Nutritional Adequacy of Different Menu Settings in Elite Spanish Adolescent Soccer Players

Guadalupe Garrido, Anthony L Webster, and Manuel Chamorro

The article describes a study that evaluated the adequacy of 2 different menu settings in a group of elite adolescent Spanish soccer players. Five-day food intake was assessed on 2 occasions, while athletes were consuming a flexible “buffet-style” diet (B; n = 33) and a fixed “menu-style” diet (M; n = 29). For all principal meals of the day food weighing was performed, and snacks were recorded by self-report. M provided significantly higher total energy and carbohydrate intakes than B. Breakfast and snacks both provided more energy in M. Calories obtained from fat were excessive in both settings. Calcium and vitamin D were below recommendations in B but not in M. Fiber, magnesium, folate, vitamin A, and vitamin E intake fell below recommended values in both settings. M provided significantly greater quantities of magnesium and vitamins D and E. Both feeding options were far from optimal in satisfying current scientifically based recommendations for active adolescents.

Key Words: dietary intake, meal composition, food patterns

Adolescence is a critical period of life with dramatic physiological and anatomical changes that require higher energy and nutrient intakes. The importance of adequate nutrition to match the greater growth and developmental demands of this period of life has been well established (13). Because nutritional habits acquired during childhood and adolescence can track into adulthood (17, 34), the study of nutritional adequacy and dietary trends in younger populations becomes of even greater significance. Unfortunately, there is increasing evidence that today’s youth follow unhealthy nutrition habits that can contribute to various medical conditions during both adolescence and adulthood, including obesity, osteopenia, cancer, Type 2 diabetes, coronary heart disease, hypercholesterolemia, and hypertension (13, 19, 36, 37). In recent years it has become evident that another major contributor to the onset of obesity and its associated complications is lack of physical activity during childhood and adolescence (2, 33). Like nutrition, physical activity patterns demonstrate a tracking phenomenon into adulthood, which highlights the importance of establishing healthy activity habits early in life (17, 22).
In soccer, as for many other competitive sports, there are now more aggressive identification and recruitment strategies for talented young players. The most elite are often successful in securing scholarships from professional organizations that cover accommodation, education, and training. These young athletes therefore spend a substantial portion of their teenage years away from their home environment.

In the athletes’ halls of residence meal settings typically take 1 of 2 forms: fixed “menus” or more flexible “buffets.” There have been no published studies investigating the nutritional adequacy and implications of these different menu settings in this population. Therefore, the aim of this study was to describe the adequacy of 2 different menu settings in a group of elite adolescent Spanish soccer players: a self-chosen buffet-style menu and a fixed menu.

Methods

The study sample included 62 adolescent and young adult males (age 13–19 years) who were members of the different age-group squads of Real Madrid Football Club (Madrid, Spain) recruited throughout Spain: cadets (14–15 years old, 43% of subjects), juniors (16–18 years old, 52% of subjects), and third-division players (19 years and older, 5% of subjects). All lived away from their families during the sport season (August–May) in a hotel close to the sport facilities (until 1999) or at a residential school (after 2000). Training regimens included 4 (cadets) to 5 or 6 (juniors and third division) 2-h sessions per week plus a weekend game. All players but 2 participated in the games scheduled for the weekend before and after both study periods (May 1999 and May 2001). Subject characteristics are provided in Table 1.

Five-day food intake (4 weekdays and a weekend match day) was measured during the same month of the year (May) in 2 different locations. In the hotel the soccer players (n = 33) were provided a buffet (B) for breakfast, lunch, and dinner where food was entirely self-chosen. In the college residence the athletes (n = 29) were fed according to a fixed menu (M) for the 3 primary meals (there was no choice on the part of the athletes regarding food provided). Different subjects were involved in these 2 locations. Both groups were similar in age and basic anthropometric data (Table 1). In addition, both groups were similar in terms of number of subjects per age category. In both settings (B and M) meals took place at fixed times of day, and training sessions were always performed in the afternoon more than 3 h after the last main meal (lunch). All subjects played 1 match per week, and the nutritional intake of a match day was assessed in both settings.

