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Nutritional intake and nutritional status in elite Mexican teenagers soccer players of different ages

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Abstract

Introduction: **nutritional intake and status of soccer players has attracted not much research attention. Many soccer players follow an inadequate nutritional intake and have a poor nutritional status. This is relevant in youngsters soccer players, in order to improve performance and promote healthy dietary practices.**

Aims: **analyze anthropometric characterizes, evaluate nutritional intake and status, dietary habits and pre- and post-exercise meals in elite teenagers soccer players.**

Methods: **seventy-two young male soccer players (15-20 years) from four junior teams of a soccer Club from the Mexican National Soccer League were measured for height, seat height, weight, 6 skinfolds, 6 diameters and 7 circumferences, height-for-age and BMI-for-age values. Skin, adipose, muscle, bone and residual tissue masses were calculated with the Ross and Kerr equation. Resting energy expenditure and intake was also measured. Daily dietary intake was self-recorded for 4 consecutive days (excluding the match day) using a digital food-weighing scale and a food record questionnaire. Dietary analysis was performed using the NutriBase 7 Clinical software. Several biochemical values were determined. One-way analysis of variance (ANOVA) and *post hoc* testing was performed using *t*-tests with a Bonferroni correction.**

Results: **all soccer players were within the normal range values for anthropometric parameters studies, when compared with other adolescent elite soccer teams. Values of plasma glucose, urea, creatinine, uric acid, lipid profile and total proteins were within normal range for young adult population, although albumin levels were high. Moreover, 14% and 20% of soccer players presented hyperuricemia and elevated total cholesterol levels respectively. Energy expenditure and intake were within normal range for all teenager elite soccer players. However, two teams shower significant lower intakes than demands. All macronutrient intakes were within recommendations, except protein that was higher. Micronu-**

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INGESTA NUTRICIONAL Y ESTADO NUTRICIONAL DE JUGADORES DE ÉLITE ADOLESCENTES, DE FÚTBOL MEXICANO, DE DIFERENTES EDADES

Resumen

Introducción: **la ingesta nutricional y el estado nutricional de los futbolistas no han suscitado mucha atención. La mayoría de los futbolistas siguen una dieta inadecuada y tienen una condición nutricional pobre. Esto adquiere mayor importancia cuando se trata de jugadores jóvenes, ya que se podrían mejorar su juego y sus hábitos nutricionales.**

Objetivos: **analizar las características antropométricas, la ingesta y el estado nutricional, los hábitos dietéticos y la alimentación antes y después del ejercicio en equipos de élite de futbolistas adolescentes.**

Métodos: **se estudiaron a 72 jugadores masculinos de 15-20 años, pertenecientes a cuatro equipos junior de un club mejicano de la Liga de Fútbol Nacional. A los jugadores se les midió el peso, la altura, la altura sentado, seis pliegues cutáneos, seis diámetros, siete circunferencias, los valores estatura para la edad e IMC para la edad. La masa de piel, tejido adiposo, músculo, hueso y masa residual se calcularon con la ecuación de Ross y Kerr. Se midió el gasto energético y la ingesta energética diaria. Se recogió la ingesta diaria durante cuatro días (excluyendo el día del partido) y se empleó una báscula digital y un cuestionario dietético. El análisis dietético se realizó con el programa NutriBase 7 Clinical. Se midieron varios parámetros bioquímicos. Se empleó el test ANOVA y los test *post hoc* usados fueron el de la t´Student y el de Bonferroni.**

Resultados: **los parámetros antropométricos de todos los futbolistas estudiados se encontraban dentro de los valores normales para futbolistas de élite adolescentes. Los valores plasmáticos de glucosa, urea, creatinina, ácido úrico, perfil lipídico y proteínas totales estaban dentro de los valores normales de la población adolescente. Sin embargo, la albúmina se encontraba elevada y el 14 y el 20% de los futbolistas presentaban niveles altos de ácido úrico y colesterol. La ingesta energética y el gasto energético eran los habituales en los futbolistas de élite adolescentes, aunque dos equipos tenían una ingesta energética inferior a sus necesidades. El consumo de micronutrientes era superior a las recomendaciones**

trient intake exceeded the recommendations for general population. Soccer players had pre- and post-exercise meals with an appropriate range of carbohydrates. Food intake was mainly based on cereals, derivatives and potatoes; meat, poultry, fish, shellfish and eggs and biscuits and confectionery and poor in fruit, vegetables and milk and dairy products.

