</td>
<td>143 ± 33</td>
<td>0</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>2790 ± 554</td>
<td>NA</td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>3745 ± 615</td>
<td>NA</td>
</tr>
</tbody>
</table>

Note: RAE = retinol activity equivalents; NE = niacin equivalents; DFE = dietary folate equivalents; EAR = Estimated average requirements; NA = Not applicable.

Mean daily intake of vitamins and minerals compared with the applicable DRI values is summarised in Table III. A substantial proportion of participants did not meet the recommended intakes for folate (74%), vitamin A (61%), vitamin C (39%), magnesium (26%) and calcium (22%), and only one referee met the DRI value for vitamin E. All the other micronutrients were consumed in adequate amounts. Sodium was the only micronutrient whose mean intake was above the upper limit (2300 mg), with 78% of participants exceeding the maximum value recommended for sedentary individuals.

Referees classified the period studied as a typical week of training during the season. On average, participants underwent 2.9 training sessions during the week and had to referee 0.9 football matches during the weekend. All referees made a dietary intake in preparation (4 h before exercise) and recovery (4 h after exercise) periods in all the exercise (training and game) sessions. On the contrary, most participants (79%) did not report any food or fluid intake during exercise, while the minority drank water (16%) or carbohydrate-electrolyte beverages (5%). Values presented in Table IV refer only to the registered intakes before, during and after training sessions and matches.

Discussion

To the best of our knowledge, the current study is the first comprehensive assessment of nutritional intake of elite football referees. Some important nutritional inadequacies were identified, namely a deficit of carbohydrate intake to meet the requirements for training and competition.

The mean BMI we found (24.5 kg·m\(^{-2}\)) was within the range described in the literature for referees (Caballero et al., 2011; Da Silva et al., 2008; Rontoyannis et al., 1998), and higher than the values reported in elite players (22.8–23.2 kg·m\(^{-2}\)) (Bloomfield, Polman, Batterly, & O’Donoghue, 2005). Ten out of 23 referees (43%) had a height for weight ratio above 25.0 kg·m\(^{-2}\), which places them within the overweight category. As BMI is not a valid measure for assessing body composition of athletes (Torstveit & Sundgot-Borgen, 2012), it would have been better if we had measured referees’ body fat, but unfortunately we did not.

The main nutritional aim of any athlete should be to meet the higher energetic needs (Rodriguez et al., 2009). The results of this study revealed wide differences in energy intake, ranging from 2209 to 3259 kcal, as was already described for players (Iglesias-Gutiérrez et al., 2012; Maughan, 1997; Noda et al., 2009). It is recognised that dietary records of athletes are prone to error information mostly through under-reporting (Magkos & Yannakoulia, 2003), which can compromise the interpretation of dietary data. However, applying the Goldberg cut-off point, none of the individuals in the sample appeared to under-report their energy intake. Since energy-expenditure estimates were not undertaken in the current study, we cannot conclude on the adequacy of energy intake.

The intermittent and high-intensity nature of football refereeing require a heavy reliance on glycogen and has the potential to challenge its stores. Both principal and assistant referees display evidence of fatigue towards the end of the game. Significant reductions in the total distance covered (Weston, Castagna, Impellizzeri, Rampinini, & Abt, 2007), in the distance covered running backwards and sideways (Krstrup et al., 2009) and in the time engaged in high-speed running and sprinting (Krstrup & Bangsbo, 2001) have been reported in the second half compared with the first half. Moreover, referees are more distant from infringements during the second half (Krstrup et al., 2009), which can hamper a proper judgement (Stølen et al., 2005). Thus, it seems that they experience increased difficulty in keeping up with play towards the end of the game.
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when the most crucial outcome-related activities are more prevalent (Stølen et al., 2005). Therefore, referees should follow a diet rich in carbohydrates to keep the ability to engage in high intensity work in the last parts of the game (Da Silva et al., 2008). As there are no specific guidelines, referees are instructed (Reilly & Gregson, 2006) to follow the recommendations established for players (5–12 g · kg\(^{-1}\)) (Burke et al., 2006) in order to maintain muscle glycogen stores during exercise and to optimise its restoring between training sessions. In this study, the average carbohydrate intake was inappropriately low (4.1 ± 0.8 g · kg\(^{-1}\)) in accordance with the data published in football players (Iglesias-Gutiérrez et al., 2005; Maughan, 1997; Rico-Sanz et al., 1998; Ruiz et al., 2005). Indeed, Ono and colleagues reported it to be difficult for football players to follow a diet rich in carbohydrates (Ono, Kennedy, Reeves, & Cronin, 2012). We were expecting that the higher physiological requirements for main referees could have led to an increased spontaneous intake of carbohydrates compared with the assistant referees, resembling the findings described in players with different playing positions (Iglesias-Gutiérrez et al., 2012). However, we did not find any significant difference on carbohydrates intake between main and assistant referees (4.0 ± 0.7 g · kg\(^{-1}\) and 4.1 ± 0.9 g · kg\(^{-1}\), respectively), perhaps because their training regimes didn’t differ a lot. Diets lacking carbohydrates for prolonged periods, combined with the demands of training and match play, can result in premature glycogen depletion, suboptimal glycogen restoration and subsequent compromised performance (Bangsbo et al., 2006). The timing of carbohydrates intake also plays a key role in the preparation and recovery from exercise. The ingestion of significant amounts (200–300 g) of carbohydrates before exercise (3–4 h) is recommended as an effective strategy to enhance carbohydrate availability and improve athletic performance (Rodriguez et al., 2009). However, carbohydrates intake was very poor (66 g) in this time period. Athletes should ingest carbohydrates (30–60 g per hour) to maintain its availability during exercise (Rodriguez et al., 2009). However, only one referee drank a carbohydrate-electrolyte fluid during the break, which can offer benefits compared with the intake of water in the time spent running backwards (Da Silva & Fernandez, 2003) and in fluid replacement (Da Silva et al., 2011). The intake of carbohydrates observed during the recovery period (0.39 ± 0.2 g · kg\(^{-1}\) · h\(^{-1}\)) was well below the target (1–1.2 g · kg\(^{-1}\) · h\(^{-1}\)) for optimal replenishment of muscle glycogen stores (Burke et al., 2006). Once the carbohydrate intake is insufficient, the co-ingestion of protein could assist in post-exercise glycogen resynthesis, contributing also to the repair exercise-induced muscle damage. Nevertheless, the protein consumption observed (0.2 ± 0.1 g · kg\(^{-1}\) · h\(^{-1}\)) was under the guidelines (0.4 g · kg\(^{-1}\) · h\(^{-1}\)) (Nédélec et al., 2013).

