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Original Article

Dietary Patterns and Obesity Associated Factors in Primary School Children

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ABSTRACT

Background and Objectives: To provide efficient recommendation for the prevention of childhood obesity and eating disorders, it is necessary to understand and explore their dietary patterns (DPs). The main aim of the current study was to explore dietary patterns among primary school aged children and determine the relationship between different dietary patterns and factors including anthropometric measurements, family size, school performance, weekly consumption of breakfast and physical activity.

Materials and Methods: Male and female primary school children aged 7-11 (n=761) were recruited in a cross-sectional study from all districts of Tehran(2003-2004). The students and their caregivers (mainly their mothers) were interviewed to complete a 24 h recall. Dietary patterns were explored by exploratory factor analysis of the 23 food groups.

Results: Three major DPs were identified: healthy, transitional and western. The tendency of children towards western diet increased with their age (P<0.001). In larger families, the tendency towards healthy DP was lower (P<0.001). Class performance score of the children was positively correlated to healthy DP (P=0.009). Frequency of weekly consumption of breakfast was negatively correlated to western DP (P<0.001). BMI was positively associated with healthy and western DPs.

Conclusions: Effective interventions for adapting older children and larger families to healthy eating is urged. For better judgment about correlation of DPs and adiposity more studies are recommended.

Keywords: Dietary patterns, Pediatric, Adiposity, School

Introduction

Childhood is a crucial period in which food likes and dislikes are acquired (1), and balanced diet in childhood will protect the individuals against many diseases in adulthood (2), therefore, children's nutrition is among the health priorities in the world (3). In recent years, nutrition experts adopted a new approach, called “dietary pattern” (DP), to study the interaction between diet and health (4). Assessment of dietary patterns are in fact a way for evaluating the dietary behaviors which in turn contributes to useful and up-to-date information about the etiology of various diseases (5).

It is stated that dietary patterns in early childhood is usually nutritious ; however, as children grow and become more independent, the adherence to dietary guidelines diminishes (6). Some studies have been performed to explore any association between DPs and influencing factors. BMI, socioeconomic status, gender, eating habits, biochemical indicators and location of residence in urban or rural areas are reported to be associated with DPs among children and adolescents (7-9)

So far, no comprehensive data is available regarding the children’s dietary intake in Iran,

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though, studies indicated that the dietary quality of school children is not promising (10-11). In Iran, most of the dietary pattern studies were focused on adults and children's food intake was rarely investigated. The current study was conducted to evaluate the dietary patterns of primary school children in Tehran. Additionally, the relationship between some factors including BMI, sedentary activity and class performance with DPs were analyzed.

Materials and Methods

Primary school children (n=761) were recruited in a cross-sectional survey through a multi-stage random sampling from December 2003 to October 2004 (1:1 male to female ratio). Initially, 46 private and/or public schools in 19 educational districts of Tehran were selected as clusters and 23 children (from first to fifth grades) were selected randomly from each school. The sample size of first graders were taken twice assuming that their food consumption pattern could be different from other grades (12, 13). Firstly, invitation letters were sent to mothers or caregivers of the selected children for the interview. Weight and height of all children were measured while they were wearing light clothing and no shoes. Weigh was measured by a digital scale to the nearest 0.5 kg (Soehnle, Germany). Height was measured by a tape fixed on the wall to the nearest 0.5 cm. Class performance of children were evaluated by their academic grades which were obtained from the school office. Data on age, birth, family size, duration of TV watching and working with computer was gathered by a self-reported questionnaire. Information on food consumption and snacking patterns were obtained using a 24-hour food recall questionnaire. It was designed in a way to define all eating occasions (i.e. breakfast, morning snack. lunch, afternoon snack, dinner and before sleeping snack). Furthermore, time of each eating occasion was recorded in related section(s). A section was considered for recording name of main and side dishes consumed in main meals (breakfast, lunch and dinner).

All interviewers were nutritionist and were trained before the study. The mothers/caregivers were interviewed to collect more information about all the foods and beverages consumed in 24 hours (no weekends). All 24-hour recalls were rechecked with the children. After quality control of all the recalls, the food items were coded and household measurements were quantified as gram weights according to existing sources (14).

The study protocol was approved by the Research Council of the National Nutrition and Food Technology Institute affiliated with Shahid Beheshti University of Medical Sciences and Health Services.

Statistical analysis: Variables were described by Mean standard deviation (SD) and were compared between gender groups and grades. DPs were explored by exploratory factor analysis of the 23 food groups. In order to verify the appropriateness of using factor analysis, the sample uniformity was tested by examining the distribution of the variables in a loading plot. To verify the data adjustment, Kaiser-Meyer-Olkin (KMO) measurement of sample adequacy and Bartlett's Test of Sphericity (BTS) was employed to test the presence of correlations between variables. Principal component analysis was used for factor extraction.

