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Dietary Self-Management in University Soccer Players: Are There Differences by Athletic Performance?

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ABSTRACT

Worldwide, athletes have become increasingly concerned about becoming emaciated in recent years. Moreover, university athletes who continue to train at a high intensity are more likely to be undernourished due to intense nutrient depletion and frequent dietary deficiencies. We therefore investigated energy deficits through a dietary survey of athletes in order to determine whether their ability to self-manage food varied according to their athletic ability. Thirty-four participants who were members of a university soccer club were included in this study. To assess self-management ability based on athletic ability, athletes were divided into two groups: a high athletic ability group (group A) and a general athletic ability group (group B). We found that hemoglobin levels were 15.7 (SD 1.3) g/dl for group A and 15.5 (0.8) g/dl for group B, with no anemic subjects in either group. Group A had significantly higher serum ferritin levels than group B. A nutritional assessment showed that group A had significantly higher levels of energy, protein, carbohydrate, iron, vitamin B2, vitamin C, and dietary fiber than group B. When athletes' nutrient intake was compared to their nutritional intake goals, group A met more items than group B. In addition, a comparison of PFC rates (Protein: Fat: Carbohydrate as % of total energy) showed that group A was within the target amounts, whereas group B had a higher percentage of fat. These results suggest that group A was more capable of self-management of their diet than group B.

Keywords: Athlete; Soccer; Nutrition; Self-Management; Diet

Introduction

Athletes have become increasingly concerned about being overweight in recent years. Relative energy deficiency in sport (RED-S) is a condition in which energy intake is low relative to total energy expenditure. This condition has been shown to affect athletes' health [1]. RED-S has been an international cause for concern since the 1990s; however, no effective screening tool has been clearly demonstrated. It has also been reported that it is difficult to assess energy intake and consumption in sports settings [2]. Several years ago, the RED-S concept began to be taken up in Japan. While the focus has been on female athletes, with RED-S being considered to be less important in male athletes, it has been suggested that the incidence in male athletes will increase in the future. In addition, college athletes who continue to train at a high exercise intensity, while intensely depleting nutrients, often fail to consume sufficient nutrients through their diet and, as a result, are prone to nutritional deficiencies. Thus, appropriate dietary guidance and nutritional support are necessary for maintaining conditions and improving performance [3]. It is difficult to determine the nutrients and the amounts of nutrients that are needed to support athletes due to the vast differences among individuals [4]. Soccer players' performance is determined by several factors, such as their exceptional game skills, cognitive ability to make correct decisions in the game, and moderate-to-high aerobic and anaerobic power. Robinson, et al. [5] noted that intravascular sports tend to cause hemolysis.

As factors, they suggested intramuscular breakdown, osmotic stress, and membrane lipid peroxidation caused by free radicals re-

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leased by the active leukocytes. This means that soccer players may suffer from energy deficiency and anemia. In this study, we screened university soccer players for their RED-S and iron status. We also assessed whether there were any differences in self-management ability by comparing athletes according to their competitive abilities.

Methods

Subjects

Thirty-four participants (age: 18-22 years old) who were members of a university soccer club were included in this study. The study's purpose and content were thoroughly explained to the subjects, and they voluntarily consented to participate. To assess self-management ability based on athletic ability, university athletes were divided into two groups: a high athletic ability group (group A), which comprised students who were scheduled to play in the J-League from the 2024 academic year, and a general athletic ability group (group B). This study was reviewed and approved by the Research Ethics Committee of Kokushikan University (approval number: 23012).

Measurement Items

Body Measurements: Height was measured with a height meter, and body weight, body fat percentage, and skeletal muscle weight were measured using the impedance method with an InBody 770 body composition measuring device (InBody Japan Inc.). Body mass index (BMI) was calculated using weight and height.

Blood Analysis: The iron nutritional status was investigated, since iron deficiency anemia is caused by insufficient dietary intake. In the morning, participants reported to the laboratory. Blood samples were drawn from the antecubital vein after each subject had been seated quietly for at least 15 min. The samples were analyzed in a local commercial laboratory (Kyoto Microbiology Research Institute, Kyoto, Japan). Red blood cells (RBC), hemoglobin (Hb), hematocrit (Ht), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and ferritin levels were measured. Anemia was defined as an Hb level of <13 g/dL. Iron depletion was defined as a ferritin level of <20 μg/L. Hemolysis was determined by the indirect bilirubin concentration, which is the total bilirubin minus the direct bilirubin concentration.