Besides the depletion of glycogen stores, dehydration may also contribute to the development of fatigue (Castagna et al., 2007). Krustup and Bangsbo (2001) described a longer distance from infringements and a shorter distance covered at high intensity in dehydrated referees. Main referees suffer a moderate dehydration similar to players during a game (Maughan, Watson, Evans, Broad, & Shirreffs, 2007), whereas assistant referees experience less dehydration (Da Silva & Fernandez, 2003). The total body water loss during a match, between 1.6 and 2.1 L in main referees and 0.8 and 1.2 L in assistant referees, is only partially replaced by the voluntary fluid intake (Da Silva et al., 2011; Da Silva & Fernandez, 2003; Krustup et al., 2002). Consequently, referees end the game with a fluid deficit between 0.6% and 1.97% of their pre-match body mass (Da Silva & Fernandez, 2003). In our work, fluid intake (6.5 ml·kg\(^{-1}\)) was within the recommended values for the 4h prior to exercise (5–7 ml·kg\(^{-1}\)) (Rodriguez et al., 2009). During exercise, the average ad libitum intake we found was higher (438 mL) than the previously reported figures (250–420 mL) (Da Silva et al., 2011; Da Silva & Fernandez, 2003; Krustup et al., 2002), but 79% of referees did not drink any fluid. This is more relevant because none of the participants consumed enough liquids throughout the day according to the RDI, which do not take into account the additional losses induced by exercise.

Athletes require more dietary protein than their sedentary counterparts to support muscle synthesis, enhance the repair of exercise-induced damage and provide amino acids for oxidation during exercise. The protein requirement of athletes involved in intermittent high-intensity sport, like football, is suggested to be between 1.2 and 1.7 g · kg\(^{-1}\) (Tipton & Wolfe, 2004). The protein intake we found was within the range of usual intake by footballers (Boisseau, Le Creff, Loyens, & Poortmans, 2002; Iglesias-Gutiérrez et al., 2005; Maughan, 1997; Noda et al., 2009; Rico-Sanz et al., 1998; Ruiz et al., 2005; Russell & Pennock, 2011). All referees ensured the minimum recommended value and ten exceeded the upper limit, with a maximum intake of 2.1 g · kg\(^{-1}\). However, there is limited evidence that a protein intake at this level is unsafe for healthy, exercising individuals (Lowery & Devia, 2009).

Fat is important as an energy source during exercise and as a vehicle of fat-soluble vitamins. The mean intake of fat was within the range suggested for athletes (20–35% DEI) (Rodriguez et al., 2009)
and reported in players (Iglesias-Gutiérrez et al., 2005, 2012; Maughan, 1997; Noda et al., 2009; Ruiz et al., 2005; Russell & Pennock, 2011). However, fat accounted for a very high percentage of DEI (>35%) for almost half the sample (11 referees) which can be harmful for health and does not benefit performance (Rodriguez et al., 2009). Regarding the qualitative distribution of fats, we found a profile very similar to Spanish (Iglesias-Gutiérrez et al., 2005; Ruiz et al., 2005), and far from French (Boisseau et al., 2002) and British (Russell & Pennock, 2011) players, reflecting the Mediterranean nature of the diet in Iberian countries.

We found a high proportion of athletes with micronutrient intakes lower than recommended, resembling the results in players (Iglesias-Gutiérrez et al., 2005; Noda et al., 2009). The low intake of antioxidant vitamins observed may weaken the antioxidant defence of referees. Periods of exhaustive training can increase reactive oxygen species to a level that exceeds the higher antioxidant capacity in athletes, leading to cellular dysfunction, muscle damage, fatigue and a decreased physical performance (Bloober, Goldfarb, & McKenzie, 2006). An inadequate folate intake, as we observed, can hinder erythrocyte production, protein synthesis and tissue repair, and a severe deficiency may result in anaemia and reduced endurance performance (Rodriguez et al., 2009). In contrast, most referees ingested sodium above recommendations. However, we must take into account the high sweat losses described for referees (Da Silva & Fernandez, 2003). Although there are no data on referees, considerable sweat sodium losses were reported in players, either during a game (2.4 g) (Maughan et al., 2007) or training sessions (1.96 g) (Shirreffs, Sawka, & Stone, 2006). Therefore, although it is unlikely that a whole-body sodium deficit will occur in most players, some may require much more than the upper limit (2.3 g·d⁻¹).

Conclusion

Our data show that referees’ intake was inadequate, characterised by an excess of fat, saturated fat and cholesterol, and a deficit of polyunsaturated fat, fibre, vitamin E, folate, vitamin A, vitamin C, magnesium and calcium. Likewise, water and carbohydrates intakes did not meet the demands imposed for training and competition and this behaviour can compromise the preparation and recovery from exercise. Referees would benefit from dietary counselling in order to maximise performance and improve health.

References


