Original Article

The use of dietary supplements among soccer referees: How much do they know?

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ABSTRACT

Referees are essential for the correct execution of each soccer match and national soccer associations support them with physical training guidelines in order to improve agility, aerobic and sprint capacity, to reduce the risk of injury and to meet the minimum required performance levels. Despite the importance given to performance skills no specific nutritional guideline is provided to support the performance required. This study was aimed to investigate soccer field and assistant referees knowledge and consumption of dietary supplements. Seventy-one European referees participated to this survey by filling a short and quick anonymous questionnaire designed to collect information about their refereeing category, educational level, frequency of supplement consumption, type of supplement consumed. Moreover, a sub-group of 20 participants wore a training watch to record energy expenditure, distance, and heart rate during training sessions and matches. Our data show that referees frequently consume supplements especially those refereeing in lower categories, moreover they often follow a friend's suggestion when deciding to take a supplement instead of trusting a professional prescription. According to our survey, national and international soccer federations should care more about their referee nutritional education. **Keywords:** Dietary supplements; Soccer; Football; Referee.

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INTRODUCTION

According to the "Federation Internationale de Football Association" (FIFA), 270 million people actively play soccer worldwide. Among them around 5 million are referees and officials. These data make soccer one of the most played sports whose popularity is continuously growing as demonstrated by data from the report "FIFA Big Count 2006" showing that the number of people actively involved in soccer has increased by almost 10% between 2000 and 2006 (FIFA-communication-division, 2007).

Field referees (FR) and assistant referees (AR) are essential for the correct execution of each match, moreover soccer rules make their presence mandatory in every official competition (FIFA, 2017). It is worth noting that only few referees are professionals in Europe and some Latin American countries (Schenk, Bizzini, & Gatterer, 2018) while the majority of them, also when refereeing higher soccer competitions, are non-professional.

Even though, training international standards for referees are still lacking (Schenk et al., 2018) national soccer associations support referees with theoretical physical education and physical training guidelines in order to improve agility, aerobic and sprint capacity, to reduce the risk of injury and to meet the minimum required performance levels.

According to FIFA guidelines, FR physical tests consist of:

1) 6 x 40 m sprints with a maximum allowed time between 6.60 and 6.00 s for each sprint according to gender and categories,
2) 40 x 75 m run / 25 m walk interval test with a maximum allowed time between 17 s / 75 m run and 24 s/25 m walk or 15 s/75 m run and 18 s/25 m walk according to gender and categories.

Moreover, an optional Yo-Yo test might be used to assess referee aerobic fitness.

AR have to pass different tests designed to assess their 1) ability to change direction, 2) ability to perform repeated sprints over 30 m, 3) capacity to perform a series of high-speed runs over 75 m interspersed with 25 m walking intervals (FIFA, 2016).

Passing these tests and meeting the minimum required performance levels, avoiding the risk of injury, requires specific and regular physical training and high fitness level even though referees are not professionals. In this context, while Casajus et al. (Casajus & Castagna, 2007) published data showing that the mean VO_2max observed in 45 top class Spanish FR (age between 27 and 45 years) was 54.9 ± 3.9 mL x kg^{-1} x min^{-1}, Castagna et al. (Castagna, Bendiksen, Impellizzeri, & Krustrup, 2012) demonstrated that mean VO_2max in 245 AR was significantly lower (44.5 ± 5.8 mL x kg^{-1} x min^{-1}). To meet these high quality performance standards, referees need to train themselves 3-4 times per week (Teixeira, Goncalves, Meneses, & Moreira, 2014; (Weston, Drust, Atkinson, & Gregson, 2011; (Weston, Helsen, MacMahon, & Kirkendall, 2004). As recently reviewed by Schenk et al. (Schenk et al., 2018), referees should care about their macro and micronutrients intake, considering a mean energy expenditure between 2600 and 3000 kcal/die for training and match days respectively (Anderson et al., 2017). Unfortunately, most national and international soccer associations do not provide any specific dietary support or guidelines for referees, leaving them the duty to develop their own diet. Likewise, no specific suggestions are provided about dietary supplementation of nutrients or other molecules like ergogenic aids. To our knowledge the only document that addresses the topic of dietary supplementation for referees available on FIFA website is represented by

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an informative article that points out the importance of fluid intake to prevent dehydration (FIFA, 2006), but no other issues of dietary supplementation is discussed.