Conclusions: **the population of soccer players did not have optimal nutritional habits. However, their nutritional intake and status was better than in other published studies. The main problems of these teams were that they had a high protein diet and that in some teams the nutritional intake was not enough to cover the demands. Finally, nutritional intake was found to be of poor quality. Thus, we recommend nutritional education for soccer players of these teams.**

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Key words: *Soccer. Nutritional intake. Nutritional status. Body composition. Teenagers.*

para la población normal. Los futbolistas ingerían comidas pre y post-ejercicio, con unas cantidades adecuadas de carbohidratos. Su alimentación se basaba fundamentalmente en el consumo de cereales, pastas y derivados; productos cárnicos; pescados; huevos; bollería industrial y golosinas. Además era muy pobre en frutas, verduras y productos lácteos.

Conclusiones: **la población de futbolistas estudiados no tuvo unos hábitos nutricionales óptimos. Sin embargo, fueron mejores que los que se vieron en otros estudios publicados. Los principales problemas nutricionales observados fueron que la dieta era elevada en proteínas, que en algunos casos era insuficiente para cubrir las demandas energéticas y que era poco variada. Así pues, se recomienda una educación nutricional para esos equipos de futbolistas.**

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Palabras clave: *Fútbol. Ingesta nutricional. Estado nutricional. Composición corporal. Adolescentes.*

Abbreviations

BM: Body mass.
BMI: Body mass index.
FAO: Food and Agriculture Organization of the United Nations.
HDL: High density lipoprotein.
ISAK: International Society for the Advancement of Kinanthropometry.
LDL: Low density lipoprotein.
MUFA: Monounsaturated fatty acids.
PAL: Physical activity level.
PUFA: Polyunsaturated fatty acids.
REE: Resting energy expenditure.
RDI: Reference daily intake.
SAF: Saturated fatty acids.
TEE: Total energy expenditure.
UNU: United Nations University.
WHO: World Health Organization.

Introduction

Soccer is a strength an intermittent power-contact sport. It is characterized by periods of high-intensity, followed by periods of sub-maximal effort over approximately 90 min. During a game, players run approximately 9–12 km, depending on their position and intensity of play[1,2] Usually, the average intensity during a match is about 70%–75% of the VO_2max[3]. Actually, most professional football players play in more than one competitive game per week for almost all the year. In addition, they have to train most days of the week, sometimes, twice a day, throughout this time.

Apart from innate skills, training and sound tactics, a well-chosen diet is the single most important factor influencing athletic performance[4] and can offer many benefits. Adequate nutrition helps to: i) optimize energy production, control and efficiency sport[5]; ii) reduces the risk of injury and illness[6]; iii) enhanced recovery within and between matches and workouts and allows optimum gains from the training programs[7].

In addition, it is important for achievement and maintenance of an ideal body weight and physique. In the case of adolescent soccer players this issue is of particular relevance, because many anthropometric changes occur during the formative years of a soccer player and they determine, in part, the sport performance of the player in the future[8]. In addition, there are teenagers soccer players who are being developed towards a potential career in elite and they also play in a number of competitions. This can lead to heavy physical demands on these young players.

Consequently, good nutritional intake during adolescent period can be decisive for a soccer player´s future sporting career[9].Despite the advantages of a good nutrition, many players do not meet their nutritional goals.

Although soccer is currently the world´s most popular sport the nutritional intake and status of soccer players has attracted not much research attention. A recent review that has focused on this issue indicates that only few studies have addressed nutrition for football[10].From the few available studies, it seems that total energy intake is often insufficient[11]. In addition, diets are unbalance[11].

In the case of developing soccer players or teenager players the information available is even more limited.

The demands and competitiveness of adolescent soccer players is increasing. This enhances the risks associated with these players, who increase their independence in food choice, usually have poor nutritional knowledge, dietary behavior and practices[12]. Teenager players should be encouraged to develop good nutritional habits at an early age. Thus, it is important to

evaluate the nutritional status, intake and dietary habits of adolescent football players. The aim of this study was to analyze anthropometric characterizes, evaluate nutritional intake and status, as well as dietary habits and finally, to evaluate pre- and post-training and game meals. To this end, we selected four elite teams of Mexican National Soccer League, based on players from 15-20 years old.