Dietary Survey: The dietary survey was conducted using a recorded diet and a photographic diet. Surveys were conducted on two consecutive days, in any order, with or without training. When giving the subjects the diet record forms, we explained the precautions regarding the diet survey and asked them to use their student ID card (placed next to the item in question) in place of a scale when taking photo-recording examples and photographs. For commercial products and restaurant food, the participants were asked to take pictures so that the nutritional information and menu labels of the product names could be seen. For the diet survey form, students were asked to record the name of the dish they ate, the name of the ingredient, and the amount (approximate) of the food they ate, as much as possible.

Life Activity Survey: A survey form was developed to evaluate life activity. The subject's self-records were used to determine how much time was spent sleeping, eating, going to school, participating in club activities, and working part-time for two consecutive days. The energy consumption was calculated using the factorial addition method.

Statistical Analysis

Descriptive statistics were reported as the mean (SD). Differences in the mean values between the two groups were analyzed using the t-test. P values of <0.05 were considered to indicate statistical significance.

Results

Their physical characteristics are listed in Table 1. There were no differences in age, height, weight, body fat percentage, or muscle mass between groups. Table 2 shows the blood results of the two groups. There were no anemic subjects in either group. Serum ferritin levels were significantly higher in group A than in group B. There were no significant differences between the groups in RBC count, hematocrit level, hemoglobin concentration, MCV, MCH, or MCHC. Two of 8 athletes in group A and 12 of 26 athletes in group B were considered to have possible hemolysis. Table 3 shows a comparison of the nutritional intakes of both groups. Group A had significantly higher levels of energy, protein, carbohydrate, iron, vitamin B2, vitamin C, and fiber than group B. The fat, vitamin B1, and calcium intake of the two groups did not differ to a statistically significant extent. Group A met their nutritional targets for energy, protein, fat, iron, vitamins B1 and B2, and fiber (Table 2). The carbohydrate and calcium intake were low. Group B met the target amounts for fat, iron, and vitamin C, while their intake of energy, protein, carbohydrates, calcium, vitamins B1 and B2, and fiber did not meet the target amounts. When the nutrient intake per kg of body weight per day was compared, Group A was found to have significantly higher levels of energy, protein, and carbohydrate intake in comparison to Group B. The amount of energy expended in daily living was significantly higher in group A than in group B (3711 (SD 540) kcal vs. 3017 (SD 510) kcal) (Table 4).

Table 1: Participant characteristics.

		A (n=8)	B (n=26)
Age	years	21.4 (0.9)	20.6 (1.2)
Height	CM	176.7 (8.2)	174.4 (6.8)
Weight	kg	69.6 (11.8)	65.6 (6.1)
BMI	kg/m2	22.1 (1.9)	21.6 (1.3)
Fat	%	10.4 (2.3)	11.2 (2.8)

Note: Mean (SD)

Table 2: Blood parameters.

		A (n=8)	B (n=26)
Red blood cell	104/μl	542.1 (32.7)	515.8 (30.8)
Hematocrit	%	47.6 (3.0)	46.4 (2.4)
Hemoglobin	g/dl	15.7 (1.3)	15.5 (0.8)
Ferritin	ng/ml	157.6 (41.6)*	111.5 (48.1)
MCV	fL	87.8 (3.6)	90.1 (2.8)
MCH	pg	29.0 (1.5)	30.0 (0.9)
MCHC	%	33.0 (0.9)	33.3 (0.7)

Note: Mean (SD)

*: vs B

Table 3: Nutrient intake of the participants and nutrient targets.

		Target	A (n=8)	B (n=26)
Energy	kcal	3500	3544 (455)	2748 (632)*
Protein	g	130	171 (37)	123 (28)*
Fat	g	105	117 (30)	108 (43)
Carbohydrate	g	500	486 (108)	347 (84)*
Calcium	mg	1,000~1,200	740 (317)	586 (329)
Iron	mg	10~15	15 (3)	11(3)*
Vitamin A	μgRE	900	793 (429)	823 (837)
Vitamin B1	mg	2.1~2.8	2.5 (0.8)	1.9 (0.9)
Vitamin B2	mg	2.1~2.8	2.8 (0.9)	1.9 (1.0)*
Vitamin C	mg	100~200	247 (121)	133 (93)*
Dietary fibeer	g	28~35	34 (7)	25 (7)*
Energy rate				
Protein	%	15	19 (3)	18 (4)
Fat	%	27	30 (7)	35 (8)
Carbohydrate	%	57	55 (8)	51 (8)

Note: Mean (SD)

Table 4: Nutrient intake per kg of body weight.

