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Relationship between Energy, Macronutrient and Micronutrient Consumption with Obesity among School Aged Students in Shiraz, Fars

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Abstract

Background: Obesity is increasing in Iranian school aged and there is lack of information on the energy and macronutrient intake of children. The objective of this research was to study the energy and macronutrient intake in Iranian school children.

Materials and Methods: This is a cross-sectional descriptive study conducted on Iranian school aged boys and girls aged 14-19 years old from all the populated regions of Shiraz, Fars. Information was obtained through a questionnaire for the entire sample on the frequency of food items. We used a Nutritionist IV to analyze dietary intakes. All data entered in SPSS version 16 for statistical analysis.

Results: The age of the students ranged from 14 to 19 years. Mean ages of the girls and boys were 16.0 ± 0.97 and 16.0 ± 0.93, respectively. There were no significant difference regarding any macro and micro nutrient among these two groups (boys and girls) (P-value > 0.05). Calorie intake was not different among these two groups. Folate, iron, calcium and fiber intake were lower than the Recommended Dietary Allowance. Overall, the mean energy intake of students ranged between 312 and 3’896 of the Recommended Dietary Allowance for different age groups and also two genders. The percentage of mean energy intake when compared to the Recommended Dietary Allowance decreased with increasing age of boys and girls.

Conclusion: Low intake of fruits and vegetables and dietary fiber, high sugar intake and high energy % of saturated fat and dietary cholesterol by Iranian children is likely to increase their risk of obesity and cardiovascular diseases later in life. So, nutritional education programs in schools should emphasize the importance of healthy balanced diets and the risks of consuming empty calories.

Key words: Energy intake; micronutrients; macronutrients; anthropometry; children; Iran

Introduction

Evidences revealed that many chronic diseases such as obesity, hypertension, diabetes and certain types of cancer and coronary heart disease result from diet and lifestyle in childhood and adolescence as a potential lifelong effect (1). Increased demand for energy and nutrients occur in the sensible growth of adolescence. Total nutrient needs are higher during adolescence than any other time in the lifecycle (1). Obesity is becoming increasingly recognized as one of the public health problems even in world due to modernization, affluence, and increased food consumption (2). Imbalance between energy intake and output and to the accumulation of large amounts of body fat is a cause of obesity (3). Obesity prevention during this phase of life, childhood and adolescence has been considered as a public health priority (4).

Recently, changes of socioeconomic status in Iran as experiencing rapid epidemiological transition contributed to substantial shifts from healthy foods to unhealthy and high energy dense diets with elevated fat and sugar but low levels of vitamins and minerals. The obesity in children and adults in this territory increased consequently due to this nutrition transition (5).

Changes in particular eating patterns of school aged children and adolescents may explain increasing adiposity by low intake of fresh fruits, vegetables and milk as well as a high intake of carbonated beverages and empty calorie foods (6). Some studies showed that fast food consumption accompanied with lower dietary quality (7).

According to the published papers, the quality of Iranian's diet needs to be improved (8). Iranian teenagers are most susceptible to unsound food habits which place them at higher risk of an adverse nutritional status.

While studies have been conducted on the nutritional status and dietary habits of Iranian children (9, 10), there is lack of information about energy and macronutrient intake. Such information could guide us to suggest need based changes in the eating habits of children for delaying or preventing the development of chronic diseases. Hence, the main question regarding the dietary pattern among school aged children and its relation to anthropometric variable still remains and it will be interesting to be assessed. The current study addresses the intake of energy and

micronutrients as well as food frequency in Iranian school aged children.

Methods and Materials

The data relate to two cross-sectional study of healthy high school adolescents aged 12 to 20 years, who were selected randomly applying a multistage scheme of sampling from the four educators districts of Shiraz. We chose randomly 4 high schools in each district (2 boy's school and 2 girl's school). In high school selected randomly on class each grade and all of them were evaluation. The sample carried out during spring 2010, consisted of 1'414 subjects (525 male and 889 female).

Shiraz is the capital of Fars province and one of the five principal cities of Iran, with a population of 1.7 million. Therefore, this sample can be considered as a representative sample of urban children of Iran. The study protocol was approved by Shiraz University of Medical Sciences Ethics Committee.