Methods

Subjects

Seventy-two young male soccer players (aged 15-20 years) were recruited, for a descriptive cross-sectional study, from four junior teams of a soccer Club from the Mexican National Soccer League. All the players in those teams were invited to take part in the study and all agreed to participate. Written consent was obtained from each of the participating soccer players and their families, according to the study design approved by the Committees on Ethical Research of the Instituto Politécnico Nacional (México DF, México).

At the time of the study, the players were in the middle of the Champions League season, and trained for 5 days per week, 2h per day, plus one League match per week.

Body composition and energy expenditure calculations

Height and seat height were measured to the nearest 0.1 cm using a fixed stadiometer (Seca 214, México DF, México), and weight was measured to the nearest 0.1 kg with a portable balance (Seca 813, México DF, México). Body mass index (BMI) was calculated as body mass (BM) in kilograms divided by height in meters squared (kg/m^2). Skinfolds (mm) were measured at six sites (triceps, biceps, subscapular, abdominal, front thigh, medial calf; precision 0.2 mm) using Harpenden skinfold caliper (West Sussex, UK). The sum of the six measurements was used for analysis. Six diameters were measured to the nearest 0.1 cm (elbow, wrist, ankle, upper arm, forearm, thigh) with the Campbell 10 and 20 calipers (Rosscraft, Canada). Seven circumferences (head, neck, chest, waist, hip, thigh and calf) were measured using a flexible steel anthropometric tape (Anthrotape, Rosscraft, Canada).

All measurements were performed according to standard procedures used by the International Society for the Advanced Kinanthropometry (ISAK). All data were collected by the same ISAK level-3 anthropometrist.

Height-for-age and BMI-for-age values (z-score) were calculated using WHO Anthroplus software (http://www.who.int/growthref/tools/en/). To calculate skin, adipose, muscle, bone and residual tissue masses (all of them in kg)the Ross and Kerr anthropomorphic fractionation protocol was used[13].

Resting energy expenditure (REE) was calculated using the FAO/WHO/UNU predictive equation (version of year 1985), according with the group of age[14]. Total energy expenditure (TEE) was calculated by the factorial method (TEE = physical activity level (PAL) x REE). PAL value selected was 1.8, which reflected active lifestyles.

Nutrient analysis

Daily dietary intake was self-recorded by the soccer players for 4 consecutive days (excluding the match day). To ensure the weight of food consumed was properly recorded, all participants and their families were provided with a digital food-weighing scale (SF-400, México DF, México; maximum 5 kg, precision 1 g) and a food record questionnaire. They also received specific oral guidelines and detailed written instructions about how to complete the dietary register. In addition, they were asked not to alter their usual dietary behavior during this period. All food diaries were recorded during the same month to avoid seasonal dietary changes. Finally, food records were carefully reviewed immediately after completion.

Dietary analysis was performed using the NutriBase 7 Clinical software (version 7.18, CyberSoft, Incorporated, Phoenix, AZ, USA). All analyses were performed by the same trained person. From this analysis, detailed information on intake of calories, proteins, carbohydrates, fats (saturated, monounsaturated and polyunsaturated), cholesterol, dietary fiber, vitamins (A, B group, C and D) and minerals (sodium, potassium, calcium, phosphorus, iron and zinc) was obtained. The unit of analysis was the average of the sum of nutrient intake over 4 days. Moreover, to analyze the contribution of different food groups to the total daily energy intake, foods were classified into 7 groups (cereals, derivatives, legumes and potatoes; milk and dairy products; vegetables; fruits; meat, poultry, fish and eggs; oil, butter and margarine; biscuits and confectionery). The reference dietary intakes adopted in this study are the recommended values for the general population by age and sex (from the Food and Nutrition board, Institute of Medicine, USA), without taking into account physical activity.

Biological sample collection and laboratory methods

Blood samples were drawn the day before the beginning of the study. All of the subjects had fasted for 12 h overnight and avoided performing intense physical activity 24 hours (h) prior to sample collection. Blood was obtained by antecubital venipuncture of the non-dominant forearm. Serum was obtained after 45 min of clotting by centrifugation at 1500 *g* for 20

min at 4ºC and stored at -80ºC until analysis. The biochemical analyses were performed on completion of the study. Thus, all samples were measured within one analytical run with a BenchTop chemistry analyazer (Selectra E, Vital Scientific, Spankeren, Netherland). The parameters measured were glucose, total cholesterol, HDL-cholesterol, triglyceride, uric acid, urea, creatinine, total proteins and albumin. LDL-cholesterol levels were calculated by the Friedewald equation.

