Austin Journal of Nutrition and Food Sciences

Austin Publishing Group

Open Access Full Text Article

Research Article

Physical and Nutritional Status of Professional Japanese Futsal Players

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Received: March 29, 2014; **Accepted:** May 28, 2014; **Published:** May 29, 2014

Abstract

Adequate energy and nutrient intakes are essential for elite athletes to optimize their performance. While athletes have been reported to have a poor energy intake, there has been no report on nutritional status in futsal players who may require different physiological characteristics to soccer. The current study aimed to examine physical and nutritional status of professional Japanese futsal players. Anthropometric and dietary assessments using a food frequency questionnaire based on food groups (FFQg) were conducted on 15 professional male futsal players (12 field players and three goalkeepers: 26.4 ± 0.9 years old). On average, participants had 176.8 ± 1.1 cm and 72.8 ± 1.3 kg with percentage body fat (%BF) of 11.2 ± 0.5%. Although no difference in skinfolds was observed, goalkeepers had greater weight and circumference with a higher %BF than field players. The study also showed that none of the assessed nutrients and total energy intakes met the adequate intake (AI). Protein (p<0.05) and dietary fibre (p<0.01) intakes were significantly low even compared with 80% of the AI. Low nutrient intakes may be explained by significantly low consumption of all food groups. The current study suggested insufficient nutrient intakes among professional Japanese male futsal players. A further encouragement and nutritional support may be warranted in order to improve nutritional status of Japanese futsal players.

Keywords: Futsal; Nutritional status; Anthropometry

Abbreviations

Σ8SF: Sum of eight skinfolds; %BF: Percentage Body Fat; BMI: Body Mass Index; BMR: Basal Metabolic Rate; EER: Estimated Energy Requirement; FAD: Flavin Adenine Dinucleotide; FFQg: Food Frequency Questionnaire based on food groups; FFM: Fat-Free Mass; FIFA: Fédération Internationale de Football Association; FM: Fat Mass; ISAK: International Society for the Advancement of Kinanthropometry; JISS: Japan Institute of Sports Science; PAL: Physical Activity Level; SE: Standard Error; SFBIA: Single-Frequency Bioelectrical Impedance Analysis; TEM: Technical Error of Measurement; TPP: Thiamin Pyrophosphate

Introduction

Adequate consumption of energy and nutrients are essential for body build and to optimize sports performance. Sufficient consumption of energy maximizes liver and muscle glycogen store. Also adequate nutrients, such as vitamin B group and protein, together with sufficient energy intakes allow efficient energy metabolism and muscle gain. A recommended amount of protein depends on the type (i.e. aerobic or anaerobic) and physical activity level of the sports. A previous study reported that power- and strength-oriented sports will require1.2 – 1.8 g/kg/day of protein [1].

Futsal is a team sport which is officially sanctioned by Fédération Internationale de Football Association (FIFA). It is often recognized as a mini-soccer or indoor soccer as game played by two teams of five members (i.e. four field players and a goalkeeper) and often played indoor. Futsal has a similar rule to soccer and consistent with other team sports, players involve in a number of different types of exercise (i.e. walking, jogging, medium speed running and sprinting) intermittently throughout the game. However, futsal will be played in a much smaller size of the pitch, has shorter periods of play (20 minutes per period instead of 45 minutes) and has no restriction in a number of substitutions whilst soccer allows only three [2,3]. Such differences in rule influence physiological abilities required by players of different sporting events. Previous studies comparing with soccer players reported no difference in agility capacity [4] but futsal players have a greater acceleration capacity based on a 10 m sprint test [5]. Also other study from match analysis reported that about 20 % of the entire distance covered by futsal players was either in high-intensity running or sprints [6]. These reports indicate that futsal has different sporting characteristics from soccer and also clearly from other endurance- or power-oriented sports. While it has been suggested that muscle glycogen is important in improving performance of team sport players [2], multi-sprinting nature of futsal further suggests adequate energy consumption, particularly from carbohydrate as a crucial dietary factor that may influence performance of the players. However, existing studies on athletes reported inadequate energy consumption for their physical activity level [7,8]. In addition, to our knowledge, there has been no detailed study on nutritional status among futsal players.

