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Evaluation for the effects of nutritional education on Chinese elite male young soccer players: The application of adjusted dietary balance index (DBI)

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ABSTRACT

Objectives: To evaluate the effect of nutrition education on Chinese elite male young soccer players through the knowledge, attitude, behavior (KAP) survey and an adjusted dietary balance index (DBI).
Methods: 30 Chinese elite male young soccer players were randomly divided into two groups: lecture group (N = 15, Age: 16.7 ± 1.8 years, Height: 173.9 ± 9.0 cm; Weight: 62.4 ± 13.0 kg; Training years: 5.6 ± 2.7 years) and non-lecture group (N = 15, Age: 16.8 ± 1.7 years, Height: 175.5 ± 7.9 cm; Weight: 62.5 ± 12.3 kg; Training years: 6.2 ± 3.3). The comics book was given to the non-lecture group, while the a four-week nutritional quality education along with comic books were given to the lecture group. Before and after 4 weeks nutritional education, dietary nutritional status of both groups was assessed. The main outcome measurements included the scores for each part of the KAP survey, diet status (food-weighing method) and the dietary index in the adjusted DBI-07 system (DBI-low bound score, LBS; DBI-high bound score, HBS; and DBI-diet quality distance, DQD).
Results: In the lecture group, significant differences were found in the scores of general nutrition knowledge, sports nutrition knowledge and total scores of KAP dietary questionnaire after 4 weeks nutritional education ($P < 0.01$). However, there is no significant difference in dietary attitude and dietary behavior ($P > 0.05$) on both two groups. There is no significant change in the DBI-low bound score (LBS), DBI-high bound score (HBS) and DBI-diet quality distance (DQD) of dietary quality index ($P > 0.05$) in both two groups.
Conclusions: Four weeks nutritional quality education improved the understanding of dietary nutrition among Chinese elite male young soccer players.

Introduction

Despite the primary important role of heredity and daily training, reasonable dietary structure and nutrition supplement are essential for improving physical performance as well as promoting the post-exercise recovery.[1,2] Previous studies shown that consuming a diet rich in carbohydrates or carbohydrate mixtures before training increased muscle glycogen concentration, delayed muscle fatigue and improved exercise performance.[3] Soccer has a high demand for physical capability such as body movement velocity and endurance performance. To meet the demands for a tremendous quantity of physical movement and intense antagonism during the prolonged playing time, there is a large amount of

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requirement for energy consumption. Studies on dietary intake of soccer players have also found that carbohydrate supplementation increased the total distance of running,[4,5] improved high intensity exercise ability.[6–10] However, challenging situations were still frequently found that the soccer players had daily energy intake lower than the energy consumption, and also with inadequate vitamin and mineral intake.[11–14] This makes it essential to improve the dietary status of the soccer players.

One of the biggest reasons for inappropriate diet attributes to the unconvincing nutrition knowledge from the internet or mass media. Nutritional education by the professional in nutrition area is the most direct and effective way to reserve this situation. Dietary evaluation plays a role as the primary step for this process. It provides fundamental information and direction for the future steps for the nutritional education as well as the following-up post-education evaluation. In most cases,[11,12,15–17] the dietary condition is traditionally evaluated through the average intake of food and every single nutrient. It calculates parameters (including the daily energy intake, the ratio of heat-producing nutrient supply, calcium, iron, vitamin A, vitamin C, etc.) that reflect the dietary status. However, the daily dietary intake includes varied compounds that may interact with each other and then therefore affect the general absorption and bioavailability.[18] Consequently, the traditional way of dietary evaluation may be failed to take the dietary complexity into consideration. It was also challenging when assessing the relationship between a single food or nutrient and disease. To address this issue, researchers proposed a Healthy Eating Index (HEI)[19] that combines food categories with nutrients. Subsequently, several other parameters had been created such as alternative healthy eating index (AHEI),[20] Diet Quality Index (DQI),[21] Diet Quality Index-International (DQI-I),[22] etc. With reference to the methods of HEI and DQI, He Yuna et al.[23] recently established a Diet Balance Index (DBI) by using the food group as an indicator. Based on the recommended intake of the balanced diet, DBI is a dietary quality assessment tool that reveals the either inadequate or excessive food intake. Therefore, the purpose of this study is to utilize the adjusted DBI to evaluate the effect of nutrition education on the soccer players. It was hypothesized that, following the four-week nutritional education, the soccer players would have an improvement in their dietary status and dietary quality.