Therefore, due to the lack of strategies targeted to provide a correct nutritional education for referees, aim of our work was to evaluate, by a short questionnaire, referees knowledge on dietary supplements and their effects.

METHODS

Participants

Seventy-one participants, 50 FR and 21 AR, (mean age 33.73 ± 5.33 years) from different European countries participated in this survey. Among them, 2 were female FIFA referee.

According to referee categories classification reported in "Fitness test for referees" (FIFA, 2016) published by FIFA in 2016, the 71 participants to this study belonged to different referee categories as follow: 55 International or Category 1, 0 Category 2 and 16 Lower categories.

All participants gave their informed consent to the treatment of their anonymous data.

Physical Activity evaluation

Twenty male participants, 10 referees and 10 assistant referees gave their consent to wear a training watch (Polar M400 equipped with Polar H7 heart rate sensor (Polar, Finland)) to record exercise intensity ($kcal \cdot kg^{-1} \cdot h^{-1}$), distance (km), mean and maximal heart rate and running during five training sessions and two matches (Al Sayed, Vinches, & Hallé, 2017; (Pobiruchin, Suleder, Zowalla, & Wiesner, 2017).

Dietary supplements questionnaire

The questionnaire was designed to collect anonymous information on general individual parameters (such as age, gender, height and weight), educational level, employment status, referee categories, information about the knowledge and about the consumption of dietary supplements (such as type and commercial name of supplements used and the frequency of consumption). Moreover, specific questions were presented to access the aim and the reason why they consume supplements and how they decided to take supplements. The questionnaire is reported as supplementary material.

Before asking referees to fill in the questionnaire we evaluated the time needed to complete it by submitting it to a group of 40 people (age between 25 and 50 years) of different educational level; according to the collected data the mean time needed to fulfil the questionnaire was between 2 and 3 minutes.

Statistical analysis

Physical activity data are reported as means ± SD. To access the continuous distribution of all variables the Kolmogorov–Smirnov normality test was applied. Variables such as energy expenditure, running distance, mean and maximal heart rate were analysed by Student's t-test. Values of $p < 0.05$ were considered as statistically significant.

RESULTS

Physical activity

Tables 1 and 2 show intensity, running distance, mean and maximal heart rate reordered by FRs and ARs during soccer matches and training respectively. During a match, performance requirements for FRs are significantly higher than for ARs in terms of energy expenditure, mean and maximal heart rate, moreover FRs are required to run longer distances than ARs. On the contrary no differences have been observed when the same parameters were collected during training. All participants declared to train between 2 and 3 times per week, independently from their category.

Table 1. Physical activity parameters recorded during match performances

	FRs	ARs
Energy expenditure (kcal)	1266.2±75.8*	994.8±165.4
Running distance (km)	8.71±0.51*	6.10±1.25
Mean heart rate (bpm)	162.2±3.4*	157.0±7.1
Max heart rate (bpm)	189.7±4.8*	183.3±5.9

Energy expenditure, running distance, mean and max heart rate were obtained as reported in Material and Methods section. According to the Kolmogorov-Smirnov normality test, all variables resulted continuous. Data were analysed by Student's t-test.
** p <0.05 FRs vs ARs.*

Table 2. Physical activity parameters recorded during training sessions

	FRs	ARs
Energy expenditure (kcal)	977.3±299.2	701.2±343.9
Running distance (km)	5.84±2.10	4.93±2.37
Mean bpm	138.5±15.0	140.7±9.3
Max bpm	187.7±19.4	182.4±14.4

Energy expenditure, running distance, mean and max heart rate were obtained as reported in Material and Methods section. According to the Kolmogorov-Smirnov normality test all, variables resulted continuous.

Educational level

Figure 1 shows the educational level of the referees participating in this survey. As reported in Figure 1A no participants had an educational level lower than College degree, in fact 32% had a College degree while the remaining 68% had an University degree, bachelor, master or higher, suggesting that soccer FRs and ARs are characterized by high educational level. Figure 1B shows the percentage distribution of the educational level between College and University degrees among referees of International/Category 1 and lower Category. International/Category 1 referees present a higher percentage of participants with University degree.