The present study was therefore aimed to investigate physical characteristics and nutritional status of Japanese professional futsal players in Japan.

Citation: Kagawa M, Kobata T, Ishida R and Nakamura K. Physical and Nutritional Status of Professional Japanese Futsal Players. Austin J Nutri Food Sci. 2014;2(6): 1032.

Methods

Participants

Participants were professional Japanese male futsal players registered at a team in the F-league, the first division futsal league in Japan that consists of 10 teams. The F-league runs a season from June until February, with two major cup tournaments in August and March. Players will have self-training period in early January and pre-season preparation period after the tournament in March.

This cross-sectional study was conducted as a part of nutritional support program that was requested by one of the teams competing in the F-league during the 2012 season. While the program was offered to all registered players in the team, Japanese players who agreed to utilize the data for analysis by signing informed consent form and completed both anthropometric and dietary assessments at the beginning of the season (May) were considered as participants in the study. Out of 20 players invited, 18 players (15 field players and three goalkeepers) agreed to participate. Two Brazilian players and one Japanese player who did not complete a dietary assessment were excluded and thus the final sample size used in the analysis was 15 (12 field players and three goalkeepers). The study was approved by the Human Research Ethics Committee of Kagawa Nutrition University.

Anthropometry

All participants underwent anthropometric measurements, including eight skinfolds (triceps, subscapular, biceps, iliac crest, supraspinale, abdominal, front thigh and medical calf) and six circumferences (relaxed arm, chest, umbilicus, gluteal, mid-thigh and calf maximum). All skinfold and circumference measurements except for umbilicus circumference were measured using the standard protocol by the International Society for the Advancement of Kinanthropometry (ISAK) [9]. Umbilicus circumference was measured at the level of umbilicus. At each support session, Technical Errors of Measurement (TEM) were calculated for all measured variables. Calculated intra-tester TEMs were within the recommended levels reported elsewhere [10]. In addition, body mass and percentage body fat (%BF) were measured using an Single-Frequency Bioelectrical Impedance Analysis (SFBIA) device (Inner scan 50 BC-309, Tanita Corporation, Tokyo, Japan). Measured %BF was then used to calculate Fat Mass (FM) and Fat-Free Mass (FFM).

Table 1: Demographic characteristics of the participants.

	All players (n = 15) Mean ± SE	Field players (n = 12) Mean ± SE	Goalkeepers (n = 3) Mean ± SE
Age (years)	26.4 ± 0.9	26.3 ± 1.0	26.6 ± 2.3
Height (cm)	176.8 ± 1.1	175.7 ± 1.1	181.0 ± 1.5
Weight (kg)	72.8 ± 1.3	71.1 ± 1.0	79.7 ± 2.3**
BMI (kg/m^2)	23.3 ± 0.3	23.0 ± 0.2	24.3 ± 0.9
%BF (%)	11.2 ± 0.5	10.6 ± 0.5	13.7 ± 0.3*
Fat mass (kg)	8.2 ± 0.5	7.5 ± 0.4	10.9 ± 0.6**
Fat-free mass (kg)	64.6 ± 1.0	63.6 ± 1.0	68.8 ± 1.8*
Basal metabolic rate (kcal/d)	1842.1 ± 28.3	1812.7 ± 27.7	1959.8 ± 50.1*
Estimated energy requirement (kcal/d)	3684.2 ± 56.6	3625.3 ± 55.3	3919.5 ± 100.1*

* Significant difference between different positions at the 0.05 level.

** Significant difference between different positions at the 0.01 level.

Dietary assessments

Energy and major nutrient intakes were assessed using a validated Food Frequency Questionnaire based on food groups (FFQg: Excel Eiyo-kun FFQg, version 3.0, Kenpaku-sha, Tokyo, Japan) [11]. The FFQg asked to answer foods they consumed in the past two months by selecting a portion size and frequency of each food group. The questionnaire was aided with an instruction and examples of portion sizes. FFQg forms completed by the participants were checked by registered dietitians in a face-to-face setting to clarify questions from the players and to avoid incomplete responses.