Anthropometric Assessment

Well-trained technicians were performed all measurements. A questionnaire on socio-economic status and anthropometric measures were completed. For each subject's weight, height, waist circumference (WC), hip circumference (HC) and skin fold thickness were measured by trained auxologists. WC was determined by measuring waist diameter at midpoint between iliac crest and lower border of the tenth rib, with an average of three measurements considered as WC. Three skin folds (triceps, sub-scapular and abdominal) were taken. Skin folds were measured in triplicate using a Harpenden caliper and the average of the right and left were used. According to the techniques presented by Cameron (11), height and weight were measured to the 0.1 cm and 0.1 kg respectively using a SECA digital scale (Germany) marked stadiometer. Body mass index (BMI) was calculated as body weight in kilogram divided by square of height in meter. Ages were recorded based on the difference between dates of visit precisely and date of birth in days and then converted two years (to decimal points) subsequently. The Omron Full Body Sensor Body Composition Monitor and Scale (BF 500) estimates the Body Fat Mass (BFM) and body fat percent (% BF) by the BIA.

Dietary Assessment

Information on food and nutrient intake was obtained through a food-frequency questionnaire (FFQ), initially developed for use on adults and previously validated (12, 13). Accordingly, for the purpose of this study, this

questionnaire was adapted for children's use by amending the list of foods and portions consumed. In particular, some foods frequently consumed by children were added. The questionnaire included food items. For every food item, the standard serving was defined. Frequency of consumption considered the following categories: times daily, weekly, monthly, annually and never. Portion sizes of consumed foods were converted to grams using household measures (14). Each food and beverage was then coded according to prescribed protocol and analyzed for content of energy and nutrients using nutritionist IV software.

The amount of food consumed was recorded in household measures, transformed into grams and then converted into numbers of food servings, according to the energetic equivalence of each food group pyramid. To estimate the intake of energy and nutrients, foods (in grams) were reported and analyzed by a program of Nutrition.

Potential confounder

Height was measured to an accuracy of 0.1 cm with the use of a stadiometer, and weight was measured to 0.1 kg with the use of Body Fat Analyzer weighing scales. BMI was calculated, and overweight status was defined by age- and sex- specific cutoffs for BMI (normal < 25, overweight 25 to 30, obese > 30).

Statistical Analysis

We used a Nutritionist IV to analyze dietary intakes. Averages of energy and nutrient data by age groups and gender were then exported into Microsoft Excel 2007. All data entered in Statistical Package for the Social Sciences (version 16, SPSS, SPSS Inc, Chicago, IL) for statistical analysis. Independent t-test was applied to identify relationship between the sex and other quantitative factors also chi square test used comparison between sex and obesity. Analysis of variance used for comparison total fat dense diets and other quantitative factors. A *P*-value less than 0.05 was considered to be statistically significant.

Results

The age of the students ranged from 14 to 19 years. Mean ages of the girls and boys were 16.0 ± 0.97 and 16.0 ± 0.93, respectively (Table 1).

Tables 2 and 3 represent daily energy and nutrient intakes of school aged girls and boys with respect to Recommended Dietary Allowance (RDA). There were no significant difference regarding any macro and micro nutrient among these two groups (boys and girls) (*P*-value > 0.05). Calorie intake was not different among these two

groups. Folate, iron, calcium and fiber intake were lower than the RDA.

Overall, the mean energy intake of students ranged between 312 and 3’896 of the RDA for different age groups and also two genders. The percentage of mean energy intake when compared to the RDA decreased with increasing age of boys and girls.

Table 4 shows the distribution of mean energy, macronutrient densities and dietary fiber by levels of total fat dense diets in girls and boys.

Table 1. Anthropometrics Indices in Study Samples

Variables	**Boy**		**Girl**		***P*-value**
	Mean	**SD[a]**	**Mean**	**SD**	
Age	16.03	0.96	15.92	0.90	0.046
Fat percent	22.88	9.74	24.57	9.18	0.007
Total body fat	13.85	7.79	15.07	8.25	0.018
Weight	57.65	12.24	58.69	13.96	0.194
Height	164.28	8.56	165.56	7.77	0.016
BMI	21.28	3.73	21.33	4.18	0.840
Waist	74.53	10.85	76.59	12.41	0.004
Hip	90.67	9.74	92.20	8.36	0.010
Waist/Hip ratio	0.83	0.22	0.83	0.10	0.865
MAC	24.44	5.01	25.57	7.42	0.002
Triceps skin fold	14.35	6.36	16.52	7.65	< 0.001
Sub-scapular skin fold	15.72	7.68	17.58	8.21	< 0.001
Abdominal skin fold	16.34	8.69	17.95	9.69	0.004
Normal	395 (76.0%)		745 (84.0%)		< 0.001
Overweight	86 (16.5%)		115 (13.0%)		
Obesity	39 (7.5%)		27 (3.0%)		