Dietary supplements consumption

Figure 2 represents the dietary supplements consumption distribution among participants to the study divided according their referee category (figure 2A) and educational level (figure 2B).

Data show that participants refereeing in lower categories or with a lower educational level have an aptitude to consume more dietary supplements. In fact, 18.75% of referees playing in lower categories consume supplements more than 5 times/week while no one of those refereeing in International or Category 1 reach such a consumption. Similarly, only those with a lower educational level consume supplements more than 5 times/week while referees with a university degree do not consume supplements more than 5 times/week.

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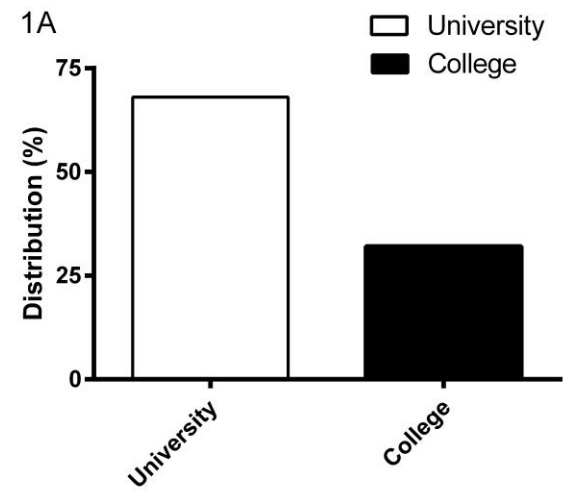
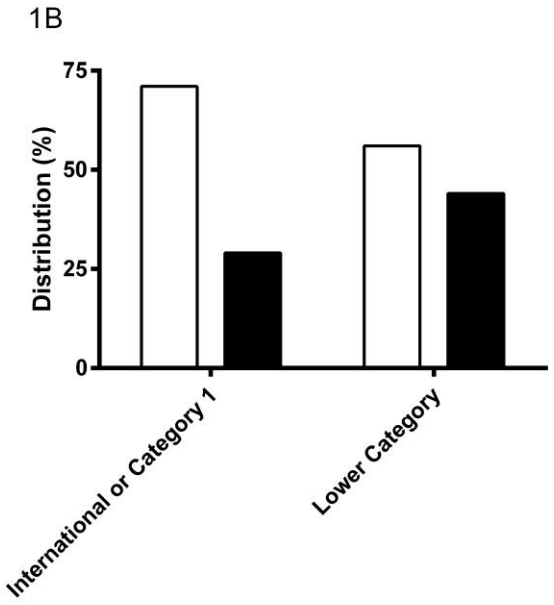
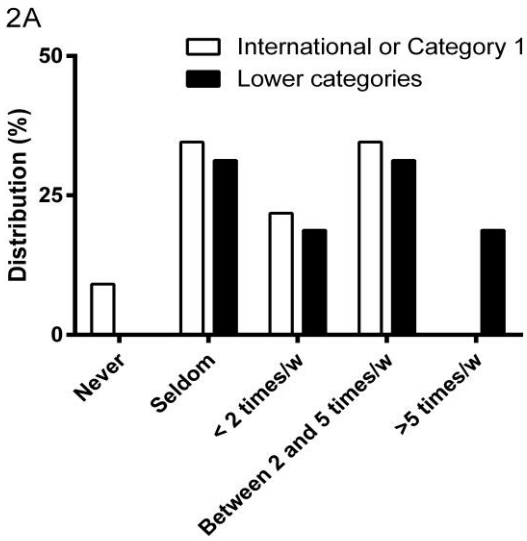
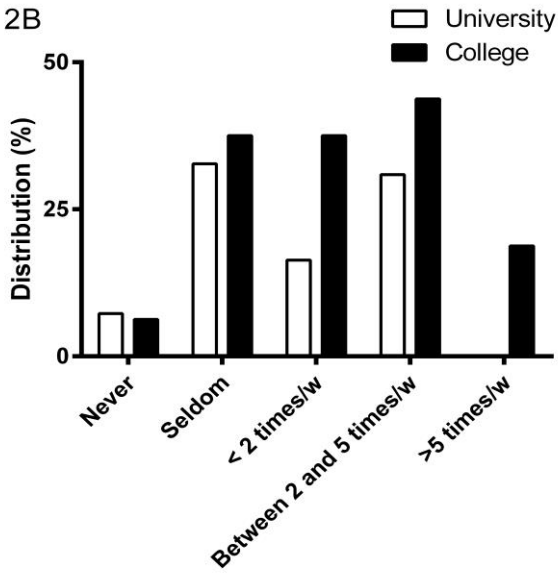








Educational level of referees participating in the study (1A). Educational level among referees of different FIFA categories (1B).

