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Dietary intake of female U.S. soccer players

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Abstract

The purpose of this pilot study was to assess the dietary intake of female soccer players from the Under-21 (U-21) United States women's national soccer team. Participants completed three-day food records and a medical history questionnaire. The female soccer players reported an energy intake of 34 kcal/kg body weight (total 2015 kcal/day). The contribution of protein, fat and carbohydrate to total energy intake were 15%, 30% and 55%, respectively. Dietary intakes of vitamins D and E were less than two-thirds of the recommendations and intake of all minerals was greater than two-thirds of the recommendations. The self-reported health status suggests that this was a healthy group of female athletes. Responses to the nutrition attitude questions suggest that these athletes may benefit from appropriate education regarding the role of nutrients in health and performance. In summary, results of this pilot study suggest that these young female soccer players should be encouraged to eat small, high carbohydrate nutrient dense meals, frequently throughout the day, and they should be provided with appropriate nutrition counseling. © 2003 Elsevier Inc. All rights reserved.

Keywords: Athletes; Macronutrient intake; Micronutrient intake; Soccer; Female

1. Introduction

Soccer is the fastest growing sport in the United States (U.S.) among youth and collegiate women. The U.S. Youth Soccer Association reports that there are currently over 3,000,000 players between the ages of 5 and 19 years in the U.S., representing an increase from 100,000

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players in 1974 [1]. Since the passage of legislation commonly known as Title IX in 1972, there have been 2.37 million female high school athletes compared to only 300,000 prior to 1972 [2]. Participation by females in soccer has been attributed to this rapid increase [2]. Men's soccer tends to be one of the main team-participation sports in most countries, however this is not yet true for women's soccer [3]. Soccer is still seen as a developing sport in many countries for female athletes [3]. Although the research is not extensive, there is some understanding about the energy needs and dietary habits of male soccer players [4–7]. Many of the nutritional recommendations for female soccer players, however, have been extrapolated from the general recommendations for female team sports, such as basketball [3].

Soccer is an entity in itself in the sports world and the physical demands placed on a soccer player are different from those of a basketball or field hockey player due to the high intensity nature of the sport allowing for no time-outs. Physical demands of the sport placed on the body, such as jogging, dribbling, tackling, jumping and acceleration, are intense, both aerobically and anaerobically, during training and matches. Energy expenditure is estimated to be high, up to 4300 kcal, on a match day for some male players [5]. In general, carbohydrate, protein, and fat intake recommendations have been established for male soccer players, however much speculation and inference has built the foundation of dietary recommendations for female soccer players [4–8].

The limited information available on female soccer players suggests that they walk, jog or run approximately 8500 meters in a single match in conjunction with approximately 100 sprints of varying lengths [3]. Brewer [3] found that women soccer players expend an average of 1100 kcal during a match, and existing studies suggest that energy intake of these females athletes rarely exceeds 2880 kcal/day even on match day [3,5]. It is also estimated that females play at approximately 85% of their maximal oxygen consumption (VO_2max) for greater than two-thirds of the match [3]. This implies a heavy reliance on carbohydrate as an energy source during training sessions and matches. In other female sports, such as basketball and field hockey, typical energy intake averaged 1513 ($\pm$ 406) kcal/day during the competitive season [3]. If female soccer players dietary intake models that of male soccer players and other female-related sport athletes, it suggests that these players may potentially be at risk of an energy deficit.

Although the studies regarding women's soccer players are limited, there is one review that does explore the nutritional aspects of women's soccer [3]. In comparison to men, women have typically only been "part-time players" meaning that they have had to balance soccer with a full-time career and/or family which could possibly make it more challenging to meet their energy needs. Studies have shown that female athletes from many different sports tend to maintain intense training regimens on relatively low energy intakes ($<$45 kcal/kg body weight/day) [3]. It has been found that female athletes who restrict energy intake have iron and calcium intake at 30% of recommended amounts [3]. Thus, there are many questions that remain unanswered about the adequacy of dietary intake, and overall health of female soccer players.

It is, thus, necessary to evaluate the dietary intake of female soccer players to establish specific dietary guidelines to enhance their peak athletic performance and overall health. Therefore, the main objective of this pilot study was to examine the dietary intake and overall

health status of female, U.S. soccer players who were members of the under 21 (U-21) U.S. women's national team.

2. Methods

A convenience sample of female soccer players from the U-21 U.S. women's national soccer team during their training period was recruited for participation in the present study. Eighteen elite, female soccer players from the U-21 U.S. women's national soccer team out of a possible 29 players, participated in the study. Seven of the subjects did not return food records despite several reminders, and thus the nutrient intake data reported here represents the intake data from 11 participants (61% return rate). All study protocols were approved by the Institutional Review Board for the protection of human subjects. All participants signed an informed consent form and, when necessary, it was signed by a legal guardian.