Table 1  Subject Characteristics

<table>
<thead>
<tr>
<th>Group</th>
<th>Buffet-style diet (n = 33)</th>
<th>Menu-style diet (n = 29)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>16.9 ± 1.5</td>
<td>16.1 ± 1.4</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>178.4 ± 4.9</td>
<td>178.9 ± 7.0</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>73.8 ± 4.9</td>
<td>70.7 ± 8.2</td>
</tr>
<tr>
<td>Body-mass index (kg/m²)</td>
<td>23.2 ± 0.8</td>
<td>22.1 ± 2.0</td>
</tr>
</tbody>
</table>

No significant differences were found between the groups.
To assess dietary intake, the principal investigator weighed food using a digital scale (Mettler-Toledo S26; accuracy ± 0.5 g). All food was weighed before being eaten, and waste food was also recorded. Snacks (morning, afternoon, and evening) were recorded by self-report. Food frequency (daily or weekly serving intakes) of selected foods was also evaluated. Food records were analyzed with a software package (Nutritionist IV, San Bruno, CA) that allows addition of new foods and recipes to its database. Precise ingredients of each recipe were carefully noted from detailed interviews with the kitchen staff involved in food preparation. We evaluated diet adequacy by comparing mean intakes with current dietary-reference-intake (DRI) values (12, 13, 14, 15, 16) and recommendations from the American Heart Association (19). The DRI recommendations used for macronutrients and micronutrients are appropriate for athlete populations such as soccer players (35, 38).

For analysis of blood cholesterol and triglycerides, blood samples were drawn into vacuum tubes from an antecubital vein after an overnight fast. Tubes with clotted blood were centrifuged for 15 min at 6000 rpm at a temperature of 3–4 °C to obtain serum and stored at –40 °C until subsequent analysis for triglycerides and total-cholesterol levels. These tests were performed with commercially available kits (Gernon, Lindau, Germany) using a colorimetric enzymatic method.

**Statistical Analysis**

Statistical analysis was performed with Statgraphics 4.0 software. Analysis of variance (1-way ANOVA) was used to determine the differences of energy, macronutrient, and micronutrient intakes between M and B. All data are presented as mean ± standard deviation. Alpha was set a priori at $P < 0.05$.

**Results**

**Energy and Macronutrient Intake**

Absolute and relative energy intakes were significantly higher ($P \leq 0.05$) for M, as were absolute and relative carbohydrate (CHO) intake (Table 2). No significant

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Energy, Carbohydrate, and Protein Intake Expressed in Absolute Terms and Relative to Body Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group</strong></td>
<td><strong>Buffet-style diet</strong></td>
</tr>
<tr>
<td>Energy intake (kcal/d)</td>
<td>2740 ± 531</td>
</tr>
<tr>
<td>(MJ/d)</td>
<td>11.5 ± 2.2</td>
</tr>
<tr>
<td>%EER</td>
<td>64–73</td>
</tr>
<tr>
<td>Energy intake (kcal/kg body weight)</td>
<td>37.8 ± 8.3</td>
</tr>
<tr>
<td>Carbohydrate (g/d)</td>
<td>316 ± 70</td>
</tr>
<tr>
<td>Carbohydrate (g/kg body weight)</td>
<td>4.4 ± 1.1</td>
</tr>
<tr>
<td>Protein (g/d)</td>
<td>111 ± 23</td>
</tr>
<tr>
<td>Protein (g/kg body weight)</td>
<td>1.5 ± 0.3</td>
</tr>
</tbody>
</table>

*P ≤ 0.01. **P ≤ 0.001.