Methods

Study design

Institutional ethical approval was obtained before conducting the study (Ethical approval code: 2016—008). The investigators fully explained the nature of the study, the procedures, and the potential risks, etc. This study was carried out in the soccer team of SP Being Yicheng BTV Sangao, which is one of the top soccer teams in Beijing city. This study was designed as a randomized control study. The total observation time was four weeks. The flow chart of the study procedure as demonstrated in Fig. 1.

Participants

30 young soccer players from SP Being Yicheng BTV Sangao were enrolled in the present study. The subjects were randomly divided into two groups: one group was given a comic book (non-lecture group), while the other was given a four-week nutritional education along with the comic book (lecture group). The basic information of the subjects is shown in Table 1.

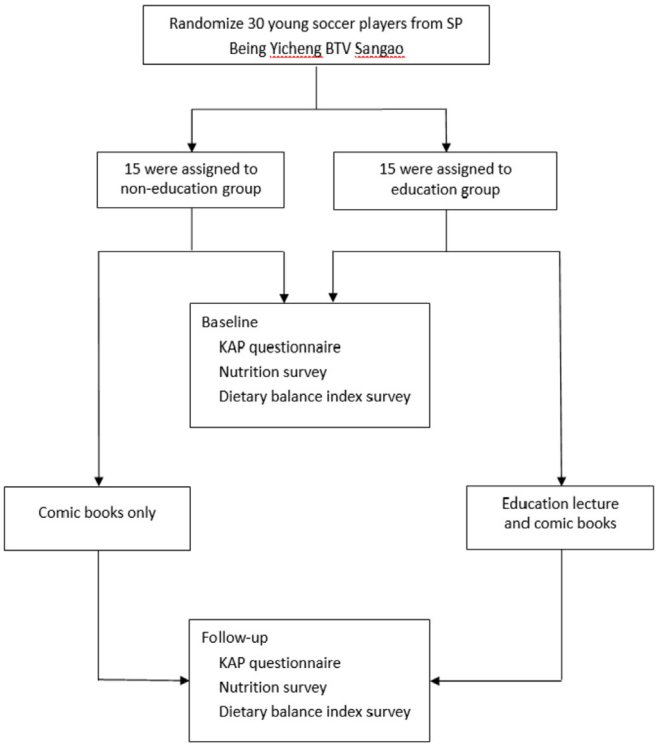

Fig. 1. Flow chart of the investigation.

KAP questionnaire

KAP questionnaire was developed and adjusted by the professionals in sports nutrition area. The reliability and validity were also tested with some specific items in the questionnaire. The questionnaire included five parts: basic information, general nutrition knowledge, sports nutrition knowledge, dietary behavior, and dietary attitude. The total number of questions in the questionnaire was 49, and the total score was 100 points. Five questions (No.31—34,36) were used for reference and therefore not included in the calculation of the total score. The KAP questionnaire was distributed prior to nutrition education for baseline assessment. Four weeks later, the identical questionnaires were distributed for the post-intervention assessment. All the questionnaires were completed at the same location with the supervision of investigators. To avoid any misunderstanding to the questions, the investigators explained the content of the questionnaire thoroughly during the whole process of filling out the questionnaire. The participants were required to make response to the questions independently, and then return it directly to the investigator right after the investigation.

Dietary nutrition education

The comic books for both non-lecture and lecture groups were demonstrated as cartoon. The cartoon was an internal teaching material developed by the General Administration of Sports of China for the athletes' quality education. For the lecture group, a four-week dietary nutrition education intervention was conducted in addition to the cartoon. The frequency of nutrition education was once a week, with 30 min per time.

Dietary survey

By the application of the food weighting method, three days'

Table 1
Basic information of participants.

Group	Number	Age (y)	Height (cm)	Weight (kg)	Training years(y)
lecture group	15	16.7 ± 1.8	173.9 ± 9.0	62.4 ± 13.0	5.6 ± 2.7
Non-lecture group	15	16.8 ± 1.7	175.4 ± 7.9	62.5 ± 12.3	6.2 ± 3.3

Note: y = years; cm = centimeter; kg = kilo gram.

dietary survey of young soccer players were conducted at SP Being Yicheng BTV Sangao, before and after the four weeks' nutritional education. Electronic scales with accuracy of ±0.1g were used to weigh the foods chosen by players. The leftover was also weighted for the precise calculation of the actual food intake in each meal. When marking records, the seasonings and cooking oil were in different dishes and then equally assigned to each dish after weighing. Snacks and beverages that consumed by the participants were also recorded. The intake of all kinds of food measured by weighing and recording was statistically analyzed by EXCEL2007 according to China Food Composition Table 2002. The average data was obtained by weighing and dietary review method-and was considered as the daily dietary intake.