We used orthogonal varimax rotation to identify the major dietary patterns based on the number of food groups. To determine the number of DPs, we used the Scree plot and eigenvalues more than 1.5. The factor score for each pattern was calculated by summing intakes of food groups weighted by their factor score matrix. The derived factors (two DPs) were labeled on the basis of our interpretation of the data and of other studies. The Spearman's Rank Correlation Coefficient was used to test the association between DPs and the mentioned variables. Data was analyzed by SPSS version 21 (SPSS Inc., Chicago, IL, USA).

Results

General characteristics of the children are summarized in two groups (Table 1). Based on nutritional content similarities, 23 food groups (Table 2) were defined, and food items were assigned in the related groups.

Table 1. General characteristic of primary school children in Tehran (n=761).

Educational Grades	First grade (Mean±SD)			(Grades 2nd to 5th(Mean±SD)		
General characteristic	Male (N=183)	Female (N=195)	Total (N=378)	Male (N=197)	Female (N=186)	Total (N=383)
Age (year)	6.4±0.71	6.4±0.6	6.4±0.6	8.9±1.2	8.9±1.3	8.9±1.2
Birth order (No.)	1.9±1.1	1.8±0.9	1.8±1.0	1.9±1.4	1.8±1.2	1.9±1.3
Family size (No.)	4.2±1.3	4.0±0.8	4.1±1.1	4.3±1.1	4.3±1.3	4.3±1.2
Class performance score of the previous grade (Out of 20)	---	---	---	19.6±0.95	19.6±0.78	19.6±0.8
The frequency of breakfast intake in a week (time)	5.8±2.1	6.0±2	5.9±2.0	5.7±2.0	5.7±2.1	5.7±2.1
Weight (kg)	23.7±5	24.8±5.5	24.3±5.3	33.5±9.4	34.1±10.7	33.8±10.1
Height (cm)	120.5±6.0	121.1±6.0	120.8±6.0	135.2±10.1	134.5±9.8	134.8±9.9
BMI[a] (kg/m2)	16.2±2.40	16.8±2.69	16.5±2.5	18.0±3.41	18.6±4.83	18.3±4.1
TV[b] time (min)	142.6±81.6	151.6±80.9	147.2±81.3	154.0±74.0	156.5±77.4	155.2±75.6
PC[c] time (min)	40.0±32.6	53.45±44.7	48.3±40.9	50.1±75.8	75.26±67.2	64.5±71.8

a Body Mass Index
b Television
c Personal Computer

Table 2. Food grouping used in DP analyses among primary school children in Tehran (n=761).

Food groups	Food items
Cereals	Whole grains and refined grains
Legumes	Beans, lentils, peas, broad beans, soy protein, mung bean, split peas
Vegetables	All kind of vegetables and their juices
Fruits	All kinds of fruits and their juices
Dried fruits	Fruit leather, tamarind, raisins and currant, fruit chips
Industrial fruits	Canned fruits, industrial juice
Meats	Red meats, poultry, fish and seafood
Processed meats	Hamburger, pizza, sausage, hot dog, ready-to-eat cutlet and kebab, and similar fast foods
Eggs	All eggs
Dairy products	High and Low fat dairy, flavored milk, ice-creams plain or mixed with fruit juices
Nuts	All kinds of nuts, coconut
Seeds	Watermelon and pumpkin seeds, sesame, sesame extract, soy beans, cannabis
Sugars	Different kinds of transitional sweets, honey, jam, marmalade
Pastries	Pastry creams, biscuits, wafers, sugar bread, cookies, pancakes, sponge cakes, pretzels, crackers
Salt and seasonings	Tomato paste, ketchup, lime juice, vinegar, pomegranate paste and juice, cacao powder, salt, and Qarehqurut*
Appetizers	Pickles
Animal oils	Butter, animal oil, suet
Vegetable hydrogenated oil	Different brands of vegetable hydrogenated oil
Vegetable oils	Sesame oil, olive oil, sunflower oil, corn oil
Fatty sauces	Mayonnaise and other white sauces
Carbonated Soft Drinks	Different kinds of nonalcoholic beer and beverages
Other Soft Drinks	Diet coke, jelly, gummi, soda, syrup
Caffeine	Tea, coffee and herbal teas

*: Qarehqurut is a concentrated form of yoghurt, after removing the fat from it.

Table 3 shows the factor loading obtained after varimax rotation. The first factor accounted for 7.64% of the total variance (22.23%) and was named transitional. The second factor which explained 7.47 of the total variance was named "western". The third factor which accounted for 7.12 of total variance was named "healthy". In fact, we extracted three major DPs: transitional DP (including cereals, legumes, vegetables, fruits, egg, sugars, vegetable hydrogenated oil, caffeine and less industrial fruit juices and carbonated soft drinks); western DP (including cereals, processed meats, seasonings, carbonated soft drinks, fatty sauces and less dairy); healthy DP (including cereals, vegetables, fruits, dried fruit, meats, dairies, nuts, salt and seasonings, liquid oils, and less sugars).