All participants were weighed, wearing light clothing and without shoes, prior to any intake and physical activity, using a calibrated digital scale. Similarly, height was measured using a standard tape measure. Each player completed detailed three-day food records and a medical history questionnaire. Participants were mailed the records and questionnaires with detailed instructions for completing them. Furthermore all participants received detailed verbal instructions on how to complete food records and the medical history questionnaire.

Participants were required to maintain food records for two weekdays and one weekend day. Participants were given guidelines and common household measures such as cups and tablespoons to estimate portion sizes. They were also given a conversion chart (e.g., 3 teaspoons = 1 tablespoon) to enable better estimation of quantities of food and beverages consumed. Participants were required to provide detailed descriptions of food and drink consumed, record brand names of commercial and ready-to-eat foods, estimate portion sizes, method of preparation, place of consumption and use of condiments or added fat. Participants mailed food records back to the researchers upon completion. Food records were reviewed for completeness and missing details were clarified with the athlete. Food records were analyzed for energy, macronutrient and micronutrient intake using the Food Processor nutrition analysis software (version 7.40, ESHA Research, Salem, OR). The participant's nutrient intakes were compared to the appropriate age and gender Dietary Reference Intakes [9].

The medical history questionnaire enquired about participants past and present medical history, menstrual history, body image perception, supplement usage and attitudes towards specific sports nutrition practices [10].

All data were analyzed using the Statistical Package for the Social Sciences for Windows (version 9.0, SPSS, Chicago, IL). Means ($\pm$ standard deviation) and frequencies were calculated for all study variables.

3. Results

Characteristics of the female soccer players are summarized in Table 1. All field positions were represented (goalie, defenders, midfielders and forwards) in this study. Eighty-nine

Table 1
Characteristics of the female soccer players (n = 18)

	Mean (SD)
Age (yrs)	19.2 (1.1)
Height (cm)	162.1 (12.6)
Weight (kg)	59.7 (7.1)
BMI (kg/m^2)	21.8 (1.6)

percent of the players were Caucasian, 5.6% were African American and 5.6% belonged to other ethnic backgrounds. The mean body mass index (BMI) of the female soccer player's indicates that they were within the normal ranges. Responses on the medical history questionnaires indicated that these players considered their ideal body weight (IBW) to be 60.8 kg (± 1.27), which is similar to the mean recorded body weight (59.7±7.1 kg). Fifty-nine percent of the players reported that they found it "somewhat easy," while 41% of the players found it "very easy" to maintain their in-season weight. The most common health condition reported by these players was asthma (11%). All players had achieved menarche. Thirty-three percent reported a very regular cycle (within 3 days), 61% reported a regular cycle (4–10 day variation), and 6% reported having a very irregular cycle (more than 10 day variation). Only 39% of these players reported changes in regularity and duration of their menstrual cycles with their training regimen. In general, this sample of female soccer players reported occurrence of menstrual periods an average of 11.4 times per year, approximately every 27 days, with a mean duration of 4.7 days. Only 17% reported going longer than 2 months without having a menstrual period.

Mean macronutrient and micronutrient intakes are reported in Table 2. On the average, participants consumed 2015 kcal per day, with 55% of energy from carbohydrates, 15% from protein and 30% from fat. Dietary cholesterol was within the recommended dietary guidelines, while dietary fiber intake was slightly below recommended levels. All participants met at least 66% of the current dietary recommendations for the following nutrients: vitamin A, vitamin C, thiamin, riboflavin, niacin, folate, vitamin B6, vitamin B12, calcium, iron, phosphorous, zinc and magnesium. However, vitamin D, vitamin E, folate, calcium, magnesium, phosphorous and zinc were less than 100% of the recommendations. Fifty-five percent of these athletes consumed a nutrient supplement occasionally, 33% consumed it daily and 11% did not consume any supplements. The most popular nutrient supplements were multivitamins (61%), vitamin C (44%), calcium (22%), iron (22%) and zinc (17%). Given the variability in the type of nutrient supplements used and their nutrient composition, they were not included in the nutrient intake analysis. Sixty-one percent of participants reported use of ergogenic type supplements such as sports beverages (61%), energy bars (39%), Ma Huang (ephedra) (5.6%), and fat burners (5.6%).

Forty-four percent of participants considered their eating habits to be good or fair and 11% consider their eating habits to be poor. Participants reported consuming meals and snacks an average of 4.9 (± 0.24) times per day and eating out on the average of 2 (± 0.31) times per week.