Adjustment and calculation of athletes' dietary balance index (DBI-07)

Considered the specificity of athletes, the energy of athletes was divided into three levels. The actual daily energy intake and the value range of DBI-07 was adjusted according to the Dietary nutrients and appropriate food intake for Chinese athletes and the actual energy intake of young soccer players. When the actual intake of each indicator reached the recommended intake, the value was determined as 0. Athletes were forbidden to drink in the daily training process while were advised to rehydration in time, so the alcohol index will be adjusted to beverage, and juice. After the adjustment, the recommended intake was 350–600g cereals, 1050–1100g vegetables and fruits, 500g milk, 50g beans, 100–365g livestock and poultry meat, 70–150g fish and shrimp aquatic products, 50–100 g eggs, 45–65 g cooking oil, 10g salt, 1000 ml beverage and juice. The adjusted DBI-07 scores were also calculated by DBI scores of healthy adults, including total score (TS), high bound scores (HBS), low bound scores (LBS) and diet quality distance (DQD).

Statistical analysis

The score of the KAP questionnaire and the intake of each main nutrient were presented as Mean ± SE and all the data were analyzed with Excel2007 and SPSS 21.0. Independent-sampled T test and paired-sampled T test were applied to determine the difference among KAP questionnaire scores and nutrient intake. The population distribution of TS, LBS, HBS, and DQD were determined differently by Mann-Whitney U rank and Wilcoxon rank. Significance level was set as $P < 0.05$.

Results

Reliability and validity test of the KAP questionnaire

The internal consistency reliability of the questionnaire was tested by calculating the alpha reliability coefficient through SPSS. The Cronbach alpha coefficient was 0.781.

The test-retest reliability of the questionnaire was tested by Pearson reliability coefficient method through SPSS. The Pearson coefficient was 0.757. Expert judgment method was used to assess the validity of the KAP questionnaire, and the review results shown in Table 5. Ten experts (6 professors and 4 associate professors) were participated in the test for KAP questionnaire and the result suggested a good validity(See. Table 2).

Dietary quality before nutrition education

The total score, the high bound score, the low bound score and the diet quality distance was best at 0 or nearly 0. When the total score is negative, nutrition education is effective when the total score increases after nutrition education. When the total score is positive, the total score increases, nutrition education is effective. Nutrition education is effective when the high bound score, the low bound score and the diet distance decreases. Mann-Whitney U rank test shown that there was no significant difference in total score ($Z = -0.812$, $P = 0.436$), high bound score ($Z = 0.785$, $P = 0.461$), low bound score ($Z = -0.625$, $P = 0.539$) and diet quality distance ($Z = 0.021$, $P = 1.000$) between lecture group and non-lecture group before nutrition education.

Dietary questionnaire survey scores alternation following nutrition education

There were significant differences in general nutrition knowledge, sports nutrition knowledge scores and KAP dietary questionnaire scores in the lecture group before and after nutrition education, but there was no significant difference in nutritional attitudes and dietary behaviors. There was no significant change before and after nutrition education in the non-lecture group. There was no significant difference in the first week between the lecture group and the non-lecture group (Fig. 2).

Changes in calorie intake ratio of three daily meals following nutrition education

Compared with the results of the first week of the subjects, the results showed that there were no significant changes in the calorie intake ratios of breakfast, lunch, dinner and snack between the lecture group and the non-lecture group. There was no significant difference in the first week between the lecture group and the non-lecture group (Table 3).

Changes in daily nutrients intake following nutrition education

Paired-sampled T test indicated that, there was no significant

Table 2
Expert validity evaluation form.

	Reasonable	Almost reasonable	General	Unreasonable
Effectiveness	7	3	0	0
Structural design	6	3	1	0
Content	7	2	1	0

Notes: the numbers in the table indicated the number of experts who made choices among the opinions ("reasonable", "almost reasonable", "general" and "unreasonable") towards each of the three dimensions ("effectiveness", "study design" and "content") of the validity assessment.

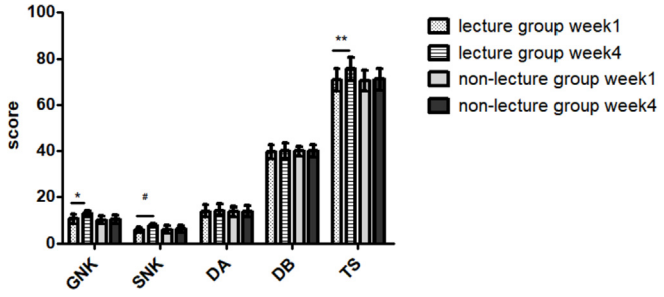

Fig. 2. Changes in the survey scores of the KAP dietary questionnaire.
Notes: vs. the first week *:P < 0.01; #: P < 0.05,**: P < 0.01.General nutrition knowledge (GNK); Sports nutrition knowledge (SNK); Dietary attitude (DA); Dietary behavior (DB); Total score (TS).