Based on the obtained results, Body Mass Index (BMI: kg/m^2) was calculated from the self-reported height and measured body mass and a sum of eight skinfolds (Σ8SF: mm) was calculated from measured skinfolds. The FFQg data was entered into a dietary analysis program (Excel Eiyo-kun, version 5.0, Kenpaku-sha, Tokyo, Japan). The Estimated Energy Requirement (EER in kcal) was calculated using the equation (28.5 [kcal] x lean body mass (or FFM) [kg] x Physical Activity Level (PAL)) which was proposed by the Japan Institute of Sports Science (JISS) [12]. The PAL of 2.0 was used for ball sports during training season. Adequate Intake (AI) for other nutrients including carbohydrate (g), protein (g), fat (g), calcium (mg), iron (mg), retinol equivalent (μg), vitamin B_1 (mg), vitamin B_2 (mg), vitamin C (mg), total dietary fibre (g) and dietary salt (g) were determined based on recommendations for athletes [13] and the Dietary Reference Intakes for Japanese 2010 [14]. In addition to nutrients, amounts of food group consumptions (in g) were estimated using references [13,15]. The food groups include cereals, potatoes, green vegetables, mushrooms and other vegetables, seaweeds, legumes, seafood, meats, eggs, dairy products, fruits, confectionary, sweet beverages, sugar, nuts, oils, and seasonings. From the EER and the recommended nutrient and food group intakes, energy intake per body mass (kcal/kg), protein intake per body mass (g/kg) and percentage of adequate intakes for both nutrients and food groups were also calculated. Prior to analyses, presence of over- and under-reporters was determined. Based on a previous study result, individuals with energy intake greater than1.6 MJ or 384.2 kcal/d of EER were considered over-reporters [16]. For assessment of under-reporters, calculated BMR using the JISS equation was multiplied by the energy intake-to-BMR ratio of 0.88, which is the cut-off point based on the Goldberg critical evaluation of energy intake data using the 99.7% confidence interval [16]. In the present study, under- or over-reporters were not identified.

All statistical analyses were conducted using PASW statistics (version 18.0.0, IBM, Chicago, IL, USA). Descriptive statistics on physical and nutritional results were obtained. Normality of selected variables such as age, height, weight, BMI, %BF, Σ8SF and total energy intake were confirmed using the Shapiro-Wilk test. Nutrient and food group intakes between results obtained from the players and AI were compared using paired t-test. In addition, differences in intakes between field players and goalkeepers were assessed using independent t-test. All results were expressed as mean ± SE. A significant level of 0.05 was used unless otherwise stated.

Table 2: Anthropometric characteristics of the participants.

	All players (n = 15) Mean ± SE	Field players (n = 12) Mean ± SE	Goalkeepers (n = 3) Mean ± SE
Triceps (mm)	7.9 ± 0.6	7.7 ± 0.6	9.6 ± 0.6
Subscapular (mm)	8.1 ± 0.6	8.1 ± 0.3	9.2 ± 0.5
Biceps (mm)	3.9 ± 0.2	3.9 ± 0.2	3.9 ± 0.2
Iliac crest (mm)	10.4 ± 1.0	10.4 ± 1.3	10.4 ± 0.2
Supraspinale (mm)	6.7 ± 0.3	6.6 ± 0.4	7.3 ± 0.4
Abdominal (mm)	9.5 ± 0.7	9.0 ± 0.8	11.9 ± 0.2
Front thigh (mm)	8.0 ± 0.5	7.8 ± 0.6	9.0 ± 0.9
Medial calf (mm)	4.9 ± 0.3	4.7 ± 0.3	5.6 ± 0.5
Sum skinfolds (mm)	59.9 ± 3.1	58.2 ± 3.8	66.9 ± 0.9
Arm relaxed (cm)	29.7 ± 0.4	29.2 ± 0.4	31.5 ± 0.6*
Chest (cm)	95.7 ± 0.8	94.8 ± 0.8	99.4 ± 1.5*
Umbilicus (cm)	79.2 ± 0.7	78.2 ± 0.7	82.9 ± 0.3**
Gluteal (cm)	98.0 ± 1.0	96.9 ± 0.9	102.7 ± 2.2*
Mid-thigh (cm)	53.7 ± 0.6	53.4 ± 0.6	55.1 ± 1.5
Calf max (cm)	38.7 ± 0.3	38.5 ± 0.3	39.6 ± 0.7