With respect to weight control methods used by these soccer players, the following were

Table 2
Macro and micronutrient intake of female soccer players (n = 11)

	Mean (SD)[a,b]	
		% Energy
Energy (kcal)	2015 (19)	—
Carbohydrate (g)	282 (118)	55
Protein (g)	79 (33)	15
Fat (g)	67 (28)	30
Saturated fat (g)[c]	22 (10)	10
Polyunsaturated fat (g)	8 (6)	4
Monounsaturated fat (g)	15 (8)	6
Cholesterol (mg)	196 (113)	—
Dietary fiber (g)	17.7 (5.2)	—
Vitamins		% Recommendations
Vitamin A (RE)	917 (505)	115
Vitamin C (mg)	128 (110)	171
Vitamin D (g)	2.6 (2.4)	52
Vitamin E (mg -tocopherol)	8.3 (8.8)	55
Thiamin (mg)	1.6 (0.9)	142
Niacin (mg)	21.5 (11.9)	153
Riboflavin (mg)	1.7 (1.0)	156
Folate (μg)	338 (213)	84
Vitamin B6 (mg)	1.9 (1.2)	146
Vitamin B12 (μg)	3.0 (2.8)	127
Minerals		
Calcium (mg)	887 (510)	89
Iron (mg)	16 (7.8)	108
Phosphorous (mg)	926 (471)	93
Magnesium (mg)	223 (103)	72
Zinc (mg)	9.5 (6.1)	79
Sodium (mg)	3780 (1679)	N/A
Potassium (mg)	2313 (1049)	N/A

[a] Values are Mean (SD) of 3-day food records.
[b] Values do not include contribution from multi-vitamin/mineral supplement.
[c] Values for individual fatty acid classes do not equal total fat amount due to missing database value.

most common: exercise beyond normal training regimen (22%), skipping meals (16.7%), high protein/low carbohydrate diet (16.7%), nutrition counseling with a health care professional (5.6%) and liquid diets (5.6%). Participant's perceptions about their physical fitness and body image were positive.

Female soccer players' attitudes to the sports nutrition practice questions indicate a good understanding of proper hydration, an adequate understanding of the role of macronutrients and poor understanding of the role of micronutrients in performance (Table 3).

4. Discussion

This pilot study found that the physical characteristics of U.S. female soccer players in the U-21 team were comparable to those reported in studies of European elite, female, soccer

Table 3
Attitudes of female soccer players (n =18) towards sports nutrition practices

Sport Nutrition Practice	% Agree	% Disagree	% Don't Know
Carbohydrate and fat are primary source of energy for muscles	50	28	22
Eating carbohydrates makes you fat	17	72	11
Sweets should not be eaten prior to an athletic event	50	17	28
Protein is the primary source of energy for muscles	33	33	28
Protein supplements are needed in addition to diet for muscle growth and development	17	61	22
Meals high in fat should be consumed 2 to 3 hours before an event	28	50	22
Vitamin and mineral supplements increase energy levels	33	11	56
Dehydration decreases athletic performance	100	0	0
Fluids should be replaced before, during and after events	100	0	0
Thirst is a good indicator of when to hydrate	11	78	11
PowerAde and other sports drinks are better than water at replacing fluids	11	78	11

players [11,12]. Height does not seem to be a factor in determining success in soccer; however, it may benefit certain positions such as center backs, and forwards to be taller in order to head the ball more easily [11]. According to existing height and weight guidelines, the players in the present study fall into a healthy height and weight category [13]. Participant's actual body weights also corresponded with their mean desired IBW of 60.8 kg ($\pm$ 1.27), which suggest that this group is aware of recommendations for healthy weight. Body fat percentage was not determined on U-21 players in this study; however, BMI was 21.8 ($\pm$ 1.6), which falls into the normal range of 20–25, indicative of normal weight individuals [14].

There have been no studies to date regarding the medical history of elite female soccer players. Based on self-reported information, the present study found that the most common health condition was asthma, which can seriously impair breathing and performance of these soccer players if not treated appropriately. In general, the self-reported health status information suggests that this was a healthy group of athletes.

Amenorrhea was not evident in these young female soccer players. Menstrual irregularities have been linked to intensive training, excessive energy expenditure and inadequate nutrition [11]. Incidence of eating disorders in soccer players is less common than in sports where low body fat is crucial. However, female soccer players are still at risk of disruption of menstrual cycles due to their high training intensity and inadequate energy intake [3,15].

Compared to similar sports, such as basketball, where the reported energy intake averaged 1513 ($\pm$ 406) kcal/day during the season, the present study indicates that these young soccer players have a slightly higher energy intake [3]. However, these results are consistent with most studies regarding female athletes, which indicate that daily energy intake rarely exceeds

2880 kcal [5]. The reported energy intake of these soccer players (2014 kcal/day) was less than the estimated energy requirements derived from the Harris-Benedict equation plus an activity factor (2716 kcal/day). It is recommended that female athletes consume 47–60 kcal/kg body weight to provide adequate energy to sustain performance [3]. The female soccer players in the present study averaged 34 kcal/kg body weight, which parallels female field hockey players who were reported to consume only 37 kcal/kg [16]. Overall, these soccer players had energy intakes similar to that of non-athletes, which maybe inadequate for optimal performance [16].