Figure 1. Referees educational level

Frequency of dietary supplements consumption among participants to the study divided according their referee category (figure 2A) and educational level (figure 2B).

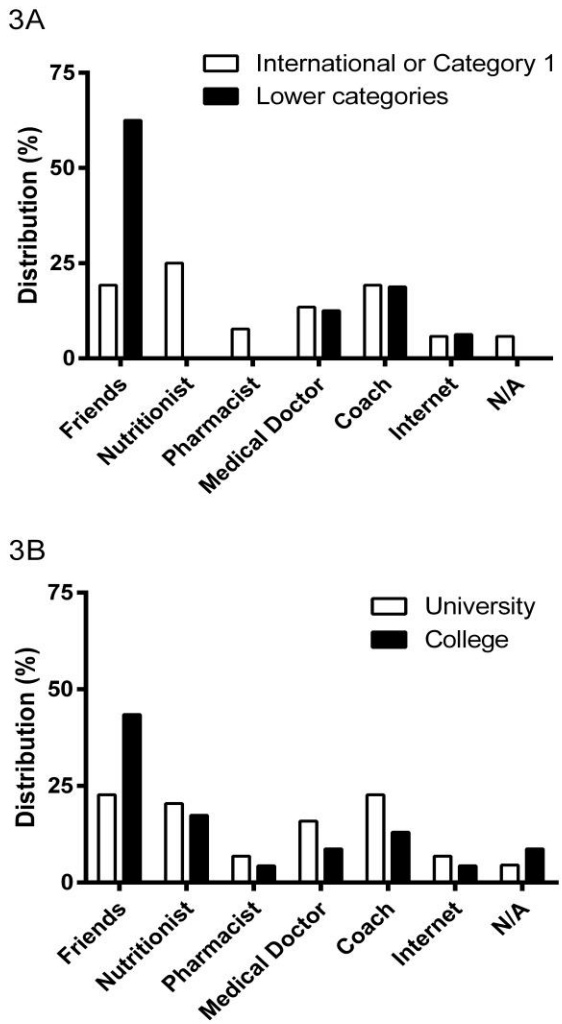
Figure 2. Dietary Supplements consumption

How participants decided to use dietary supplements

Figure 3 describes how the decision to use dietary supplements was taken following friend, nutritionist, pharmacist, medical doctor, coach or Internet suggestions. The distribution among different answers is divided according to the referee category (figure 3A) and educational level (figure 3B).

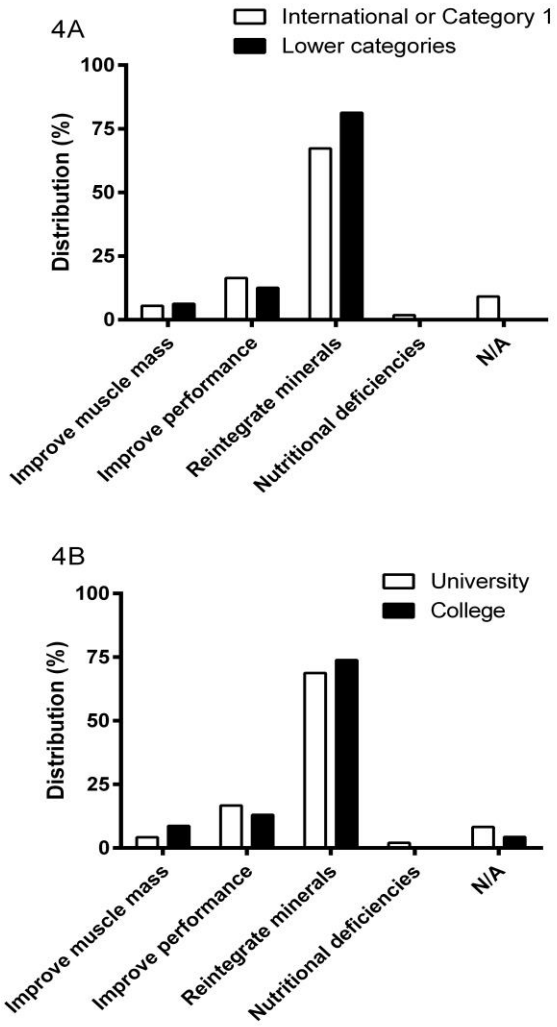
Data show that participants refereeing in lower categories or with a lower educational level are more prone to trust friend suggestion. In fact, 62.5% of referees playing in lower categories declared that they decided to use supplements following the advice of a friend while only 19.2% of those refereeing in International or