Table 5
Change of Wilcoxon rank statistics of dietary quality in two groups.

	TS	HBS	LBS	DOQ
Non-lecture group				
First week	−15	10	21	34
The fourth week	−16	10	20	35
Z	-.18[b]	-.73[c]	-.52[b]	-.35[c]
P (2-tail)	.86	.46	.60	.73
Lecture group				
First week	−17	8	21	35
The fourth week	−17	9	21	35
Z	−1.49[b]	−1.178[c]	−1.596[c]	−0.191[b]
P (2-tail)	.13	.24	.11	.85

Notes: TS = Total Score; HBS = High Bound Scores; LBS = Low Bound Scores; DOQ = Diet Quality Distance; a.Wilcoxon symbol level verification; b. According to negative grade; c. According to positive grade.

change in total calories and average daily intake of protein, fat, carbohydrate and total energy between the non-lecture group and the lecture group before and after nutrition education. There was no significant difference between the lecture group and the non-lecture group at the first week.

Compared to the first week, the average daily intake of vitamin A, vitamin C, calcium and zinc both increased after the nutrition education, however there was no significant difference between the two groups. There was no significant difference between the lecture group and the non-lecture group at the first week (Table 4).

Change of dietary quality scores following nutrition education

After nutrition education, 46.67% of the young soccer players' total score increased, with an average rank of 8.14 and a rank sum of 57.00; 53.33% of the young soccer players' positive end score decreased by 5.94 and the rank sum was 47.50; 53.33% of the young soccer players' negative end score decreased, with an average rank of 7.56 and a rank sum of 60.50; 40% of the young soccer players' negative end score decreased. The dietary quality distance of junior soccer players decreased, with an average rank of 9 and a rank sum of 54. There was no significant difference in the total score ($Z = -0.18$, $P = 0.86$), the high bound score ($Z = -0.73$, $P = 0.46$), the low bound score ($Z = -0.52$, $P = 0.60$) and the diet quality distance ($Z = -0.35$, $P = 0.73$) of the young soccer players in the non-lecture group.

Wilcoxon rank test was used to compare the dietary quality index at the first week and the fourth week of the lecture group. The total score of dietary quality in this study is negative (Table 5). After nutrition education, 66.67% of the young soccer players' total score increased, with an average rank of 8.60 and a rank sum of 86.00; 60% of the young soccer players' positive end score decreased by 8.89 and the rank sum was 80.00; 66.67% of the young soccer players' negative end score decreased, with an average rank of 8.75 and a rank sum of 87.50; 46.67% of the young soccer players' negative end score decreased. The dietary quality distance of junior soccer players decreased, with an average rank of 7.07 and a rank sum of 49.50. There was no significant difference in the total score

Table 3
Changes in calorie intake of three meals.

	Lecture group (n = 15)		Non-lecture group (n = 15)	
	The first week	The fourth week	The first week	The fourth week
Breakfast (kcal)	652.0 ± 168.0	675.0 ± 165.0	724.0 ± 133.0	765.0 ± 168.0
Breakfast (%)	22.7 ± 4.5	23.2 ± 4.6	25.7 ± 4.2	26.7 ± 4.7
Lunch (kcal)	993.0 ± 152.0	1023.0 ± 134.0	980.0 ± 106.0	961.0 ± 117.0
Lunch (%)	35.0 ± 4.2	35.4 ± 3.2	34.8 ± 3.4	33.8 ± 3.6
Dinner (kcal)	801.0 ± 92.0	842.0 ± 82.0	749.0 ± 95.0	739.0 ± 73.0
Dinner (%)	28.3 ± 2.6	29.2 ± 2.0	26.6 ± 2.3	26.0 ± 2.8
Snack (kcal)	395.0 ± 131.0	347.0 ± 159.0	367.0 ± 91.0	384.0 ± 139.0
Snack (%)	13.9 ± 4.2	12.2 ± 5.6	12.9 ± 2.9	13.4 ± 4.5

Note: kcal = kilo calorie.

Table 4
Daily nutrients intake in two groups.