According to Table 4, age was positively correlated to the transitional and western DP ($P<0.001$), however, its correlation with the healthy DP was not significant. Birth order and family size were positively correlated to transitional diet and negatively to healthy diet. School performance score

was positively correlated to healthy DP (P<0.05). Weekly consumption of breakfast was positively correlated to transitional and negatively to western diet (P<0.001). BMI was positively correlated to both western and healthy DPs. Time of Television (TV) watching and working with personal computer (PC) were not significantly correlated to either of our DPs.

Table 3. Factor loading matrix for major DPs among primary school children in Tehran (n=761).

Food groups	DPs		
	Transitional	Western	Healthy
Cereals	.440	.223	.221
Legumes	.269	-	-
Vegetables	.239	-	.520
Fruits	.291	-	.325
Dried fruit	-	-	.281
Industrial fruit juices	-.213	-	-
Meats	-	-	.410
Processed meat	-	.626	-
Eggs	.213	-	-
Dairy	-	-.220	.423
Nuts	-	-	.224
Seeds	-	-	-
Sugars	.608	-	-
Pastries	-	-	-.225
Salt and seasonings	-	-	.400
Appetizers	-	.620	-
Animal oils	-	-	-
Vegetable hydrogenated oil	.390	-	-
Vegetable oils	-	-	.529
Fatty sauces		.585	-
Carbonated Soft Drinks	-.211	.600	-
Other Soft Drinks	-	-	-
Caffeine	.678	-	-
% of Variance	7.64	7.47	7.12

Values <0.20 were excluded. Bartlett's Test of Sphericity < 0.001. KMO=0.54.

Total variance=22.23

Table 4. Correlation Coefficient between each of our three DPs and some covariates

	Transitional		Western		Healthy	
Covariates	CC*	P**	CC	p	CC	p
Age (year)	0.18	<0.001	0.15	<0.001	0.06	>0.065
Birth order (No.)	0.10	0.008	-0.001	0.085	-0.12	0.001
Family size (No.)	0.11	0.004	0.03	0.09	-0.16	<0.001
Class performance score (No.)	-0.001	0.2	-0.07	0.1	0.14	0.009
Weekly consumption of breakfast (frequency)	0.21	<0.001	-0.17	<0.001	0.06	0.07
Weight (kg)	0.06	0.09	0.17	<0.001	0.15	<0.001
Height (cm)	0.14	0.002	0.15	<0.001	0.11	0.002
BMI[a] (kg/m^2)	-0.01	>0.25	0.13	<0.001	0.14	<0.001
TV[b] time (min)	-0.03	0.3	0.03	0.4	0.023	0.5
P[c] time (min)	0.06	0.3	-0.03	0.6	0.04	0.5

* Correlation Coefficient
** Spearman's p_{value}
a Body Mass Index
b Television
c Personal Computer

Discussion

In the present study, three main DPs were explored. As was expected, some of food items in our DPs were in common with DPs in other studies, however, some other food items were missing from our DPs. For example, transitional DP, which is to some extent similar to traditional dishes in Iran, is different from other countries. Also, healthy pattern which is mainly dependent on the staple food, such as bread and cereals, is primarily influenced by socio-economic, climate and agricultural status and can vary extensively in different regions. In a similar study that was aimed to identify association of Iranian dietary patterns with colorectal cancer, two DPs, healthy and Iranian patterns, were explored. It was concluded that Iranian DP seemed to increase the odds of colorectal cancer ,however, healthy dietary pattern had a protective effect against it.(15). Regarding the mentioned study sugar, hydrogenated vegetable oil and black tea of the Iranian patterns in were in common with transitional DP and fruits, vegetables and nuts in healthy patterns were in common with the healthy DP of the current study. In another study that aimed to detect major dietary patterns and their association with socio-demographic characteristics in Iranian adolescents, four major dietary patterns, “prudent diet,” fast food diet,” “animal fat diet,” and “Mediterranean diet” were explored (16). In the “prudent diet” legumes, vegetables (raw), fruits and eggs were in common with transitional DP of the current study. Another study conducted, determined the relationship between major dietary patterns and stunting in the first grade students in Tehran, discovered three major dietary patterns. They were identified as: ‘traditional dietary pattern’, ‘mixed dietary pattern’ and ‘carbohydrate-protein pattern’ (17). In the ‘traditional dietary pattern’ of the mentioned study, eggs, sugars and vegetables were in common with the transitional DP of the present study. In a systematic review on association between dietary patterns and cardio-metabolic risk factors in children and adolescents, the unhealthy patterns were characterized by processed products, poor in fiber and rich in sodium, fat, and refined carbohydrates which were similar with the western DP of the current study in which processed meats and fatty sauces are present(18).