[a] Standard deviation

Table 2. Daily Energy and Nutrient Intakes of School Aged Girls With Respect to RDA

Variables	**Mean**	**SD**	**RDA**	**% of RDA**
Energy	1046.27	477.23		
Carbohydrate	137.36	64.30	130	105.7
Cholesterol	115.43	95.24		
DHA[a]	0.014	0.034		
Calcium	347.52	165.59	1300	26.7
Vitamin A	0.69	0.55	0.700	98.5
Cu	439.22	412.01	890	49.4
Vitamin E	4.56	5.07	15	30.4
Vitamin B1	0.86	0.41	1.0	86.0
Vitamin B3	9.42	5.17	14	67.3
Folate	132.27	99.14	400	33.1
Vitamin C	66.61	50.13	65	102.5

Fiber	7.36	4.00	38	19.4
Monounsaturated fat	12.13	7.66		
Protein	33.31	16.17	46	72.4
Total fat	42.67	25.60		
Saturated fat	11.51	6.75		
Iron	7.78	4.25	15	51.9
Zinc	4.00	2.19	9	44.4
Selenium	0.049	0.035	0.055	88.7
Beta carotene	169.07	256.93		
Vitamin B2	0.69	0.38	1.0	69.0
Vitamin B6	0.71	0.39	1.2	59.2
Vitamin B12	2.88	4.53	2.4	120.1
Vitamin K	30.24	31.23	75	40.3
Polyunsaturated fat	14.04	11.57		
EPA[b]	0.005	0.012		

[a] Docosahexaenoic acid
[b] Eicosapentaenoic acid

Table 3. Daily Energy and Nutrient Intakes of School Aged Boys With Respect to RDA

Variables	**Mean**	**SD**	**RDA**	**% of RDA**
Energy	1117.62	487.82		
Carbohydrate	147.11	66.74	130	113.2
Cholesterol	130.32	90.40		
DHA	0.016	0.031		
Calcium	377.31	175.65	1300	29.0
Vitamin A	0.74	0.55	0.900	82.2
Cu	447.12	406.58	890	50.2
Vitamin E	4.62	5.40	15	30.8
Vitamin B1	0.94	0.44	1.2	78.3
Vitamin B3	10.40	5.56	16	65.0
Folate	130.07	99.34	400	32.5
Vitamin C	61.20	45.99	75	81.6
Fiber	7.33	3.93	28	26.2
Mono fat	12.94	8.53		
Protein	37.11	18.57	52	71.4
Total fat	44.58	26.24		
Saturated fat	12.79	8.09		
Iron	8.17	3.89	15	54.5
Zinc	4.43	2.64	11	40.3
Selenium	0.058	0.045	0.055	105.5
Beta carotene	144.30	189.73		
Vitamin B2	0.78	0.43	1.3	65.0
Vitamin B6	0.73	0.38	1.3	56.2
Vitamin B12	3.79	5.52	2.4	157.8
Vitamin K	30.40	34.84	75	40.5
Poly fat	13.50	10.35		
EPA	0.005	0.010		

Table 4. Distribution of Mean Energy, Macronutrient Densities, P: S Ratio And Dietary Fiber By Levels Of Total Fat Dense Diets In Girls And Boys.