* Significant difference between different positions at the 0.05 level.
** Significant difference between different positions at the 0.01 level.

Table 3: Nutrient intakes of the participants.

	All players (n = 15) Mean ± SE	Field players (n = 12) Mean ± SE	Goalkeepers (n = 3) Mean ± SE	Adequate intakes†
Total energy (kcal)	2805.1 ± 131.7**	2696.5 ± 1143.4	3239.7 ± 191.9	3700.0 ± 60.7
Energy/ weight (kcal/ kg)	38.4 ± 1.5	37.8 ± 1.8	40.6 ± 1.7	NA
Protein (g)	97.4 ± 5.7**	95.4 ± 6.6	105.6 ± 12.6	138.0 ± 2.4
Protein/ weight (g/kg)	1.3 ± 0.1	1.3 ± 0.1	1.3 ± 0.2	NA
Fat (g)	91.6 ± 6.2**	88.6 ± 6.0	103.8 ± 21.2	122.0 ± 1.8
Carbohydrate (g)	385.2 ± 18.5**	368.0 ± 19.7	454.3 ± 21.4	510.0 ± 8.5
Calcium (mg)	856.5 ± 74.0	873.6 ± 85.4	788.3 ± 167.4	1000.0 ± 0.0
Iron (mg)	10.3 ± 0.9**	10.1 ± 1.0	11.0 ± 2.2	15.0 ± 0.0
Retinol equivalent (µg)	737.8 ± 59.2*	746.6 ± 69.0	702.7 ± 130.5	900.0 ± 0.0
Vitamin B_1 (mg)	1.42 ± 0.11**	1.40 ± 0.12	1.52 ± 0.31	2.00 ± 0.03
Vitamin B_2 (mg)	1.62 ± 0.09*	1.66 ± 0.11	1.49 ± 0.17	1.90 ± 0.04
Vitamin C (mg)	135.7 ± 18.3**	141.0 ± 20.3	114.7 ± 48.7	200.0 ± 0.0
Dietary fibre (g)	16.7 ± 1.3**	16.2 ± 1.4	18.9 ± 3.8	27.9 ± 0.1
Salt (g)	9.8 ± 0.7	9.8 ± 0.8	9.7 ± 1.3	NA

* Significant difference with adequate intakes at the 0.05 level.
** Significant difference with adequate intakes at the 0.01 level.
†The age- and gender-specific adequate intakes (AI).
NA: Not available.

Results

Physical characteristics of the players were shown in Table 1. Their mean age was 26.4 ± 0.9 years. Mean BMI values calculated from self-reported height and weight were comparable between field players and goalkeepers. However, goalkeepers had significantly heavier weight (79.7 ± 2.3 kg vs 71.1 ± 1.0 kg, $p<0.01$) and marginally significant height (181.0 ± 1.5 cm vs 175.7 ± 1.1 cm, $p=0.045$) than field players. Estimated %BF from SFBIA was significantly different between field players and goalkeepers (10.6 ± 0.5% vs 13.7 ± 0.3%, $p<0.05$), which resulted in significantly greater FM, FFM, BMR and EER in goalkeepers Table 1.

Anthropometric characteristics were shown in Table 2. No significant differences were observed in skinfolds thickness measurements. However, goalkeepers showed significantly greater circumferences, particularly from the trunk region ($p<0.01$) Table 2.