Statistical analysis

All results are reported as means and standard error of the mean (mean ± SEM) calculated by conventional procedures unless otherwise stated. All calculations were performed using the Statistical software SPSS 21.0 for Windows (SPSS Inc.,Chicago, IL, USA). Individual age groups were evaluated using one-way analysis of variance (ANOVA). *Post hoc* testing was performed using *t*-tests with a Bonferroni correction. Independent *t*-tests were used to compare differences between groups. The level of significance was set a $p \leq 0.05$ for all analyses.

Results

Physical and anthropometrical characteristics

Table I shows the mean physical and anthropometrical characteristics of the players by age group. No significant differences were found between teams in any of the parameters measured (height, weight, sum of 6 skinfolds, BMI, fat mass, muscle mass, residual mass, bone mass, skin mass, height-for-age Z-score and BMI-for age Z-score. The data also showed that all soccer players were within the normal range values for all parameters studies when compared with other adolescent elite soccer teams.

Biochemical parameters

In table II, it can be observed the biochemical values of the players by age group. The data show that mean and SEM biochemical values of glucose, urea, creatinine, uric acid, lipid profile and total proteins were within normal range for young adult population. Albumin levels were increased over the normal range. In fact, 89% of soccer player presented increased blood albumin levels. However, when we looked at uric acid and total cholesterol records individually, we observed that 14% and 20% of soccer players presented hyperuricemia and elevated total cholesterol levels respectively.

Daily energy expenditure and intake and macronutrient intake

Table III shows the estimated daily resting and total energy expenditure of soccer players. In addition, it can be observed the energy and macronutrient intake of all the soccer players assessed and grouped according to their age group.

In general, there were not significant differences in estimated daily resting and total energy expenditure

Table I
Anthropometrical characteristics of soccer players

	Team A	*Team B*	*Team C*	*Team D*
N	24	24	18	6
Age (y)	15.5 ± 0.006	16.5 ± 0.04	17.3 ± 0.04	19.3 ± 0.17
Weight (Kg)	61.8 ± 1.31	65.9 ± 1.73	67.1 ± 1.26	68.3 ± 2.01
Height (cm)	171.5 ± 1.15	173.2 ± 1.37	174 ± 1.33	175.6 ± 2.77
Sum of 6 skin folds (mm)	48.4 ± 1.99	48.7 ± 3.25	53.9 ± 2.81	57.8 ± 5.47
BMI (Km/m^2)	20.9 ± 0.23	21.8 ± 0.33	22.2 ± 0.38	22.2 ± 0.71
Adipose mass (Kg)	14.2 ± 0.54	14.7 ± 0.60	15.9 ± 0.53	17 ± 1.16
Muscle mass (Kg)	28.5 ± 0.85	31.5 ± 0.83	32.1 ± 0.65	32.5 ± 1.03
Residual mass (Kg)	8.1 ± 0.77	7.9 ± 0.20	7.7 ± 0.16	7.5 ± 0.31
Bone mass (Kg)	7.5 ± 0.18	8.2 ± 0.25	7.7 ± 0.16	7.4 ± 0.22
Skin mass (Kg)	3.5 ± 0.08	3.6 ± 0.04	3.7 ± 0.048	3.8 ± 0.08
Height for age Z-score	0.1 ± 0.18	-0.1 ± 0.18	-0.2 ± 0.16	ND
BMI for age Z-score	0.3 ± 0.10	0.3 ± 0.10	0.3 ± 0.12	ND

Data are reported as means ± SEM. ND: not determined.

