Dietary diversities score and anthropometric characteristics in Iranian elementary school children

Mohsen Jafari (1), Anahita Izadi (2), Paniz Dehghan (3), Sayed Yousef Mojtahedi (4)

(1) Department of pediatric infectious diseases, Bahrami children Hospital, Tehran University of Medical sciences, Tehran, Iran; (2) Department of pediatric infectious diseases, Tehran University of Medical sciences, Tehran, Iran; (3) School of Medicine, Ziyaeian Hospital, Tehran University of Medical Sciences, Tehran, Iran; (4) Department of pediatric nephrology, Bahrami Hospital, Tehran University of Medical Sciences, Tehran, Iran

Abstract

Dietary diversity scoring is a good method to assess quality of individual's diet. The study aimed to investigate the association between dietary diversity and body mass index among elementary school students in the south of Tehran, Iran. This cross-sectional study was conducted on elementary school students, age range of 7-12 years old, in 2015. Data were collected using a personal information questionnaire and three 24-h recall questionnaires. Dietary diversity score was calculated from the number of food groups in these questionnaires. A total of 536 students, 258 (48.1%) female and 278 (51.9%) male, were recruited in the study. The mean age of the students was 9.43 ± 1.73 years. Seafood consumption was more frequent and beans was lower frequent in students at higher BMI (≥95th percentile) than the other children (34% vs 25% and 71% vs 83%, respectively, $p<0.05$). However, the statistical analysis failed to find significant relationships between children's body mass index (BMI) with consumption of diary, vegetable, fruits, protein, fat, and junk food intake. The association between children's BMI with seafood and beans consumption confirmed in multivariate analysis (OR= 1.50 and 0.52, respectively, $p<0.05$). The study finding showed that seafood and beans consumption may influence on elementary student BMI.

Key Words: Dietary diversity score, elementary school student, body mass index.
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Adequate nutrition is essential for child's mental and physical development.[1] Dietary variety defines as nutritional quality and adequacy by measuring the frequency of foods consumption from different food categories over a given time period.[2] The American dietary guidelines, to promote adequate proportion in each food group providing sufficient energy, protein, and essential micronutrients,[3, 4] can be a good indicator of diet quality and household food security.[5] The demographic and economic transition of developing countries causes significant changes in diet and lifestyle that greatly impact on population health status.[6] Pan American Health Organization/World Health Organization (PAHO/WHO) has advocated the use of dietary diversity for complementary feeding of infants and young children.[7] Previous studies have highlighted that dietary diversity is positively associated with high calorie intake among young children in developing countries.[8,9] Similarly, dietary habits with uniform food preferences and increased energy intake can contribute to increase body fat proportion.[10] Children may be the most susceptible group to have inadequate eating habits. In other word, children unbalanced diet can lead to delay in physical growth, and cognitive/emotional development.[11] In addition, childhood adiposity may predispose individual to develop diabetes mellitus, cardiovascular diseases, degenerative joint diseases, certain cancers and other health risks in the further.[10, 12] Previous studies have shown that children with a good diverse diet have a better growth status than children who consume a steady diet.[1,13] Food diversity associates with high levels of vitamins and essential nutrients availability for human body.[14] Getting the essential micronutrients, especially during childhood period, reduces the risk of underlying and metabolic diseases and increases the community health status, as well as the quality of individual's life.[15,16] Thus, increasing of people knowledge and information about these foods is necessary. The prevalence of

Table 1. *The rate of different nutritional group during last 24 hours, the average BMI for both consumers and non-consumers of the food group and correlation between consumption and BMI.*

	Frequency of consumption (%)	The Mean BMI of consumers	The Mean BMI of non-consumers	p value
Dairy products	390 (72.8)	20.43±4.85	20.39±4.60	0.939
Vegetables	365 (68.1)	20.45±4.62	20.35±5.12	0.807
Fruits	366 (68.3)	20.43±4.62	20.35±5.12	0.818
Animal proteins	395 (73.7)	20.22±4.67	20.95±5.06	0.121
Frying foods	442 (82.5)	20.38±4.86	20.59±4.40	0.696
Seafood	158 (29.5)	21.25±4.96	20.07±4.66	0.009
Junk foods	212 (39.6)	20.53±4.88	20.34±4.72	0.656
Beans	412 (76.9)	20.00±4.67	21.87±4.91	< 0.001

overweight/obesity (OW/OB) is rapidly increasing in many countries [17, 18] and these have been a matter of public concern for decades, independent to economic status of those countries.[19] Considering the increasing prevalence of obesity in children, circumspect decision should be made to improve their health.[19] On the other hand, children obesity is a multi-factorial problem, which dietary factors may play the most important role to induce it. Association between individual nutrients and obesity has been widely studied, but insufficient attention has been given on overall dietary diversity and obesity.[2,6] Thus, this study aimed to investigate correlation between nutritional diversity score and anthropometric characteristics of elementary school students.