	Lecture group (n = 15)		Non-lecture group (n = 15)	
	The first week	The fourth week	The first week	The fourth week
Calories (kcal)	2842.6 ± 317.5	2889.2 ± 240.4	2822.3 ± 258.9	2850.9 ± 280.7
Protein (g)	80.3 ± 9.9	84.0 ± 9.3	83.1 ± 7.3	85.6 ± 9.4
Fat (g)	101.9 ± 10.9	101.3 ± 9.9	100.7 ± 13.3	100.3 ± 13.8
Carbohydrate (g)	393.1 ± 49.2	400.8 ± 35.8	384.7 ± 34.0	388.8 ± 36.0
VA (μg)	573.1 ± 203.6	612.2 ± 185.6	529.9 ± 211.1	556.3 ± 169.9
VC (mg)	97.4 ± 13.7	99.2 ± 14.9	93.4 ± 14.4	94.5 ± 13.8
Ca (mg)	582.1 ± 216.6	615.8 ± 201.8	564.2 ± 240.6	587.9 ± 217.5
Fe (mg)	25.0 ± 4.2	25.5 ± 4.1	26.6 ± 3.9	26.5 ± 4.3
Zn (mg)	14.2 ± 2.9	14.9 ± 2.9	13.6 ± 2.6	13.9 ± 2.2

Note: kal = kilo calorie; g = gram; VA = Vitamin A; μg = microgram; VC = Vitamin C; mg = microgram; Ca = Calcium; Fe = Iron; Zn = Zinc.

($Z = -1.49$, $P = 0.13$), the high bound score ($Z = -1.18$, $P = 0.24$), the low bound score ($Z = -1.60$, $P = 0.11$) and the diet quality distance ($Z = -0.19$, $P = 0.85$) of the young soccer players in the lecture group.

Discussion

Nutritional education and KAP dietary questionnaire score in young soccer players

The lack of proper nutrition knowledge and ignoring the importance of dietary nutrition will lead to insufficient types of nutrients intake during exercise training. Consequently, this will predispose to the premature occurrence of exercise-induced fatigue and jeopardize the effect of post-exercise recovery. It was common to find in the previous studies[15–17] that athletes cannot accurately identify the effects of essential nutrients or the recommended energy ratio of macronutrients. The most firmly believed misconceptions among athletes is to consider the protein as the main source of energy for muscle contraction, while even an appropriate amount of carbohydrate intake can induce obesity.[15] The correct qualification rate of athletes' nutrition knowledge was 45.6%. Only 6% of participants obtained scores higher than 75 in the section of sports nutrition knowledge. Moreover, only 47.6% of participants believed that reasonable supplementation was essential for training.[17] After four weeks' nutrition education, the scores of general nutrition knowledge, sports nutrition knowledge and total scores of KAP dietary questionnaires in lecture group were significantly higher than that in the non-lecture group. However, the nutritional attitude and dietary behavior were not significantly improved.

This may be attributed to two factors. First and the foremost, is the lack of proper guidance in nutrition education for young athletes to change unhealthy eating behaviors. The goal of nutrition education can never be achieved by simply inputting the nutrition education rather than carrying out dietary behavior guidance. This education manner will lead to the separation of theory and practice. Moreover, the athletes may not necessarily comply with the dietary guidelines even though there is a good nutritional knowledge.[29] Secondly, it is the difficulty of changing dietary behaviors. The change of dietary behavior can be largely influenced by several objective factors such as economic conditions, dining environment and school food supply. Meanwhile, the change of dietary knowledge and attitude is the essential preliminary condition for the change of dietary behavior. Only with certain knowledge and good acceptance attitude, there is the possibility to achieve this change. Moreover, once the unhealthy dietary habits were formed, they cannot be changed within a short time. It is a long-term task for the transformation from accepting healthy dietary information to changing their unhealthy dietary habits.

Nutritional education and dietary intake in young soccer players

Soccer is a high-intensity intermittent exercise with a great demand on the physical fitness.[30] On top of this, it is of essential importance for the football athletes to undergo both appropriate training and nutritional strategies.[31,32] However, it has been frequently reported that football athletes have an imbalance diet in carbohydrate, fat, and protein intake.[33–38] Moreover, there was also an insufficient intake of several vitamins (Vitamin C、E) and minerals (Calcium, Iron, Zinc).[11–13,16] To improve those above situations, it is vital to address our attention on both nutritional education and dietary intake monitoring for the athletes.