EER indicates estimated energy requirements according to dietary reference intake, 2002.
differences were found between M and B for absolute and relative protein intake. When the percentage contribution of each macronutrient to total energy intake was examined, no differences for protein or fat were found between M and B (see Figure 1). Energy derived from CHO, however, was significantly higher \((P \leq 0.05)\) for M (Figure 1).

Fat (saturated, monounsaturated, and polyunsaturated) and cholesterol intake were similar for B and M (Table 3). Mean cholesterol intake (Table 3) was above the maximum safe limit of 300 mg/d (19) in both settings. Serum levels of cholesterol \((158 \pm 23\text{ mg/dL} \text{ for B and } 142 \pm 20\text{ mg/dL} \text{ for M})\) and triglycerides \((55 \pm 11\text{ mg/dL} \text{ for B and } 59 \pm 25\text{ mg/dL} \text{ for M})\) were within normal ranges, with no differences between B and M.

**Energy Distribution of Different Meals**

The energy distribution (percentage of calories obtained from protein, CHO, and lipids) in breakfast and snacks was similar in B and M (Figure 2), but breakfast and snacks in M both provided significantly more total energy \((P \leq 0.01)\) than the corresponding meals in B. In addition, percentage contribution of breakfast and snacks

![Figure 1](image.png)

*Figure 1* — Percentage contribution of macronutrients (protein, lipid, and carbohydrate) to total daily energy intake. *Significant difference between menu-style setting (SM) and buffet-style setting (SB; \(P < 0.05\)). See text for acceptable macronutrient distribution ranges.

<table>
<thead>
<tr>
<th>Table 3 Fat Distribution and Cholesterol Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group</strong></td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>Saturated fat (g/d)</td>
</tr>
<tr>
<td>Monounsaturated fat (g/d)</td>
</tr>
<tr>
<td>Polyunsaturated fat (g/d)</td>
</tr>
<tr>
<td>Cholesterol (mg/d)</td>
</tr>
<tr>
<td>% of maximum safe intake</td>
</tr>
</tbody>
</table>

\(↑\) indicates number of subjects with cholesterol intake above the maximum safe limit (300 mg/d).
to the total energy intake was higher for M ($P \leq 0.05$; Figure 2). Differences were found between M and B in energy distribution in lunch and dinner. Specifically, for lunch we found a higher ($P \leq 0.01$) percentage of energy derived from fat in M. Percentage of daily energy intake contributed by lunch, however, was lower for M than in B ($P \leq 0.01$; Figure 2). The energy distribution in dinner demonstrated a higher ($P \leq 0.01$) percentage of energy derived from CHO and a lower percentage from fat in M ($P \leq 0.01$), but there was no difference in percentage contribution of dinner to daily energy intake between M and B.

### Fiber and Caffeine Intake

Fiber intake failed to reach the adequate intake (13) for teenagers (31–38 g/d) in both M (23.3 ± 6.9 g/d) and B (18.0 ± 5.2 g/d). Caffeine intake (11.6 ± 3.8 mg/d for B and 12.6 ± 11.7 mg/d for M) was similar in both settings.

### Micronutrient Intake

With respect to micronutrients we found that intakes of most B-complex vitamins (thiamin, riboflavin, niacin, pyridoxine, and cobalamin), vitamin C, zinc, phosphorus, and iron were adequate for the 2 settings when compared with the DRIs (12, 14, 15, 16). Mean intakes of folate, vitamin A, vitamin E, and magnesium, however, failed to attain the recommended daily allowances (12, 14, 15) for both settings (Table 4). Mean calcium and vitamin D intakes were below the adequate intake (12) in B, but not in M. Intakes of vitamin E, vitamin D, and magnesium were significantly higher for M than in B (Table 4).
Table 4  Intake of Selected MicronutrientsExpressed Bothas Absolute Values and as Percentage of RecommendedDietary Allowances (%RDA) or of Adequate Intake (%AI)