Materials and Methods

In this cross-sectional study, elementary school children, aged 7-12 year-old, were recruited to the survey in Tehran's 17th district. Regarding 16% prevalence of nutritional disorders in Iranian children,[20] with an 4% accuracy and the significance level of 95%, the study sample size was calculated as 322. According to the cluster type sampling method, this number was multiplied by 1.5 (coefficient of study) and the number increased to 483. Assuming a 10% drop in samples, 532 students were considered for the final sample size. The samples were selected in two stages; in the first stage, clusters were selected through systematic random sampling from the 17th district schools. Then, from each cluster (school), the number of students specified per cluster was selected by random number method. Each student was interviewed by a trained person to complete the PHAO dietary diversity questionnaire. The questionnaire score for each person was calculated based on the provided guideline. The height and weight of the selected students were also measured by standard methods. The relationship between the score calculated for the questionnaire and anthropometric characteristics was investigated. Based on the students BMI standardized percentile curves of the body mass index for Iranian children,[21] students were divided into two groups (above or equal to the 95th percentile and below the 95th percentile) and the mean score of the questionnaire was compared in these two groups. The levels of dietary intake (macronutrients and micronutrients) were also compared in these groups.

Statistical Analysis

Data analysis was performed using SPSS 21 software. The mean of variables was compared between the two groups by student *t*-test. To examine the relationship between the questionnaire's score and the children anthropometric characteristics, the Pearson's or Spearman correlation tests were used. The consumption of different types of food in the student sub-groups was compared using chi-squared test. The p value less than 0.05 was considered as a significant level.

Results

A total of 536 students aged 7 to 12 years, including 258 (48.1%) female and 278 (51.9%) male students were recruited. The means ± SD of participants' height, weight and Body Mass Index (BMI) were 136.48 ± 13.92 cm, 38.62 ± 12.73 kg, and 20.42 ± 4.78 kg/m^2, respectively. Average ± SD of the PHAO dietary diversity questionnaire score in all subjects was 4.56 ± 1.62. The frequency of food intake from different nutritional groups during the last 24 hours, the average of BMI for consumer in each food group, and correlation between the foods consumption in the two groups (according to the BMI percentile) is shown in Table 1. Pearson correlation test failed to show a significant relationship between the total score of the PHAO dietary diversity questionnaire with children's BMI, height and weight. According to the standardized percentile curves of body mass index for children age, the students were divided in two groups; above the 95th percentile (n=264, 49.3%) and below the 95th percentile (n=272, 50.7%). Table 2 showed the rate of using different nutritional type in the two groups and the association of consumption in each group. The binary logistic regression analysis confirmed independent relationships between children consumption

Table 2. *The rate of different nutritional group during last 24 hours, the average BMI for both consumers and non-consumers of the food group and correlation between consumption and BMI.*

	The frequency of consumption in ≥95th percentile BMI group (%)	The frequency of consumption in <95th percentile BMI group (%)	p value
Dairy products	193 (73.1)	197 (72.4)	0.923
Vegetables	177 (67.0)	188 (69.4)	0.578
Fruits	177 (67.0)	189 (69.5)	0.578
Animal proteins	191 (72.3)	204 (75.0)	0.494
Frying foods	216 (81.8)	226 (83.1)	0.734
Seafood	90 (34.1)	68 (25.0)	0.023
Junk foods	105 (39.8)	107 (39.3)	0.930
Beans	187 (70.8)	225 (82.7)	0.001

of seafood and beans in the two BMI groups (above the 95th percentile = 1, and below the 95th percentile = 0) (Table 3).