Traditionally, studies on dietary nutrition of football players have been mainly based on the single nutrients or biochemical indicator evaluation.[39–41] This method is simple and focused, with the most necessary information provided during the survey. However, due to the reality of daily multiple supplementation intake, there is limitation for this method when determining the effect of nutrient intake on overall physical performance outcome,[42] as well as the interaction among the food compounds.[43] Moreover, it is also worthwhile to note that the not only the single nutrient intake but also the dietary pattern address impact on the general health outcome.[44–46] Indexes such as DQI is an integrative methodology that categorizes the type of food, assessing and calculating dietary behaviors, conditions, and attitudes. Neuhouser et al.[53] applied DQI to examine the relationship between nutrient biomarkers and overall dietary quality. Results showed that the plasma concentration of vitamin C, α-tocopherol and β-carotene were higher in participants with good dietary quality (DQI scores = 6–7), while the ratio of stearic acid and benefic acid in plasma phosphatidic acid was lower. DQI is therefore considered to be a useful tool for measuring dietary patterns. Herein, we consider that DBI established in accordance with DQI is a novel effective tool for evaluating athletes' dietary quality and nutrition education. The DBI has already been validated in previous study in which shown that this method can be utilized in altering the dietary quality at varied periods,[47,48] analyzing the relationship between dietary costs and dietary quality,[49] evaluating the differences in dietary quality between different populations and their influencing factors,[47,50] as well as investigating the effects of nutritional interventions[51] on the dietary quality in specific populations.[52]

After a four-week nutrition education for the young soccer players, there were increasing in terms of proportion of meals, vitamin A, vitamin C, calcium, iron and zinc intake. On top of those above change, it is also encouraging to find there were decreasing in the proportion of snacks and a descending trend of fat intake. In addition, the scores of DBI (such as total score, high score, low score and dietary quality index) also tend to decrease, there is no significant difference. This result aligned with previous studies[24–26,54,55] in showing an increase in nutrition knowledge and more positive attitudes regarding the importance of nutrition knowledge without any change in the dietary intake. However, some studies[27,28] still found that there was a weak positive correlation between nutritional knowledge and healthy dietary intake. The nutrition education, to some extent, can improve the athletes' knowledge and understanding for the dietary nutrition. However, it should be aware that the alternation of the knowledge may not necessarily induce a rapid change in the subsequent practices. Besides, coaches also play an essential role during the knowledge transmission. When coaches are misinformed about nutrition, athletes may receive inappropriate instructions in utilizing the newly gained knowledges and therefore may not be able to put those knowledges into practice.[56] In addition, the limited food resources in the restaurant is also one of the major concerns during the alternation of eating behavior. In the observation site of the present study, there was only a small portion of food with high quality proteins such as soybeans and soy products, fruits and fish and shrimps. For the domestic young players, they spend most of their training and dinning time in this observation site. The inadequate dietary supply in those restaurants also leads to the inability to diversify the diet choices.

Future directions for the nutritional education in the young soccer players

Notwithstanding the challenges to transform the current settings, it is crucial in our future work to rationally optimize the diet structure of young players, improve the education methods and extend the education time to promote the practicality of nutrition

knowledge education. Meanwhile, it is also essential to conduct follow-up education to strengthen the nutrition knowledge education for players as well as the service personnel in the base restaurants, and thus, ensure the rationality and diversity of dietary supplies. Future study is also warranted to examine the relationship between food diversity scores and adequate nutrient intake, as well as determining the relationship between nutrient biomarkers and overall dietary quality.

Conclusions

The four-weeks of nutrition education in the present study improves the understanding of young soccer players on dietary nutrition knowledge.