Table 3 shows nutrient intake determined from dietary assessment. Compared with AI values, the players on average consumed significantly less amount of total energy, total protein, total fat, total carbohydrate, iron, vitamin B_1,vitamin C and dietary fibre (all $p<0.01$) as well as retinol equivalent and vitamin B_2 (all $p<0.05$). Between positions, no statistical differences were observed Table 3.

Table 4: Consumption of food groups of the participants.

	All players (n = 15) Mean ± SE	Field players (n = 12) Mean ± SE	Goalkeepers (n = 3) Mean ± SE	Adequate intakes†
Cereals (g)	610.8 ± 48.3**	571.4 ± 50.1	768.3 ± 104.0	939.3 ± 12.5
Potatoes (g)	53.6 ± 14.3**	49.7 ± 13.4	69.3 ± 55.5	130.0 ± 6.5
Green vegetables (g)	83.9 ± 10.8**	79.1 ± 12.3	103.3 ± 23.7	143.3 ± 6.7
Mushrooms and other vegetables (g)	139.2 ± 23.7**	142.3 ± 23.9	126.7 ± 83.0	270.0 ± 0.0
Seaweeds (g)	5.8 ± 1.2	6.4 ± 1.4	3.3 ± 1.8	5.0 ± 0.0
Legumes (g)	91.3 ± 14.8**	77.9 ± 13.0	145.0 ± 46.5	140.0 ± 0.0
Seafood (g)	60.9 ± 9.8**	62.9 ± 12.0	52.7 ± 11.3	97.0 ± 4.0
Meat (g)	150.3 ± 19.7	142.2 ± 20.1	183.0 ± 63.7	183.3 ± 5.5
Eggs (g)	41.7 ± 7.2**	50.0 ± 7.0$^{\#\#}$	8.3 ± 6.4	75.0 ± 0.0
Dairy products (g)	261.0 ± 49.1**	289.3 ± 55.0	148.0 ± 99.0	588.0 ± 3.9
Fruits (g)	177.2 ± 34.4**	196.9 ± 39.6	98.3 ± 54.4	230.0 ± 0.0
Confectionary (g)	84.8 ± 12.1	72.7 ± 8.1	133.3 ± 47.4	NA
Sweet beverages (g)	249.9 ± 33.6	242.4 ± 39.0	279.7 ± 73.9	NA
Sugar (g)	6.9 ± 1.7	6.3 ± 1.6	9.3 ± 6.8	16.0 ± 0.7
Nuts (g)	2.0 ± 1.1	2.3 ± 1.4	1.0 ± 0.6	NA
Oils (g)	14.9 ± 1.7	13.5 ± 1.7	20.3 ± 4.2	39.0 ± 0.7
Seasonings (g)	30.6 ± 3.7	29.8 ± 3.9	34.0 ± 11.9	NA

* Significant difference with adequate intakes at the 0.05 level.
** Significant difference with adequate intakesat the 0.01 level.
$^{\#\#}$ Significant difference between positions at the 0.01 level.
†The age- and gender-specific adequate intakes (AI).
NA: Not available.

In addition to total energy and nutrient intakes, the current study also examined a consumption of each food group of the participants (Table 4). Compared with the AI values for each food group, the players consumed significantly less amount of cereals, potatoes, vegetables including mushrooms, legumes, seafood, eggs, dairy products and fruits (all $p<0.01$). When compared between the positions, the field players consumed more egg products than goalkeepers ($p<0.01$) but consumption of the remaining food groups were comparable Table 4.