Table II
Biochemical parameters of soccer player

	Team A	*Team B*	*Team C*	*Team D*
N	24	24	18	6
Glucose (mg/dl)	80.8 ± 1.46	81.8 ± 1.71	83.2 ± 2.74	86.8 ± 2.46
Urea (mg/dl)	33.2 ± 1.46	35.6 ± 1.29	42.6 ± 1.94	36.5 ± 2.24
Creatinine (mg/dl)	0.9 ± 0.02	0.9 ± 0.02	1 ± 0.02	0.9 ± 0.04
Uric acid (ml/dl)	5.3 ± 0.18	6.4 ± 0.20	6.1 ± 0.24	5.7 ± 0.40
Choresterol (mg/dl)	172 ± 5.99	165.1 ± 8.07	169.7 ± 7.23	187.2 ± 12.55
Triglicerides (mg/dl)	97.8 ± 6.03	92.2 ± 5.80	98.7 ± 9.44	111.8 ± 20.94
HDL-D (mg/dl)	64.7 ± 5.21	56.4 ± 9.54	77.6 ± 6.45	56.8 ± 7.98
LDL-D (mg/dl)	87.2 ± 6.28	78 ± 6.94	85.4 ± 7.52	84.2 ± 9.85
Albumin (g/dl)	4.9 ± 0.06	5.2 ± 0.66	5.2 ± 0.04	5.3 ± 0.17
Total protein (g/dl)	7.2 ± 0.16	6.5 ± 0.25	6.2 ± 0.12	7.8 ± 0.22

Data are reported as means ± SEM

Table III
Daily energy expendidure and intake and macronutrient intake of soccer player

	Team A	*Team B*	*Team C*	*Team D*
N	24	24	18	6
REE (Kcal)	1732 ± 23	1804 ± 30	1825 ± 20*	1724 ± 31
TEE (Kcal)	3118 ± 41	3246 ± 55	3286 ± 39	3103 ± 56
Energy Intake (Kcal)	3067 ± 151	2930 ± 73	2715 ± 131	3042 ± 117
Energy Intake/BM (Kcal/Kg)	50.3 ± 8	45.1 ± 1.44	40.7 ± 2.0*	44.9 ± 2.86
Proteins				
g	134 ± 7.5	128 ± 4.4	124 ± 5.3	145 ± 14
g/Kg BM	2.2 ± 0.12	2 ± 0.06	1.9 ± 0.07	2.2 ± 0.22
% of energy intake	17 ± 0.004	18 ± 0.004	19 ± 0.004	19 ± 0.01
Carbohydrates				
g	405 ± 20	371 ± 10	357 ± 19.4	364 ± 17.48
g/Kg BM	6.7 ± 0.4	5.7 ± 0.2	5.4 ± 0.3	5.4 ± 0.31
% of energy intake	53 ± 0.006	51 ± 0.008	53 ± 0.01	48 ± 0.022
Fiber (g)	28.6 ± 2.7	25 ± 1.31	21.4 ± 1.36	25.5 ± 1.97
Lipids				
G	105 ± 5.4	106 ± 4.2	90 ± 5.3	113 ± 6.3
g/Kg BM	1.7 ± 0.08	1.6 ± 0.06	1.3 ± 0.07	1.7 ± 0,13
% of energy intake	31 ± 0.006	33 ± 0.008	30 ± 0.007	33 ± 0.004
SAF (g/d)	37.2 ± 2.0	36.6 ± 1.60	31.2 ± 2.06	36.9 ± 2.02
MUFA (g/d)	33.4 ± 2.0	34 ± 1.56	28.8 ± 1.89	36.9 ± 2.28
PUFA (g/d)	17 ± 1.0	18 ± 0.93	17.5 ± 1.22	19.4 ± 1.56
Cholesterol (mg/d)	394.4 ± 26	394.4 ± 25	359.4 ± 22	421.8 ± 28.38

Data are reported as means ± SEM. *$p < 0.05$ *vs* Team A.

among different age groups, except for the estimated resting energy expenditure that was significantly higher ($p < 0,05$), when comparing 17*vs* 15 years old soccer players. Mean energy intake for different age groups was not significantly different. However, when energy intake was shown relative to BM (Kcal/kg), caloric intake per kilogram was found to be significantly lower ($p < 0.05$) in 17 *vs* 15 years old soccer players.

No significant differences in protein, fat, fiber or total carbohydrate intake were identified between the four groups of players. The same happened when macronutrient intakes were shown relative to BM (g/kg). In addition, the contribution of each macronutrient to the total caloric intake was not significantly different among the four teams. Moreover, carbohydrate, fiber and lipids intake were within recommended range for all soccer players. However, protein intake was slightly higher than recommended for the four soccer teams. Looking at lipid profile of the four age groups, all of them were similar. Nevertheless, the percentage of total energy intake provide by saturated acids slightly exceeded the recommendations (10.8 ± 0.3% for all soccer teams), while polyunsaturated fatty acids were slightly below the recommendations (4.9 ± 0.2% for all soccer teams). Finally, cholesterol intake far exceeded general population recommended values (392 ± 12 mg/d for all soccer teams).