Acknowledgements

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References

1. Gisolfi CV, Lamb DR. Perspectives in exercise science and sports medicine, volume 3, fluid homeostasis during exercise. *Med Sci Sport Exerc*. 1991;23(9):1116.
2. Burke LM, Mujika I. Nutrition for recovery in aquatic sports. *Int J Sport Nutr Exerc Metab*. 2014;24(4):425–436.
3. Burke LM, Hawley JA, Wong SH, et al. Carbohydrates for training and competition. *J Sport Sci*. 2011;29(sup1):S17–S27.
4. Bangsbo J, Nørregaard L, Thorsøe Fjijosm. The effect of carbohydrate diet on intermittent exercise performance. *Int J Sports Med*. 1992;13(2):152–157.
5. Souglis AG, Chryssanthopoulos CI, Travlos AK, et al. The effect of high vs. Low carbohydrate diets on distances covered in soccer. *J Strength Cond Res*. 2013;27(8):2235–2247.
6. Kingsley M, Penasruiz C, Terry C, et al. Effects of carbohydrate-hydration strategies on glucose metabolism, sprint performance and hydration during a soccer match simulation in recreational players. *J Sci Med Sport*. 2014;17(2):239–243.
7. Abt G, Zhou S, Weatherby R. The effect of a high-carbohydrate diet on the skill performance of midfield soccer players after intermittent treadmill exercise. *J Sci Med Sport*. 1998;1(4):203–212.
8. Ali A, Williams C, Nicholas CW, et al. The influence of carbohydrate-electrolyte ingestion on soccer skill performance. *Med Sci Sport Exerc*. 2007;39(11):1969–1976.
9. Russell M, Kingsley M. The efficacy of acute nutritional interventions on soccer skill performance. *Sport Med*. 2014;44(7):957–970.
10. Ebenbichler G, Mair P, Wirth C, et al. Analysis of high intensity activity in premier league soccer. *Int J Sports Med*. 2009;30(03):205–212.
11. Russell M, Pennock A. Dietary analysis of young professional soccer players for 1 week during the competitive season. *J Strength Cond Res*. 2011;25(7):1816–1823.
12. Marc B, Emma C, Penny R, et al. Assessment of energy intake and energy expenditure of male adolescent academy-level soccer players during a competitive week. *Nutrients*. 2015;7(10):8392–8401.
13. Galanti G, Stefani L, Scacciati I, et al. Eating and nutrition habits in young competitive athletes: a comparison between soccer players and cyclists. *Transl Med Unisa*. 2015;11(8):44–47.
14. Jch L, Le GF, Grandjean V, et al. Nutritional intake of French soccer players at the clairefontaine training center. *Int J Sport Nutr Exerc Metab*. 2002;12(3):268–280.
15. Devlin BL, Leveritt MD, Kingsley M, et al. Dietary intake, body composition and nutrition knowledge of Australian football and soccer players: implications for sports nutrition professionals in practice. *Int J Sport Nutr Exerc Metab*. 2017;(2):130–138.
16. Manore MM, Pattonlopez MM, Meng Y, et al. Sport nutrition knowledge, behaviors and beliefs of high school soccer players. *Nutrients*. 2017;9(4):350.
17. Nikolaidis PT, Theodoropoulou E. Relationship between nutrition knowledge and physical fitness in semiprofessional soccer players. *Scientifica*. 2014:180353.
18. Hu FB. Dietary pattern analysis: a new direction in nutritional epidemiology. *Curr Opin Lipidol*. 2002;13(1):3–9.
19. Kennedy ET, Ohls J, Carlson S, et al. The healthy eating index: design and applications. *J Am Diet Assoc*. 1995;95(10):1103–1108.
20. McCullough ML, Diane F, Stampfer MJ, et al. Diet quality and major chronic disease risk in men and women: moving toward improved dietary guidance. *Am J Clin Nutr*. 2002;76(6):1261–1271.
21. Patterson RE, Haines PS, Popkin BM. Diet quality index: capturing a multidimensional behavior. *J Am Diet Assoc*. 1994;94(1):57–64.
22. Soowon K, Haines PS, Anna SR, et al. The diet quality index-international (DQI-I) provides an effective tool for cross-national comparison of diet quality as illustrated by China and the United States. *J Nutr*. 2003;133(11):3476–3484.
23. He YN, Zhai FY. Approaching Chinese diet balance index. *J Hyg Res*. 2005;34(2):208–211 (in chinese with english abstract).
24. Chapman P, Toma RB, Tuveson RV, et al. Nutrition knowledge among adolescent high school female athletes. *Adolescence*. 1997;32(126):437–446.
25. Perron M, Endres J. Knowledge, attitudes, and dietary practices of female athletes. *J Am Diet Assoc*. 1985;85(5):573–576.
26. Werblow JA, Fox HM, Henneman A. Nutritional knowledge, attitudes, and food patterns of women athletes. *J Am Diet Assoc*. 1978;73(3):242–245.
27. Frederick L, Hawkins ST. A comparison of nutrition knowledge and attitudes, dietary practices, and bone densities of postmenopausal women, female college athletes,and nonathletic college women. *J Am Diet Assoc*. 1992;15(3):260–261.