	Energy	Energy	Protein	Fat	Carbohydrate
	(kcal/day)	(kcal/kg/day)	(g/kg/day)	(g/kg/day)	(g/kg/day)
A	3544(455)	50.6(5.1)	2.4(0.4)	1.7 (0.4)	6.9(1.4)
B	2748(632)*	41.7(8.9)*	1.9(0.4)*	1.6 (0.6)	5.3(1.2)*

Note: Mean (SD)

Discussion

In this study, college soccer players were nutritionally assessed for RED-S, with a focus on energy balance. The study also examined the association between athletic performance and the ability to self-manage one's diet. There were no anemic athletes in this study, possibly due to the fact that both groups A and B met their target for iron intake. Serum ferritin was significantly higher in group A than in group B. Dietary survey results showed that iron intake and vitamin C were significantly higher in Group A than in Group B. It is known that Vitamin C enhances iron absorption. These results suggest that Group A not only had a higher intake of iron, but also a higher intake of vitamin C, which enhances absorption and may have prevented anemia. The average daily energy intake of the soccer players in this study was 3544 (455) kcal in group A and 2657 (632 kcal) in group B. Omi proposed that the target energy intake for soccer players is 3500 kcal [6]. The same level was also reported for Puerto Rican Olympic athletes 3,952 kcal [7], Italian professional athletes 3,650 kcal [8], and Danish elite athletes 3,738 kcal [9]. The participants in group A are considered to have consumed adequate amounts of energy as soccer players. In contrast, group B's energy intake was below the target amount. In contrast to the aforementioned previous study, there are reports of some athletes with an energy intake of less than 3,000 kcal/day [10-14].

Men's international soccer team 2164 kcal [10], Australian soccer players 2247kcal [11], senior professional and youth elite soccer players 2988 kcal [12], Brazilian soccer players 2924 kcal [13], Spanish players 3030 kcal [14] have also been reported. Energy consumption is influenced by factors such as body size and practice. The activity (energy consumed) of group B was 3017 (510) kcal. Based on the above, the fact that Group B's energy did not meet the target does not imply that they were energy-deficient. The ideal energy ratio (PFC balance) is 13% to 20% protein (P), 20% to 30% fat (F), and 0% to 65% carbohydrate (C). Group A had a P: F: C ratio of 19: 30: 55, which met the target, while Group B had a ratio of 18: 35: 51, with a higher percentage of fat in total energy intake. The main sources of energy in sports are carbohydrates and fats. Carbohydrates are an important source of energy for athletes [15]. It has been reported that muscle glycogen is depleted when athletes are unable to continue exercise [6]. Williams and Rollo pointed out the importance of sufficient muscle glycogen stores for soccer players [16] Players who consume a high-carbohydrate diet with ~8 g/kg BW of dietary carbohydrate have been reported to show higher performance [17,18].

The latest guidelines on nutritional intake in soccer recommend a daily carbohydrate intake of 5-7 g/kg body weight on moderate-intensity training days and 7-12 g/kg body weight on high-intensity training days and before games17). The results of this study suggest that both group A (6.9 g/kg BW) and group B (5.3 g/kg BW) may not be able to tolerate high-intensity training, and that increasing the carbohydrate intake of both groups may help them tolerate higher intensity and longer practice sessions. Adequate protein intake is important for athletes to recover muscle proteins damaged by practice [19,20]. The recommended total daily protein requirement for soccer players has been reported to be 1.2-1.7 g/kg body weight/day [21,22]. The protein intake of group B (1.9 g/kg BW) was slightly higher than the recommended amount, while that of group A (2.4 g/kg BW) was significantly higher. Tarnopolsky, et al. [23] reported that protein intake promotes body protein breakdown [23]. They also reported that body protein synthesis was maximally enhanced at 20 g/meal [24]. It has also been reported that high protein levels enhance degradation in the intestine and the liver. Most athletes in groups A (56 g/meal/day) and B (40 g/meal/day) received protein supplements, and were able to consume 20 g of protein per day in dietary supplements alone. Based on the above, group A is considered to have a higher protein intake, which would be suitable for efficient body protein synthesis, reducing the burden on the intestines and liver.

Conclusion

None of the subjects in this study were anemic, and no athletes were identified as having a possible energy deficiency. Group A met the targets for energy, protein, fat, iron, vitamin B1, vitamin B2, vitamin C, and dietary fiber. Group B met the targets for fat, iron, vitamin C, and dietary fiber. The PFC ratio was within the target range for A, whereas B had a higher percentage of fat. These results indicate that group A had better dietary self-management skills than group B.

Competing Interests

The authors declare that they have no competing interests.

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