Daily micronutrient intake

As it is shown in figure 1, average ingestion of micronutrients (minerals and vitamins) in the four groups of players exceeded the recommendations for general population except for potassium and vitamin D. Particularly, the levels of intake of vitamins B_2, B_6 and B_{12} very high. On the contrary, potassium and vitamin D intakes were far below the recommendations. No significant differences for all vitamins and minerals analyzed were identified between the four groups of players (data not shown).

Relative contribution (%) of foods groups to total daily energy intake and distribution of energy intake (%) and macronutrients (%) across different meals.

The relative contribution (expressed as percentage) of the different food groups to the total daily energy intake is shown in figure 2. The food intake of these soccer players was mainly based on the following food groups: i) cereals, derivatives and potatoes; ii) meat, poultry, fish, shellfish and eggs and iii) biscuits and confectionery. All of them provided 72% of total daily energy intake.

Concerning the distribution of energy intake and macronutrients during the day, there were not differences between the four soccer teams. All of them had breakfast, morning snack, lunch, afternoon snack and dinner. The higher percentage of total energy ingested were at dinner (30%), lunch (29%) and breakfast (22%). The percentage of total energy ingested at snacks was the same (9%). For carbohydrate and lipids the intake was within recommended range in the case of breakfast, lunch and dinner. However, protein intake was higher than recommended in these three meals, particularly in lunch (38%) and dinner (34%). In the case of snacks the percentage of energy from carbohydrates, fats and proteins were respectively 12%, 8% and 4%.

Finally, looking at pre- and post-training and game meals, 88% of soccer players had these pre-meals independently of training or game schedule (morning or afternoon). However, during the morning schedule only 21% of soccer players had a snack. In contrast, during the afternoon schedule 44% of soccer players had the

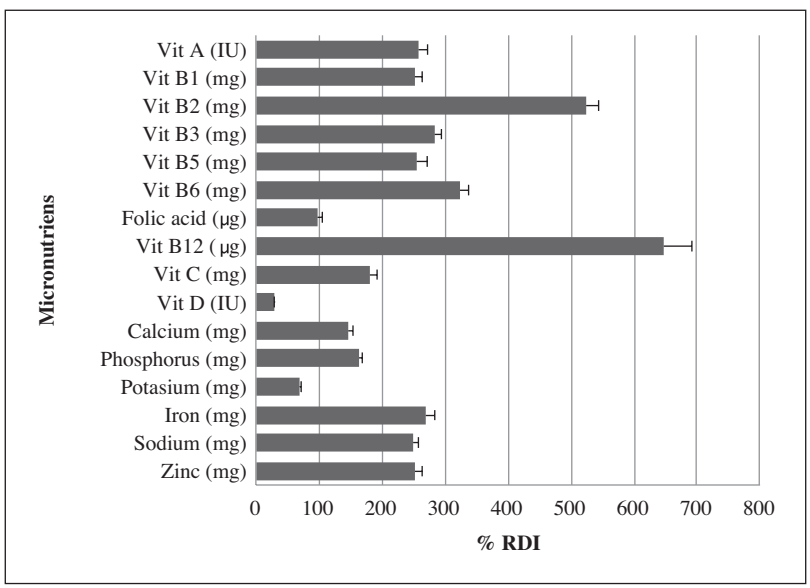

Fig. 1.— Micronutrient (vitamins and mineral) daily intake. Average daily ingestion of micronutrients in the four groups of players. Values are expressed as percentage of RDI for general population. Data are expressed as means ± SEM. N = 72 soccer players.

snack. Pre- and post-training and game meals (morning or afternoon) had 1.2±0.1 g/kg BM of carbohydrates, 1.2±0.1 g/kg BM of proteins and 0.35±0.05 g/kg BM of fats.

Discussion

Football players can stay healthy, avoid injury, and achieve and maintenance an ideal body composition and accomplish their performance goals by adopting good dietary habits. To do this it is important to analyze their anthropometric characterizes, their nutritional status and intake and their dietary habits. These studies would allow us to design proper nutritional interventions.