28. Douglas PD, Douglas JG. Nutrition knowledge and food practices of high school athletes. *J Am Diet Assoc*. 1984;84(10):1198–1202.
29. Browning A. *Nutritional Knowledge And Dietary Habits Of College Cross-Country Runners*. Bachelor's thesis. Worcester,Massachusetts: Worcester Polytechnic Institute; 2010.
30. Di-Salvo V, Gregson WG, Tordoff P, et al. Analysis of high intensity activity in Premier League soccer. *Int J Sports Med*. 2009;30(3):205–212.
31. Arief II , Budiman C, Jenie BS, et al. Plantaricin IIA-1A5 from Lactobacillus plantarum IIA-1A5 displays bactericidal activity against Staphylococcus aureus. *Benef Microbes*. 2015;6(4):603–613.
32. Wohlgemuth S, Loh G, Blaut M. Recent developments and perspectives in the investigation of probiotic effects. *Int J Med Microbiol*. 2010;300(1):3–10.
33. Economos CD, Bortz SS, Nelson ME. Nutritional practices of elite athletes: practical recommendations. *Sport Med*. 1993;16:381–399.
34. Keith RE, O'Keefe KA, Alt LA, et al. Dietary status of trained female cyclists. *J Am Diet Assoc*. 1989;89:1620–1623.
35. Nutter J. Seasonal changes in female athletes' diets. *Int J Sport Nutr*. 1991;1:395–407.
36. Steen SN, Mayer K, Brownell KD, et al. Dietary intake of female collegiate heavyweight rowers. *Int J Sport Nutr*. 1995;5:225–231.
37. Van Erp-Baart AM, Saris WH, Binkhorst RA, et al. Nationwide survey of nutritional habits in elite athletes. *Int J Sport Nutr*. 1989;10(suppl):S3–S10.
38. Grandjean AC. Macronutrient intake of US athletes compared with the general population and recommendations for athletes. *Am J Clin Nutr*. 1989;49:1070–1076.
39. Bravo-Soto GA, Madrid T. Is folic acid supplementation useful for chronic kidney disease? *Medwave*. 2016;16(suppl 5), e6591.
40. Koshkaryan V, Shen YJ, Mehran R, et al. Nutritional supplementation to prevent and slow the progression of chronic kidney disease: focus on bicarbonate. *Nutr Die Suppl*. 2010;2:39–49.
41. Wyatt CM, Spence JD. Folic acid supplementation and chronic kidney disease progression. *Kidney Int*. 2016;90(6):1144–1145.
42. Donizete CX, Oliveira D, Flavia TR, et al. Antioxidant vitamin supplementation prevents oxidative stress but does not enhance performance in young football athletes. *Nutritionidney*. 2019;63–64(7):29–35.
43. Council N. Diet and health: implications for reducing chronic disease risk. *Nutr Today*. 1969;24(1):34.
44. Randall E, Marshall JR, Graham S, et al. Patterns in food use and their associations with nutrient intakes. *Am J Clin Nutr*. 1990;52(4):739–745.
45. Kant AK, Schatzkin A, Block G, et al. Food group intake patterns and associated nutrient profiles of the US population. *J Am Diet Assoc*. 1991;91(12):1532–1537.
46. Ursin G, Ziegler RG, Subar AF, et al. Dietary patterns associated with a low-fat diet in the national health examination follow-up study: identification of potential confounders for epidemiologic analyses. *Am J Epidemiol*. 1993;137(8):916–927.
47. Guenther PM, Juan WY, Lino M, et al. Diet quality of low-income and higher income Americans in 2003-04 as measured by the healthy eating index-2005. *Nutr Ins*. 2008;12:23.
48. Popkin BM, Zizza C, Siega-Riz AM. Who is leading the change? U.S. dietary quality comparison between 1965 and 1996. *Am J Prev Med*. 2003;25(1):1–8.
49. Rehm CD, Pablo M, Adam D. The quality and monetary value of diets consumed by adults in the United States. *Am J Clin Nutr*. 2011;94(5):1333–1339.
50. Martínez-González MA, Fernández-Jarne E, Serrano-Martínez M, et al. Development of a short dietary intake questionnaire for the quantitative estimation of adherence to a cardioprotective Mediterranean diet. *Eur J Clin Nutr*. 2004;58(11):1550–1552.
51. Glanz K, Hersey J, Cates S, et al. Effect of a nutrient rich foods consumer education program: results from the nutrition advice study. *J Acad Nutr Diet*. 2012;112(1):56–63.
52. Snyder DC, Sloane R, Clipp EC, et al. Diet quality index-revised (DQI-R): a tool to promote and evaluate dietary change among older cancer survivors enrolled in a home-based intervention trial. *J Am Diet Assoc*. 2005;107(9):1519–1529.
53. Neuhouser ML, Patterson RE, King IB, et al. Selected nutritional biomarkers predict diet quality. *Public Health Nutr*. 2003;6:703–709.
54. Collison SB, Kuczmarski MF, Vickery CE. Impact of nutrition education on female athletes. *Am J Health Behav*. 1996;20:14–23.
55. Potter GS, Wood OB. Comparison of self- and group instruction for teaching sports nutrition to college athletes. *J Nutr Educ*. 1991;23:288–290.
56. Cotugna N, Vickery CE, Mcbee S. Sports nutrition for young athletes. *J Sch Nurs*. 2005;39(5):300.