Using the AI as the reference, percentage of adequacy (%) for

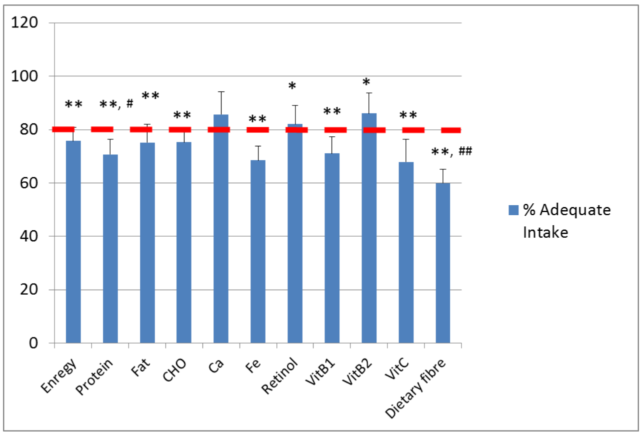

Figure 1: Percentage consumption of the recommended nutrient intakes.
** Significant difference from 100% of the adequate intake at the 0.01 level.
* Significant difference from 100% of the adequate intake at the 0.05 level
Significant difference from 80% of the adequate intake at the 0.01 level.
#significant difference from 80% of the adequate intake at the 0.05 level

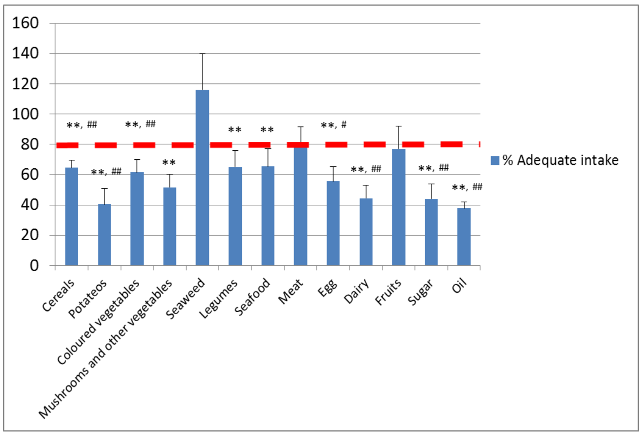

Figure 2: Percentage of recommended food group consumption. ** Significant difference with the 100% level of the adequate intakes at the 0.01 level.
Significant difference with the 80% level of the adequate intakes at the 0.05 level.
##Significant difference with the 80% level of the adequate intakes at the 0.01 level.

both nutrients and food group consumptions were assessed (Figures 1 and 2). The results clearly showed that none of the assessed nutrients met 100% of the AI. All three major nutrients as well as total energy intake were below 80% of the AI (protein: 70.7 ± 4.2%, fat: 75.1 ± 4.8%, carbohydrate: 75.3 ± 3.2%, total energy: 75.7 ± 3.2%: all p<0.01). Further, both protein and dietary fibre (59.9 ± 4.7%) were consumed significantly below 80% of the AI. Similarly, comparison of % adequacy of food groups with their AI values found that consumptions of a vast majority of food groups were insufficient. The only food groups that were not significant from 100% adequacy were seaweed, meat and fruits. The remaining food groups were significantly (p<0.01) below 100% adequate intake. Furthermore, consumptions of cereals, potatoes, colored vegetables, eggs and dairy products as well as sugar and oils were even lower than 80% of the AI. Percentages ranged from 37.8 ± 4.1% in oil sto 64.6 ± 4.8% in cereals Figure 1 & 2.

Discussion

The present study investigated physical characteristics and nutritional status of professional Japanese futsal players. Average height and weight of the study group were slightly taller and heavier than the general public of a comparable age group (172.6 ± 6.6 cm and 68.9 ± 13.2 kg) [17]. This may indicate a requirement of specific body size to become an elite futsal player. A sum of eight skinfolds obtained from the present study was much smaller than a previously reported sum of six skinfolds value of male indoor soccer players [18]. Considering smaller amount of %BF observed from Japanese futsal players and other studies that reported comparable body size of non-Japanese professional futsal players [4,19], the difference may be explained by lean physique possessed by Japanese futsal players compared to Caucasian athletes.

To our knowledge, this is the first study that reported nutritional status of futsal players in Japan. The present study clearly showed that Japanese futsal players were eating insufficient amount of energy and nutrients compared to their estimated requirements. This is consistent to other studies assessing athletes of different sporting events [7,8], suggesting that it is common for athletes to consume less amount of energy and nutrients. A less amount of total energy intake may be explained by small amount of protein, fat and carbohydrate consumptions. Considering a consumption pattern of food groups, low energy and carbohydrate intakes may be attributed by low consumptions of cereals and potatoes. Insufficient amount of energy intake affect sports performance and also degradation of muscle tissues to utilize amino acids in energy metabolism. Therefore it is strongly recommended the players to increase total energy intake by increasing consumption of carbohydrate-rich products.