Category 1 gave the same answer. Similarly, "friends" was the answer in 43.5% of those with a college degree vs. 22.7% of those with a University educational level. Interestingly, 46.1% of participants refereeing in International or Category 1 trust the suggestion or follow the prescription of a professional expert in supplements such as medical doctors, nutritionists or pharmacists, while only 13.5% of those refereeing in lower categories did the same. The coach represents the trusted person in the 19% of the participants of both referee categories, in this case the educational level seems to be more effective to determine this choice, in fact 22.7% of those with a university degree versus 13% of those with a college degree declared to follow a coach's advice when starting to take a supplement. Surprisingly, only 6.3% of the entire subject group declared to follow an Internet advertisement when deciding to take a supplement.



The distribution among different answers is divided according to the referee category (figure 3A) and educational level (figure 3B).

Figure 3. Distribution of according to which suggestion the decision to take supplements was taken



The distribution among different answers is divided according to the referee category (figure 4A) and educational level (figure 4B).

Figure 4. Distribution of the reasons to take supplements

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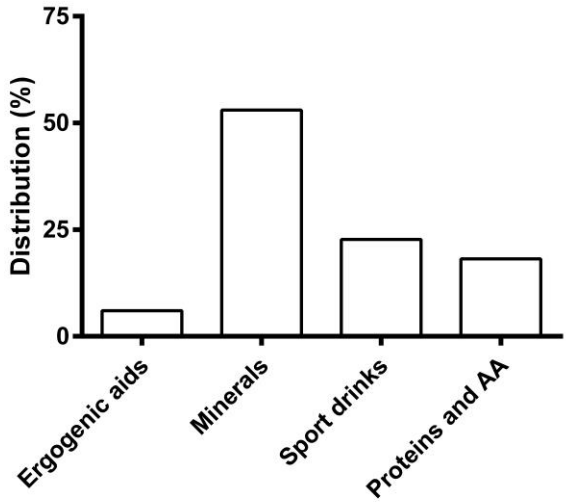
Reasons why taking supplements

Figure 4 represents the motivation to take supplements according to the collected answers. The distribution among different answers is divided according to the referee category (figure 4A) and educational level (figure 4B).

Interestingly, independently from refereeing category or educational levels, the answer "to reintegrate minerals" represents more than 70% of total answers. Only 6% and 11% of the entire subject group declared that they take supplements with the aim to improve their muscle mass or performance respectively.

Supplements used

A question asked the participants to write the commercial names of the dietary/sport supplements used. Sixty-six out of 71 participants answered the question and the answers were then divided among categories describing the ingredients in different supplements. Figure 5 shows that referee supplement consumptions are represented by mineral supplements, followed by sport drinks providing minerals, sugars and vitamins and by proteins and amino acids, while only 6% of the participants declared to use ergogenic aids such as creatine, beta-alanine, carnitine, taurine and caffeine, or mixture of plant extracts such as guarana, yerba mate, green or black tea with thermogenic purposes.



Data on different supplement consumed by the referees participating in the study were divided according different supplement categories.