Average carbohydrate intake in female-related sports and male soccer players has been reported to be 53% and 54% of total energy intake, respectively [3,7]. A diet that contains 50% of energy from carbohydrates is typically adequate for the general population. Participants in our study had a carbohydrate intake of 4.7 g/kg body weight (55% of energy), which is less than that generally recommended for high intensity/endurance athletes (6 to 10g of carbohydrate/kg body weight) [3] suggesting that the observed carbohydrate intake of these female soccer players may be inadequate to replete and maintain their glycogen reserves. The female players protein intake (15% of total energy) was consistent with that reported for male soccer players [17]. The average protein intake of the female soccer players was 1.3 g/kg body weight, which is just below the recommendations of 1.4–1.7 g/kg body weight for high intensity endurance athletes [17]. Fat intake (30% of total energy) of these female soccer players is comparable to that of female field hockey and basketball players [3]. Despite the participants lower than recommended energy intake (in comparison to the age and gender appropriate recommendations) these female soccer players met greater than 100% of requirements for most vitamins and minerals except vitamin E, vitamin D, folate, calcium, magnesium, phosphorous and zinc [9]. It is important to note that the DRIs were not determined using athletes or regularly exercising individuals. The DRIs may not reflect true nutrient needs of these athletes. If anything, athletes' needs may be greater and micronutrient deficiencies could arise if athletes are not meeting the DRIs [14]. Studies regarding female athletes and micronutrient intake show that when energy intake is less than 2400 kcal/day, typically athletes have sub-optimal intake of calcium, magnesium, iron and zinc [18]. This may in part explain why our participants had less than adequate intakes of certain micronutrients.

The majority of participants considered their eating habits to be good to fair, which is evident by regular meal patterns, infrequent skipping of meals, and appropriate macronutrient proportions. These athletes had a grazing-like eating pattern (4–6 meals/day), characterized by eating small meals frequently, which is an appropriate way to increase energy and nutrient intake.

The most commonly used ergogenic supplements were sports beverages and energy bars. Nicholas et al. [19], found that sports beverages aid in performance of stop and go sports, such as soccer, when compared to water. Carbohydrate supplementation in male soccer players has been shown to decrease net muscle glycogen usage and enhance performance at the end of the match [4]. It was observed that one player in the present study had used Ma Huang, which is a banned substance by the International Olympic Committee, suggesting that these athletes need to be educated about the use of appropriate supplements.

Although our participants maintained intense training regiments (3–4 hours/day) on less

than recommended energy intake (<45 kcal/kg body weight), attaining a low body weight did not seem to be a priority for participants. Responses of players indicate a healthy attitude regarding their overall physical fitness and body image perception. In contrast a study by Nutter [16] found eight of nine field hockey players were trying to lose weight during their playing season. There have been no studies to date regarding body image perception of female soccer players. The most common weight control method used by these athletes was exercise beyond the normal training regimen. A variety of less healthy weight loss methods such as high protein/low carbohydrate diets, skipping meals and liquid diets had been tried in the past by a few players for a short duration of time. Only one player had ever had nutrition counseling with a health care professional. Previous research has indicated that female athletes are receptive to such counseling and it may be an effective tool in improving their diets [16]. These female soccer players could definitely benefit from nutrition education about the role of macronutrients and micronutrients in health and performance as was evident by their responses to the questions related to sports nutrition practices. The positive attitudes about proper hydration observed in these soccer players may in part be due to the emphasis placed on hydration by the U.S. soccer team trainers and doctors which is exhibited by frequent water breaks during training and encouragement of continuous hydration.

Limitations of this pilot study are the self-reported data (dietary, and medical history) and a small sample size. Under and/or over-reporting on food records could have occurred, which could misrepresent the true dietary intake and nutritional status of female soccer players [3]. These data should be used to represent group nutrient intake only and further studies are needed with a larger sample size to determine the needs of these players.

In conclusion, results of this pilot study indicate that these young female soccer players have inadequate energy intake and their carbohydrate intake may be less than adequate to replete and maintain glycogen stores. These conditions may significantly inhibit athletic performance and lead to early fatigue. These female soccer players need to be encouraged to make high carbohydrate and nutrient dense food choices while continuing to eat frequent small meals throughout the day. These players should be encouraged to eat this way seven days a week and not just the day before a match.

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