Body composition is a key consideration in the physical make-up of professional soccer players and it is a primary concern in creating athletes profiles. In fact, body composition and anthropometric dimensions play a vital role in determining the success of a soccer player[15]. According to previous published data, the soccer players participating in this study (table I) had a BMI, adipose mass, muscle mass and bone mass similar to young elite soccer players[16,17]. This could be used as an indicator of a good nutritional status.

In this regard, looking at biochemical parameters of soccer players all of them had their biochemical parameters within the normal range except for plasma albumin levels. As it is shown in table II, in all teams the football players showed hyperalbuminemia. This condition is typically associated with chronic dehydration, which was not the case in our soccer players because total protein plasma levels were within the range, or the consumption of high protein diets[18]. In addition, 14% and 20% of soccer players presented hyperuricemia and elevated total cholesterol levels respectively. Both conditions are also associated with high protein diets[19]. In figure 2, we observe that 30% of total daily energy intake comes from meat, poultry, fish and eggs. In addition, in table III, it is observed that the protein intake in the four teams ranged from 1.9-2.2 g/kg BM. These values are higher than typical values reported in the literature (1.5-1.8 g/kg BM)[10] and higher than those recommended for adolescent male soccer players[20,21].

Adequate carbohydrate intake is a very important nutritional factor for exercise. However, body can only store enough to last for only one day of hard training or match. Thus, soccer players everyday need to provide enough carbohydrate to fuel their body and to optimize the recovery of muscle glycogen stores. It is well known that one of the main mechanisms of fatigue during a soccer match is the depletion of liver and muscle glycogen[22]. It has been suggested that a carbohydrate intake of 5-7 g/kg of BM is enough for moderate training and competitive demands. In case of intensive training or maximal glycogen fueling, the carbohydrate intake should increase up to 7-10 g/kg BM/day[23]. In our study, we observed that all football players had a carbohydrate intake within 5.4-6.7 g/kg BM/day (table III). These values are in the target for carbohydrate intake and are similar to carbohydrate intakes that have been reported for male soccer players[10].When data were expressed as contribution of carbohydrates to total energy intake, the values observed in the four teams ranged between 48-53% (table III). These values were greater than the one reported for male players (<50% in the majority of studies)[10]. As it has been proposed that a contribution of>55% of energy intake from carbohydrates is the adequate for soccer players[24], the soccer players of this study had an absolute intake of carbohydrates quite optimal (table III).In general pre- and post-game and training meals have to be considered a nutritional priority. This is because they allow muscle

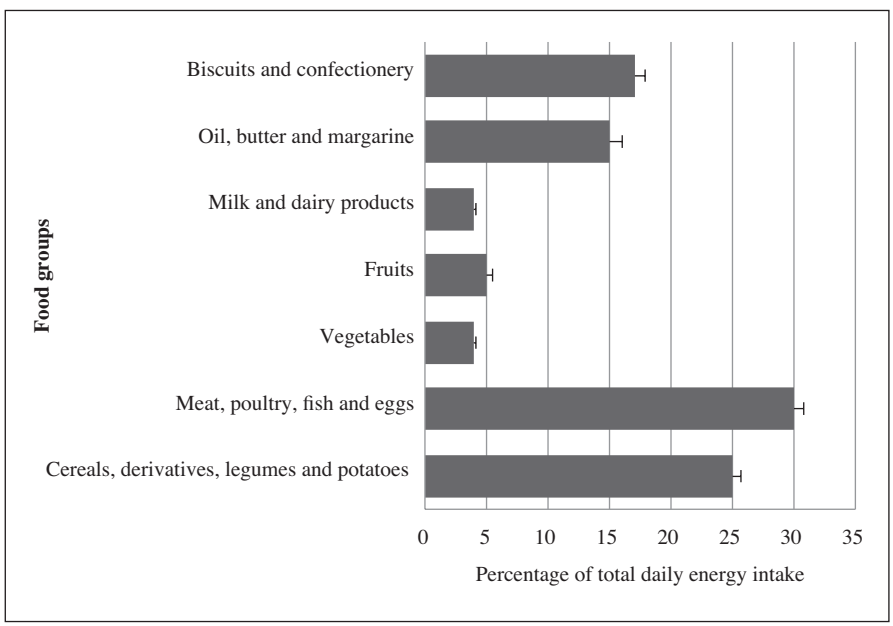

Fig. 2.– Relative contribution in percentage of foods groups to total daily energy intake. Relative contribution (expressed as percentage) of the different food groups to the total daily energy intake. Values are expressed as percentage of total daily energy intake. Data are expressed as means ± SEM. N = 72 soccer players.