<table>
<thead>
<tr>
<th>Group</th>
<th>Buffet-style diet</th>
<th>Menu-style diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium (mg)</td>
<td>1095 ± 350</td>
<td>1335 ± 322</td>
</tr>
<tr>
<td>%AI</td>
<td>90 (↓ 22)</td>
<td>103 (↓ 12)</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>256 ± 54</td>
<td>338 ± 64**</td>
</tr>
<tr>
<td>%RDA</td>
<td>63 (↓ 33)</td>
<td>86 (↓ 25)</td>
</tr>
<tr>
<td>Folate (µg)</td>
<td>317 ± 111</td>
<td>308 ± 102</td>
</tr>
<tr>
<td>%RDA</td>
<td>79 (↓ 25)</td>
<td>78 (↓ 24)</td>
</tr>
<tr>
<td>Vitamin D (µg)</td>
<td>3.2 ± 1.6</td>
<td>5.9 ± 2.0**</td>
</tr>
<tr>
<td>%AI</td>
<td>65 (↓ 29)</td>
<td>117 (↓ 8)</td>
</tr>
<tr>
<td>Vitamin A (µg)</td>
<td>772 ± 252</td>
<td>721 ± 242</td>
</tr>
<tr>
<td>%RDA</td>
<td>86 (↓ 21)</td>
<td>82 (↓ 22)</td>
</tr>
<tr>
<td>Vitamin E (mg)</td>
<td>7.9 ± 2.8</td>
<td>13.5 ± 5.5**</td>
</tr>
<tr>
<td>%RDA</td>
<td>53 (↓ 33)</td>
<td>92 (↓ 23)</td>
</tr>
</tbody>
</table>

**P ≤ 0.001.  
↓ indicates number of diets below the dietary reference intake.

Discussion

Energy and Macronutrient Intake

The first nutrition priority for athletes is to ensure adequate consumption of energy. Research has shown that the energy requirements of soccer players (including elite players) are moderate in comparison with other endurance sports (23). In general, attention must be paid to the dietary requirements associated with young athletes in differing stages of growth, maturation, and training.

The menu-style setting in this study provided a greater absolute and relative energy intake than the buffet, yet both M and B provided fewer calories than recommended for athletes of the same age, weight, and training level (1) but more calories than reported for a large sample of Spanish adolescents (30). Consumption of inadequate total energy by young soccer players and other adolescent athletes is not a novel finding, having been demonstrated in several other published studies (3, 9, 11, 20). A limitation of our study was self-reporting of snack consumption, which was the only practical method available to us. It has been shown that as children grow older, they have a greater tendency to underreport food intake (21). Therefore, we cannot rule out the possibility of underreporting of snacks as an explanation for the tendency toward relatively low energy intake in both settings.

The new DRIs for energy requirements (13) for 14- to 18-year-olds propose that the acceptable macronutrient distribution ranges for CHO, protein, and fat
are 45–65%, 10–30%, and 25–35%, respectively, of total calories. The energy distribution in both settings provided a less than ideal composition of the major macronutrients, especially for CHO and fat (Figure 1). Provision of calories from CHO fell within the acceptable macronutrient distribution range in both M and B but was at the lower end of the range (<50% of total calories), which is not desirable for such an athletic population (1, 23). When expressed relative to body weight, CHO intake in B fell well short of the minimum recommended level for athletes of 6.0 g/kg (1), whereas CHO intake in M closely approached this value. Players who want to maximize muscle glycogen refueling, in preparation for a match or for recovery, might require 7–10 g·kg⁻¹·d⁻¹ (4), far beyond actual intakes. Calories obtained from fat in both M and B exceeded the upper limit of 35% of total caloric intake. This general pattern of relative underconsumption of CHO and overconsumption of fat has been found in adolescent soccer players (3, 11) and other athletic populations (8, 9). In addition, the American Heart Association (19) recommends that less than 10% of total calories should come from saturated fats, and this was exceeded in both B and M (15% and 13%, respectively). It is interesting that despite the high cholesterol and saturated-fat intake, mean total blood cholesterol and triglycerides fell within the reference ranges in M and B, a finding that is probably related to the activity level of these athletes. Absolute and relative protein intake were adequate (1) in both settings and similar to the values required for a positive nitrogen balance in adolescent soccer players (3).