Figure 5. Supplement categories consumed by referees participating to the study

DISCUSSION

FRs and ARs are an essential component of soccer, their duty is to ensure that every rule of the game is respected during any match. Without them no soccer official match could take place. A good referee needs to possess many specific skills: leadership, decision-making firmness, excellent communication ability, high training level, ability to withstand pressure and maintenance of very high concentration level during the entire match (MacMahon, Helsen, Starkes, & Weston, 2007). Inadequate physical preparation could negatively affect the decision-making process during a match resulting in possible errors by the referee (Mendez-Villanueva & Buchheit, 2013). Moreover, a high referee fitness and training level is necessary to reduce the

risk of injuries (Gabrilo, Ostojic, Idrizovic, Novosel, & Sekulic, 2013). High referee fitness and training level is also needed to cope with the high physical demand imposed especially when dealing with professional soccer players. Data collected in this study confirm previous reports showing that refereeing a soccer match is a high demanding activity in term of both energy expenditure and heart rate. In this study, referee energy expenditure was about 1250 kcal in a 90 min match, this estimation is completely in agreement with previously published data indicating that referee energy expenditure during a soccer match is about 1200 kcal (D'Ottavio & Castagna, 2002). Similarly, our data on referee mean heart rate during the match (162 bpm) confirmed previous reports indicating that, despite the relatively short running distance, referee mean heart rate is usually around 170 bpm (Castagna, Abt, & D'Ottavio, 2007).

Referees, especially those refereeing in higher categories, are characterized by an high educational level, university or college degree, with an higher number of those possessing a university degree refereeing in higher soccer categories; to our knowledge this observation was not previously reported. Our data describe that FRs and ARs are massive consumers of dietary supplements. Particularly those refereeing in lower categories and those with a lower educational level consume supplements more than 2 times per week, while only 8% of them declare to never consume supplements. Despite the high educational level and the frequent consumption of supplements it clearly appears that FRs and ARs don't receive any specific formation on dietary supplements and their role in sport nutrition. In fact, among those refereeing in lower categories 62.5% declare to trust a friend's suggestion when deciding to use a dietary supplement, while only 12% follow the suggestion of professional expert. These data are in agreement with those published by Wiens et al. who reported that, among 567 young Canadian athletes, primary sources of information on dietary supplements were family and friends, coaches and trainers (Wiens, Erdman, Stadnyk, & Parnell, 2014). Data change when considering people refereeing in higher categories, in this case 46% trust the suggestion or follow the prescription of a professional expert in supplements such as medical doctors, nutritionists or pharmacists and only 19% trust a friend suggestion. According to our data, it appears that the refereeing category is more effective than the educational level when the referee have to decide who trust when taking any type of supplement. Probably thank to the presence of a coaching staff composed by coach, medical doctor and sometimes a nutritionist, people refereeing in higher categories benefit from a better nutritional support. On the contrary, people refereeing in lower categories do not seem to benefit from the same support.

Interestingly, more than 70% of FRs and ARs that filled the questionnaire used in this study declared that the motivation to consume supplements was to reintegrate minerals and this is independent from the educational level or the refereeing category, the second motivation was represented by the desire to improve muscle mass. In agreement with the motivations declared the supplements effectively consumed are mainly represented by minerals and then by sport drinks, proteins or amino acids and ergogenic aids.

Even though minerals are essential for the fluid and electrolytes homeostasis they are not the only nutrient category that need to be replaced especially during a high demanding physical activity such as refereeing a soccer match. As we observed, FR energy expenditure is around 1200 kcal in a 90 min match, to face such a high expenditure, carbohydrates, besides water and minerals, are needed to maintain a high performance and concentration level. So, some amount of drinks containing water, carbohydrates and minerals should be consumed whenever possible during the match, not only by soccer players but also by referees. Moreover, beside minerals and energy sources needed to face the effort required by a soccer match, referees as well as any other athletes should care about the health protective role of some nutraceutical compounds (Malaguti, Angeloni, & Hrelia, 2013).

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CONCLUSION

In conclusion, our investigation demonstrated that FRs and ARs have not a sufficient knowledge of dietary supplements. Some of them consume supplements with a high frequency, often without the supervision of a nutritionist or a medical doctor. Moreover, despite the high performance level required especially by FRs involved in top categories, most of them feel only the importance of minerals replacement, while their physical activity probably requires a more structured supplementation that includes also some energy source readily available.

Our data suggest that each national and international soccer federation should make an effort to educate referees in the field of sport nutrition and to support them with a complete staff including also a nutritionist with the aim to improve performance and health.

AUTHORS CONTRIBUTION

The study was designed by MM, MS, CA and SH; data were collected and analysed by MM and MS; data interpretation and manuscript preparation were undertaken by MM, MS, CA, and SH. All authors approved the final version of the paper".

CONFLICT OF INTEREST

Authors declare no conflict of interest.

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