According to a previous study, 1.2 – 1.8 g/kg/day of protein has been recommended for athletes [1]. The present study showed 1.3 ± 0.1 g/kg/day of protein consumption by Japanese futsal players on average. This appears adequate level of protein consumption for the group. However, the present study also indicated that the participants consume less than 80% of the AI and also consume less amounts of protein-rich sources such as legumes, seafood, eggs and dairy products. These results may suggest that the participants had a minimum level of protein intake. In order to optimize the effect of anaerobic, weight training and to increase FFM, regular consumption of protein-rich products is essential. Also the study showed that field players consumed less amount of legumes and meat but consumed more eggs and dairy products compared to goalkeepers. Animal and plant sources contain different types of amino acids and therefore it is important for the players to consume a wide variety of protein-rich products instead of rely upon specific sources.

In addition to insufficient intake of energy and major nutrients, the current study showed a significantly low consumption of iron, retinol, vitamin Bs, vitamin C, and dietary fibre. Poor intakes of these nutrients may be explained not only by low intakes of meat but also by low intakes of fruits and vegetables. Since some vitamins such as retinol (vitamin A) are fat-soluble, small use of oils may also contribute the current finding. Vitamin B groups are important components of co-enzymes of energy metabolisms such as Thiamin Pyrophosphate (TPP) and flavin adenine dinucleotide (FAD) [20]. Insufficient consumption of these nutrients may decrease efficiency of oxidative phosphorylation of the energy metabolism that takes place within mitochondria that may result in fatigue and poor sporting performance. In comparison, retinol and vitamin C are well known antioxidants. Although there is a little evidence for a need of antioxidant supplementation for athletes [21], an intake of antioxidants from daily meals will be beneficial in protection of muscle tissues from free radicals that are induced from exercise.

Conclusion

The current study has a number of limitations when interpret the results. The present study was conducted on a small sample and therefore the results cannot be generalized to the entire Japanese futsal players. Also due to participation of only three goalkeepers in the study, differences obtained from comparison between positions require confirmation. Although the dietary assessments were carried out by registered dietitians and checked thoroughly in a face-to-face setting, application of FFQg allows a recall bias to be introduced and therefore a potential under- or over-reporting by the participants. Further, since the present study simply examined nutritional status of the participants and their physical characteristic, future research should incorporate physiological components including fitness tests and analysis of blood samples. Acknowledging these limitations, however, the present study provided an insight about physical characteristics and nutritional status of professional Japanese futsal players. The study clearly indicated that the nutritional status of the players were inadequate and requires an increase in their food intakes from a wide variety of sources. While anthropometric assessments revealed a small amount of body fat among the players, this may not be a result of extensive training but simply due to a small amount of food intakes. In order to build muscles and also to increase sporting performance, it is suggested these players to increase food intakes to meet their AI standard. To achieve this, a further encouragement and nutritional support are strongly warranted. At the same time, it is strongly recommended to investigate contributing factors and effective strategies for behavior modifications in this population.

Acknowledgement

The present study was supported by the Encouragement Grant Scheme of the Institute of Nutrition Sciences, Kagawa Nutrition University. The authors would like to express appreciations to all players and team staff of Fuchu Athletic FC. The authors are also appreciative to Mr. Masanori Ito, a former dierctor of Fuchu Athletic FC for his cooperation.

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Austin J Nutri Food Sci - Volume 2 Issue 6 - 2014
ISSN : 2381-8980 | www.austinpublishinggroup.com

Citation: Kagawa M, Kobata T, Ishida R and Nakamura K. Physical and Nutritional Status of Professional Japanese Futsal Players. Austin J Nutri Food Sci. 2014;2(6): 1032.