Overall, the macronutrient intake of our subjects appeared to be somewhat reflective of recent trends in dietary intake of the Spanish population. Research has indicated that Spain has experienced a nutrition transition in recent decades toward a diet higher in fat and dairy products and lower vegetable intake than the traditional Mediterranean diet (24).

Energy Distribution of Different Meals

When energy distribution was determined in the daily meals we observed that breakfast was, in terms of macronutrient balance, the most adequate meal of the day for both B and M, although percentage of total daily energy intake was higher for breakfast in M. This finding appeared to be related to the fact that skipping breakfast was more prevalent in B; attendance at breakfast was not compulsory in that setting. Research has shown that skipping breakfast during adolescence can be linked to reduced performance in school (18, 31), and this must be discouraged, especially in adolescent athletes with higher energy demands than those of their more sedentary peers.

The energy intakes derived from lunch and snacks were lower and higher, respectively, in M. Both findings were probably linked to a dislike of the food provided for lunch in M. Wastage of lunch food was thus more prevalent in M, probably because there was no choice, whereas in B athletes could serve themselves with plenty of food options. A further finding of interest for lunch was a higher fat intake in M. Therefore, it appeared that these adolescents were more likely to eat the higher fat meat products in M and discard the healthier options such as vegetables. The lower energy intake during lunch in turn probably led to greater consumption of self-chosen snacks, which were typically of poor nutritional quality (cookies, chocolates, potato chips, and soft drinks).
Although absolute daily energy intake for dinner was similar for B and M, energy distribution in dinner was preferable in M, with a higher CHO and lower fat composition found in this setting.

**Fiber and Caffeine Intake**

Low dietary fiber intake has been linked with numerous health problems, including coronary heart disease, gastrointestinal pathologies, and increased risk of constipation (13). The fiber intakes in our study were similar to those reported for other male college athletes (9) and soccer players (3, 11) and fell well short of the recommended adequate intake of 31 g/d (9–13 y) to 38 g/d (14–18 y) (13). A recent review revealed that environmental interventions in schools show potential for positively affecting consumption of fruits and vegetables among youth (6).

Caffeine consumption in both settings was relatively low compared with a reference male adolescent population (5) and was well below the maximum safe level for children of \( \leq 2.5 \text{ mg} \cdot \text{kg}^{-1} \cdot \text{d}^{-1} \) (26).

**Micronutrient Intake**

**Calcium.** Adolescence is a period of life that requires a high calcium intake (adequate intake of 1300 mg/d) for optimal growth and development (12). A large number of diets did not meet adequate intake recommendations for calcium: 67% of B (22 diets) and 31% of M (12 diets). This has also been observed in other studies of young soccer players (3, 11, 20, 28) and is a cause of concern for this population. There is still little evidence to propose modifications to calcium intake recommendations based on differences in physical activity levels (12, 35), although some investigators have suggested that a calcium intake of less than 1000 mg/d in adolescent populations might negate the positive effect of exercise on bone mineralization (29, 32). In M the higher consumption of calcium was explained by a greater consumption of milk at breakfast and as an evening snack. We believe that the greater consumption of milk as a snack was related to the ready availability of refrigerators in the college residence, a simple measure that might in itself encourage greater consumption of calcium-rich dairy products. Stocking refrigerators with other, healthier food alternatives might also be a viable method for encouraging consumption of foods that contain a more appropriate balance of macro- and micronutrients for young athletes.