Nutrient variables	**Total Fat Dense Diets (% K cal)**				**P-value**
	< % 30	**30-37%**	**≥38%**	**Total**	
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	
Girls	N = 240	N = 269	N = 375	N = 884	
Energy (Kcal)	922.8 ± 397.0	1047.3 ± 488.2	1124.9 ± 500.8	1046.4 ± 477.5	<0.001
%Kcals from Proteins.	129.4 ± 59.6	136.5 ± 66.9	133.3 ± 66.2	133.2 ± 64.7	0.465
%Kcals from Carbohydrat	593.0 ± 263.3	576.8 ± 281.4	503.3 ± 227.6	550.0 ± 257.6	<0.001
%Kcals from Sat	64.1 ± 36.7	101.9 ± 46.1	130.0 ± 68.1	103.6 ± 60.8	<0.001
%Kcals from Monosaturate	95.0 ± 32.1	101.4 ± 51.6	146.7 ± 74.7	109.1 ± 68.9	<0.001
%Kcals from Polyunsaturate	57.9 ± 35.7	108.1 ± 63.1	183.4 ± 124.2	126.4 ± 104.1	<0.001
Cholesterol (mg)	101 ± 75.4	115.1 ± 72.6	124.5 ± 117.6	115.3 ± 95.3	<0.001
P:S[a] Ratio	1.00 ± 0.61	1.15 ± 0.61	1.53 ± 0.79	1.27 ± 0.73	<0.001
Waist to hip ratio	0.83 ± 0.21	0.84 ± 0.25	0.80 ± 0.07	0.82 ± 0.18	0.038
Total Body Fat (%)	26.8 ± 8.2	26.3 ± 8.4	26.1 ± 9.1	26.4 ± 8.7	0.655
Weight	54.7 ± 9.3	54.0 ± 9.4	54.7 ± 10.2	54.5 ± 9.8	0.661
BMI	21.1 ± 3.3	21.1 ± 3.4	21.2 ± 3.6	21.1 ± 3.4	0.954
Boys	N = 150	N = 163	N = 206	N = 519	
Energy (Kcal)	1021.8 ± 397.0	1133.0 ± 508.2	1180.7 ± 521.7	1119.8 ± 488.0	0.009
%Kcals from Proteins.	145.8 ± 61.9	153.6 ± 76.5	146.3 ± 80.6	148.5 ± 74.3	0.559
%Kcals from Carbohydrat	651.5 ± 266.6	616.4 ± 289.2	525.3 ± 235.8	590.4 ± 267.6	< 0.001
%kcals from Sat	73.8 ± 40.3	112.5 ±49.3	147.3 ± 89.4	115.1 ± 72.8	< 0.001
%kcals from Monosaturate	66.7 ± 34.1	111.6± 56.6	156.8 ± 89.9	116.6 ± 76.9	< 0.001
%kcals from Polyunsaturate	60.2 ± 36.9	112.8 ± 74.0	172.8 ± 150.5	121.5 ± 93.1	< 0.001
Cholesterol (mg)	124.8 ± 106.7	138.4 ± 81.1	127.9 ± 84.7	130.3 ± 90.5	< 0.001
P:S Ratio	1.02 ± 0.88	1.08 ± 0.55	1.36 ± 0.65	1.17 ± 0.72	< 0.001
Waist to hip ratio	0.83 ± 0.06	0.85 ± 0.10	0.87 ± 0.32	0.85 ± 0.21	0.293
Total Body Fat (%)	17.8 ± 9.2	16.5 ± 8.5	17.1 ± 8.0	17.1 ± 8.5	0.433
Weight	64.6 ± 15.9	64.2 ± 14.9	62.7 ± 13.7	63.7 ± 14.7	0.429
BMI	21.8 ± 5.1	21.7 ± 4.4	21.3 ± 4.0	21.6 ± 4.5	0.495

[a] Polyunsaturated-Saturated Ratio

Discussion

Our study is the first one to evaluate the energy, micro- and macronutrient intakes in a representative sample of Iranian school aged children. It showed an association of dietary pattern with obesity and abdominal adiposity. We used this population because there is a little specific nutritional information for this group in Iran. Furthermore, data on dietary characteristics and abdominal adiposity are rare.

This population had lower amount of dairy intake compared to the guidelines. The average protein intakes of Iranian children and adolescents were lower than the RDA standards in both boys and girls. Furthermore, some dietary habits such as consuming frying oils, hydrogenated vegetable oils, sugar sweetened beverages and fast food intake should be improved among them. The mentioned items were the key findings of this study. There were some previous reports regarding the dietary intake of youths, worldwide. Low intake of calcium, iron, zinc and vitamin A was reported from children of secondary school in England (15). The age of the population in the present study was older than them. However, the results are similar to some extent. Results from the related studies in Iran showed low intake of calcium, iron and vitamin B series in adults (7, 8).

Fiber intake by the adolescents fell apparently short of the current recommendations and may be considered inadequate for optimal health promotion and chronic disease prevention. This is apparently due to low consumption of fresh fruits and vegetables as observed in the food frequency data of the children and possibly due to insufficient quantities of other sources of fiber such as whole grains, legumes and high fiber cereals. Indeed, findings of this survey were consistent with those of a recent nutrition survey conducted on Iranian adults, 50% of whom were not consuming fruits and vegetables on a daily basis (16).

In conclusion, low intake of fruits and vegetables and dietary fiber, high sugar intake and high energy % of saturated fat and dietary cholesterol by Iranian children is likely to increase their risk of obesity and cardiovascular diseases later in life. So, nutritional education programs in schools should emphasize the importance of healthy balanced diets and the risks of consuming empty calories.

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