Discussion

This study examined the dietary diversity score of 7-12 years old students in Tehran's 17th district and its relation with children's anthropometric characteristics. In the present study 49.3% of enrolled students had BMI above 95 percent, indicating a high prevalence of obesity among these students. Comparison between the two BMI groups (relatively high and low percentile), in bivariate and multivariate analysis, revealed that higher frequency of seafood consumption, and lower frequency of snacks and legumes consumption in children at >95th percentile of BMI than the rest of children. The same as the current study, Hotloy et al. investigated the relationship between nutrition and nutritional adequacy among 77 children, which suggested the variation in diet can be as a predictor factor for children's anthropometric status.[22] Similarly, in a Chinese study on 2148 children, aged 12 to 24 months, a significant relationship between dietary diversity and anthropometric indices has found. In addition, they also observed that dietary diversity can induce the length of lactation and the anthropometric indices of children.[23] However, Royo-Bordonada et al. (2003) conducted a study to investigate the relationship between diet and biochemical indices and body mass index on 1112 children aged 6-7 years in Spain. The results did not show any significant correlation between BMI and dietary diversity.[24] In short, the results of previous studies and the current study, suggest a relationship between dietary diversity and anthropometric characteristics can be greater in the early life. Some evidences have shown a meaningful relationship between diet habits and obesity in the same age group of the present study. For example, Tanasescu et al. (2000) study on obesity risk assessment, conducted in the United States on 53 children, showed that juvenile consumption, hours of watching TV, low consumption of dairy, and BMI of parents independently are predictors factor for children's obesity. Similarly, watching television in boys was associated with more snacks and sweets consumption.[25] In addition, a cross-sectional study by Gills and colleagues (2002) on 181 Canadian children at aged 4-16 years old, examined the association between aging obesity with fat (especially saturated fat) and calorie intakes. This research divided children into two groups: obese (BMI> 95th percentile) and normal weight (BMI <75th percentile). The results showed that children in the obese group received significantly more calories, more fat, and saturated fat, which the total amount of energy received during the day was the main factor determining the chance of developing obesity and the type of diet along with this factor has a smaller role.[26] In the current study, children with BMI above 95th percentile had more seafood consumption. Torres et al. (2014) conducted a 3-years interventional cohort study to reduce obesity prevalence of the primary-school-based to promote healthy lifestyle, including dietary and physical activity recommendations. Two school clusters were randomly assigned to intervention (24 schools, 1,222 pupils) or control (14 schools, 717 pupils). At 28 months, obesity prevalence in boys was decreased 2.36% in the intervention group (from 9.59% to 7.23%) and increased 2.03% (from

Table 3. *Binary logistic regression between variables of seafood and beans consumption with BMI groups.*

	Odd Ratio	CI 95%		p value
		Lower Limit	Upper Limit	
Seafood	1.498	1.026	2.187	0.036
Beans	0.521	0.344	0.787	0.002

7.40% to 9.43%) in the control group. Fish consumption was a protector (OR = 0.39; 95% CI 0.23 to 0.67) while "fast-food" consumption was a risk factor for childhood obesity (OR = 2.27; 95% CI 1.08 to 4.77).[27] Smith and colleagues (2015) have investigated the association between 4-years changes in consumption of protein foods and 4-years weight change over a 16 to 24-years follow-up, adjusted for other lifestyle changes (smoking, physical activity, television watching, and sleep duration), BMI, and all dietary factors simultaneously. Their research found a relative weight loss in peoples with more seafood consumption (-0.14 to -0.71 kg; P < 0.001).[28] Protein-rich plant foods such as beans, legumes, and soy products play a special role in vegetarian and plant-based diets to meet human protein needs for growth and health.[29] The present study findings showed that children with more consumption of beans had BMI <95th percentile. Consumption of these foods reported to be high in some countries (e.g. beans in Mexico, soy products in Japan); however, limited consumption of these foods may exist among children.[29] A study on 203 German (2003) on age 5–6 years children found higher beans intake with lower percentage of body fat at age 7 years (16.98% compared with 17.42%; $p = 0.05$).[30] Thus, the present study finding confirmed the previous studies about influence protein-rich plant diets on children weight and BMI. The present study results suggested that seafood consumption had a significant and positive correlation with higher BMI. In contrast, legume consumption had a significant inverse correlation with BMI. Comparison of dairy consumption, vegetables, fruits, animal proteins, frying foods and snacks had no significant difference between higher BMI groups than children in the < 95 percentiles. Thus, the type of foods, independent to the foods calorie, can influence on children weight gain.

List of acronyms

PAHO/WHO - Pan American Health Organization/ World Health Organization
OW/OB - overweight/obesity
BMI - Body Mass Index

Authors contributions

AI involved in the conception and designing the study. MJ and PD performed the data collection and implementation of the study, also wrote the manuscript. AI and SYM supervised the development of work, helped in data interpretation and manuscript evaluation. SYM helped to evaluate and edit the manuscript and acted as corresponding author.

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Conflict of Interest

Authors declare no conflict of interest.

Ethical Publication Statement

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Corresponding Author

Sayed Yousef Mojtahedi, Department of Pediatric Nephrology, Tehran University of Medical Sciences, Bahrami children Hospital, Kiaii str. Damavand str. Tehran, Iran. Phone: 00989121417467.
Email: drmojtahed@yahoo.com

E-mails of co-authors

Mohsen Jafari: m_jafari@sina.tums.ac.ir
Anahita Izadi: dr.anahita.izadi@gmail.com
Paniz Dehghan: dehghan.paniiz@gmail.com

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