and liver glycogen recovery and soccer is an intermittent sport characterized by periods of high-intensity play, with an average intensity during a match of about 70%–75% of the VO_2max[25], in which glycogen is an important source of energy. The target for carbohydrate intake pre- and post-exercise, in soccer, is about 1 g/kg BM. In the case of our soccer player, these values were the good ones (1.2±0.1 g/kg BM). However, the majority of soccer players had a pre-exercise meal, independently of training and match timetable, but post-exercise meal was very low (21%) when the sport even was during the morning, probably for its proximity to lunch. In general, the studies have found, in soccer players, that carbohydrate ingestion before and during exercise reduces muscle glycogen utilization, maintains plasma glucose levels, improves running time to fatigue and coordination in the latter stages of the exercise trial[26]. Finally when we examined mean intake of dietary fiber, all teams reached the recommended daily intake (table III). However, a deficiency in dietary fiber intake has been detected in previous studies of adolescent soccer players[27].

Currently, there is almost no study dealing with the contribution of lipid metabolism in soccer. In this regards, the general population recommendations are assumed. That is player should obtain < 30% of their total energy intake from fats[28]. In this regard, football players from our study adjusted very well to the recommendations, because their fat intake values ranged between 30-33% of total energy intake (table III). It is important to consider that there are studies in male players that have reported lipids intakes of 37% or even higher[10].There is little information concerning the dietary proportion of different fatty acids in soccer players, although it is a very important issue. In our study, in the four teams, the soccer players adjusted to SAF and PUFA recommendations (table III), which is not the case in other studies[10.] However, the MUFA intake was far below (9.8%) (table III) than recommendations (15%) for general population[29], but they met the recommended intakes for athletes according to the ADA[30]. Finally cholesterol intake in our soccer players (four teams) was much higher than recommended (table III). This could be due to the high protein diet reported by our football players (figure 2) and could explain the high cholesterol plasma levels found in 20% of soccer players.

Concerning with energy balance, again few studies have analyzed this aspect with sufficient reliability[31]. This study reported that in male players, the typical daily energy intake reported was 2500-3100 Kcal. The daily energy intake found in our soccer players was within this range (2715-3067 Kcal) in all teams (table III).We also observed that the average absolute energy expenditure is significantly lower than the energy intake for team B ($p < 0.01$) and C ($p < 0.001$) (table III).This issue has also been found in other studies[8].

In general, the mean reported intakes of collegiate soccer players for vitamins and minerals were less than 75% of daily allowances, indicating a risk of suboptimal intake in some football players[32]. Surprisingly, in our study the average vitamin and mineral intake is much higher than daily allowances, particularly for vitamin B_{12}, B_2 and B_6 (figure 1) This could be explained by the high ingestion of meat, poultry, fish and eggs (30% of total daily energy intake). Although, these high values cannot be explained alone by this fact.

Two studies look at the distribution of energy and macronutrients across the main meals[8,33]. As already published studies, the soccer players of our study made five meals/day. In our study, protein consumed in lunch and dinner significantly contributed to total energy intake. However, in the two earlier mentioned studies lipids were the main macronutrient.

A recent study investigated the food sources of the nutrients ingested by soccer players. This study indicated that cereal, derivatives, and potatoes; milk and dairy products; meat, poultry, and derivatives almost accounted for 65% of total daily energy intake. However, in our study, we observed that cereals, derivatives and potatoes; meat, poultry, fish, shellfish and eggs and biscuits and confectionery provided 72% of total daily energy intake (figure 2). In both studies fruits and vegetable had an insignificant contribution. In addition, in our study, milk and dairy products are scarcely consumed.

In conclusion, this population of soccer players was not characterized by optimal nutritional habits. However, their nutritional intake and status was better than in other published studies. The main problems of these teams were that they had a high protein diet which originated high albumin, uric acid and cholesterol plasma levels. In addition, in two teams nutritional intake was not enough to cover the demands. This could affect performance capacity and facilitate fatigue development. Finally, nutritional intake was found to be of poor quality, due to the barely intake of vegetable, fruits and milk and dairy products. Thus, we recommend that nutritional education for soccer players of these teams in order to improve their nutritional goals and their professional future.

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