Similar to the findings of another study, age was positively correlated to western DP in the current study population; it means that the desire to lean towards unhealthy patterns has increased with age (19). Birth order and family size were correlated positively to transitional DP and negatively to healthy DP. Since economic considerations are probably of the main concern in big families, they preferred transitional to healthy diet which contains more expensive components such as meat, dairy products and nuts. School performance score was positively correlated to healthy DP; it means that students with healthy dietary habits had better school performance and subsequently higher scores, which was consistent with other studies (20-22).

We observed that the frequency of breakfast intake in a week was negatively correlated to western DP. This was not surprising since the breakfast in our studied population typically contained dairy products that was almost absent in western DP. In addition, breakfast is considered as part of a healthy diet with positive impact on children’s health (23, 24). Based on the CASPIAN-IV study, the prevalence of overweight and obesity among breakfast skippers were significantly higher than non-skipper counterparts. Furthermore, the frequency of psychiatric distress was significantly decreased among non-skippers (25, 26).

In addition, we found a significantly positive correlation between BMI and western DP. However, BMI was also positively correlated to healthy DP which was characterized by high consumption of fruits and vegetables as well as low intake of pastries. Based on the results of Chinese Health and Nutrition Survey (CHNS) in children, three DPs (modern, transitional north and transitional south) were identified. After adjustment for total energy intake and some confounders subjects in the highest quartiles of the modern and transitional north patterns were found to have significantly greater risk of obesity (OR 3.10, 95 % CI 1.52, 6.32, and OR 2.42, 95 % CI 1.34, 4.39, respectively) (27). In a cross-sectional study in Brazil on 6-12-year-old students, two eating patterns, "obesogenic" and "prudent", were identified (28). Obesogenic eating pattern included sweets and sugars, typical Brazilian dishes, pastries, fast food, oils, milk, cereals, cakes and sauces; and prudent eating pattern included oils, cereals, roots and tubers, legumes, fruits, leafy

vegetables. Obesogenic DP was positively associated with increased BMI. Moreover, Avon Longitudinal Study showed that the "health-conscious" and "traditional" patterns were associated with high intakes of fruits and/or vegetables and better nutrient profiles than the "processed" patterns. An "energy-dense, low-fiber, high-fat" DP was associated with increased adiposity (29). The healthier DPs contained more fruits and vegetables, whole-grain cereal products, and plain potatoes; and the less healthy patterns contained more chocolates/confectionery, white bread, cakes/biscuits, low-fiber breakfast cereals, fried potatoes (chips), and full-fat milk which all tend to have poorer nutrient profiles (29). Lazarou *et al*. showed that frequent (3-5 times/week) consumption of soft drinks, delicatessen meat, sweets, fried and junk food could increase the obesity risk by 75%, however, this risk was 33% lower in children with a similar DP plus >2 times/week consumption of fish and seafood (30). By considering these data, we could deduce that modifying a single dietary habit is able to change the obesity status of children.

Balthazar *et al.* evaluated the differences in nutrient composition and dietary patterns between eutrophic and obese school children. They studied 83 obese and eutrophic children (42 obese and 41 eutrophic), aged 7-11 years and found no differences between the two groups in terms of energy, protein , lipids and carbohydrates consumption. The mean intake of fiber was higher in eutrophic group (20.7g) in comparison with obese group (14.8g). Correlation of the dietary fiber with the number of servings of beans was strong (r=0.77), compared to fruits (r=0.44) and leafy vegetables (r=0.13). Therefore, obesity was more related to a DP with low dietary fiber intake than excessive energy consumption and macronutrients imbalance (31).

These inconsistent results could be caused by several reasons: first, instead of two food groups of high- and low-fat dairy products and meats, we had only one category. Second, we did not segregate whole grain cereals from refined cereals. Perhaps high intake of high-fat dairy products and meats and refined cereals yielded such inconsistent results.

Contrary to the result of other studies (32, 33) in the present study, time of TV viewing and working with PC were not significantly correlated to either of our DPs. In this respect, more reliable results may be obtained by longitudinal studies.

Conclusions

According to our findings, children's tendency toward unhealthy diet increases with age, and the tendency toward healthy eating usually decrease in larger families. Therefore, there is an urgent need to familiarize older children and children in big families with healthy eating behaviors. School performance of children is positively correlated to healthy eating which in turn, emphasizes the importance of healthy dietary patterns among them. We observed no significant difference between healthy and unhealthy (western) dietary pattern in terms of increased BMI, and both DPs were positively correlated to BMI. More investigations are needed to study and judge the correlation between dietary patterns and adiposity.

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