**Magnesium.** Our findings of low magnesium intake have also been reported in other studies with young male soccer players (3, 11). The number of diets deficient in magnesium was 100% in B and 45% in M. Magnesium content is very low in processed food, and in B these were widely consumed. In M, the low magnesium intake probably resulted from a relative lack of consumption of the vegetables and legumes in the dishes provided. It is worth noting that the recommended daily allowances for magnesium for adolescents age 14–18 y (410 mg/d) are nearly double those of 9- to 13-y-olds (240 mg/d) (12). Therefore, it is especially important that older adolescents be educated about the importance
of consuming sufficient amounts of magnesium to support growth and optimal athletic performance.

**Folate.** Current DRIs for folate are now expressed as micrograms (µg) of dietary folate equivalents. The marginal folate intake in both settings must be viewed with some caution because the folate used to fortify foods (such as breakfast cereals) has extra activity in comparison with naturally occurring folate (1 µg of fortified folate is equivalent to 1.67 dietary folate equivalents, whereas 1 µg of natural folate is equivalent to 1.0 dietary folate equivalent) (25). Although food fortification in developed Western nations has generally contributed positively to increased folate intake in the general population (7), research has continued to find deficiencies in adolescent populations (11, 30).

**Vitamin D.** It is well known that vitamin D, in addition to calcium and magnesium, is an important micronutrient for optimal bone health (12). The lower intake of vitamin D in B was probably a result of the lower intake of dairy products, especially in snacks and breakfast. Standardization of dietary requirements of vitamin D is complicated by the fact that it can be obtained both exogenously (diet) and endogenously (from exposure of the skin to sunlight). In practice, this adolescent population is not at significant risk of vitamin D deficiency because they spend a large amount of time training outside, and the resulting cutaneous production of vitamin D more than likely meets their requirements.

**Vitamin A.** Low intake of vitamin A, as found in both settings, is of concern in an active adolescent population because vitamin A is critical for many functions including repair and growth of body tissues (15). Dietary recommendations express vitamin A requirements as retinol activity equivalents because of recent advances in understanding the conversion of provitamin A carotenoids into the active form of vitamin A (15). The nutritional software used expressed vitamin A intake as micrograms of retinol equivalents and did not account for intake of provitamin A, so intake of retinol activity equivalents was probably underestimated. Other studies in young male soccer players (3, 28) and in Spanish adolescents (27, 30) have shown a similar trend toward low vitamin A intake and status. Increased consumption of fruits and vegetables would help address concerns regarding low vitamin A intake (6).

**Vitamin E.** The low intake of vitamin E in both settings was most likely caused by low consumption of unsaturated fats in relation to saturated fats. The difference observed in vitamin E intake between M and B is probably related to the fact that menu items in M were cooked in sunflower oil, which is a much richer source of vitamin E than olive oil, the latter being more widely consumed in B. The recommended daily allowance for vitamin E increased the requirements from 10 to 15 mg of α-tocopherol per day (16). The necessity of this increase, however, has been subject to debate (10), so the “deficient” intakes of vitamin E in this and other studies with adolescent athletes (3, 9, 11) must be viewed with some caution. It should be noted, however, that the average intake of vitamin E in B was well below the old recommendation of 10 mg/d and that M provided a significantly greater daily amount of this important micronutrient.
Conclusions

The nutritional intake of this group of adolescent soccer players, although slightly higher in terms of total energy, did not differ in percentage distribution of macronutrients from what is found in the general population in Spain, irrespective of feeding pattern (buffet or fixed menu). Neither feeding option met the age-specific DRIs for several micronutrients (vitamins A, E, folate, and magnesium) to satisfy current scientific-based recommendations for an active adolescent population. These findings have important implications regarding food provision and selection for elite adolescent athletes who are housed and fed in halls of residence and for whom parental influence is lower than home-housed adolescents. To improve diet quality, greater emphasis can be placed on increasing intake of fruits, vegetables, whole grains, and lower fat dairy and animal products in this population. In addition, young athletes can be counseled regarding nutritional practices (including fluid intake and snacks) that will effectively support an active lifestyle and provide the basis of an overall eating plan for long-term health.

References


