Nutritional status and dietary intake among adolescent girls

Aazam Doustmohammadian[1,*], Seyed Ali Keshavarz [2], Sorayya Doustmohammadian [3], Mitra Abtahi [1], Minoo Shahani[4]

[1]Nutrition Research Department, National Nutrition and Food Technology Research Institute, Faculty of Nutrition Sciences and Food Technology, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[2]Department of Nutrition and Biochemistry, School of Public Health and Institute of public Health Researches, Tehran University of Medical Science, Tehran, Iran
[3] Shahid Beheshti University of Medical Sciences, Tehran, Iran
[4]Proteomics Research Center, Shahid Beheshti University Medical of Sciences, Tehran, Iran

 *Corresponding Author: email address: doost_mohammadi@yahoo.com (A. Doustmohammadian)

ABSTRACT

Nutritional status during adolescence plays an important role in human lifecycle. The aim of this study was Nutritional status and dietary intake among adolescent girls. In a cross sectional study, using two stage cluster sampling 256 adolescent girls were randomly selected from 8 Semnan secondary schools. Weight and height were measured and body mass index (BMI) was calculated. In adolescents, anthropometric indices were defined based on the CDC 2000 cut-off points for age and gender-specific BMI. Data of energy and nutrient intake was collected with the 24-hour dietary recall and food record questionnaires. The results showed that the prevalence of underweight, normal weight, overweight, and obese was 5.7%, 77.7%, 11.7%, and 4.7% in Semnan adolescent girls, respectively. In comparison with DRI recommended values, the intake of energy and some micronutrients such as vitamin B12, folate, calcium, zinc, and fiber was insufficient among adolescent girls in Semnan. Malnutrition (underweight and overweight) is higher than the expected rate. Findings of our study showed that micronutrients deficiency among adolescent girls is a major problem among adolescent girls in Semnan and prevention measures are necessary to induct.

Keywords: Nutritional status; dietary intake; adolescent girls

INTRODUCTION

Nutritional status during adolescence plays an important role in human lifecycle [1]. The global economic development and urbanization has resulted in great changes in the weight status of adolescents worldwide [2]. A decreasing trend in the prevalence of under-nutrition has been identified in developing countries. On the other hand, an increasing shift towards higher rates of overweight and obesity among adolescents has been reported in developed and developing countries [3].

The National Food Consumption Survey conducted in 2001-2003 showed that the prevalence of thinness, pre-obesity and obesity among boys aged 15 to 19 years old was 27.6%, 5.1% and 3.6%, respectively. The related figures for girls were 10.5%, 9.7% and 3.9%, respectively [4]. Prevalence of overweight in high school students increased to 11.2% in 2004. As a result, new cases of children with the metabolic syndrome may appear which in turn is likely to create an enormous economic and public health burden for Iran in the near future [5].

Malnutrition (under nutrition or over nutrition) which refers to an impairment of health either from a deficiency or excess or imbalance of nutrients is of public health significance among adolescents all over the world. It creates lasting effect on the growth, development and physical fitness of a person.

Owing to sudden and special growth tacking place in this phase, the nutritional requirements also increase tremendously compared to preceding years of growth. During this phase, diet should provide not only sufficient calories but also essential elements and nutrients such as protein, vitamins and minerals required for growth. Nutritional and physical growth during adolescence creates increased demands of energy and nutrients such as vitamin B6, B9, B12, A, and vitamin C. Thiamin and riboflavin play essential roles in energy metabolism so are important in this cycle [6].

Evidence suggests that under-nutrition still exists as a public health problem in Iran; particularly amongst young children. Results of the Study on Food Consumption Patterns in adolescents indicated that adolescent girls were more at risk for inadequate calcium intake than boys[7, 8].

Few studies have investigated the relationship between socio-demographic factors and health and nutrition in Iran, particularly in Semnan. The objective of this cross-sectional study is to assess dietary intake and nutritional status in adolescent girls. Considering the fact that improving the health status of adolescent girls, as future mothers, will ensure the health of the future generation, we hope that the results of this study can be used for designing relevant intervention programs that will address the needs of this age group of the community.

METHODS

Pilot study and sampling

A pilot study was performed in a sample of 40 students (10 students of each four age groups) who were similar to the study population. Height and weight were measured and BMI was calculated. The weight standard deviation of students was higher than their height and BMI. Using following formula, 64 students of each four educational grade of high school were determined. Based on the pilot study a sample of 256 students was selected. According to socio-economic status, Semnan city was divided to four areas (north, south, west and east).Two schools were selected randomly from each of the 4 different areas. Using a two-stage random sampling method, 256 girl students aged 14-18 year old from 8 high schools were selected. Only student in puberty age (14-18 years) were included. Those few students who for some reason were younger or older than this defined age group were excluded and new students were exchanged. Data collection took two months (April and May 2004).Questionnaires were pre-tested and modified according to the study objective.

Anthropometric measurements

Height and weight were measured according to WHO protocol [9]. Height was measured to the nearest 0.1 cm using a tape fixed to a wall. Using a Buerrer scale, weight was measured to the nearest 0.5 kg. Students wore light indoor clothes and weight was measured without shoes. The scale was calibrated before the examination. All of the measurements were performed by two trained health workers. One took the measurements and

the other recorded the readings. To minimize variations in anthropometric measurements, all measurements were obtained by the same experienced staff members. BMI was calculated as weight in kilogram divided by height in meter square. Underweight was defined as having a BMI lower than 5th percentile of age- and sex-specific BMI (CDC 2000-Center for Disease Control and Prevention); normal weight was defined as BMI between 5th and 85th percentiles; at risk for overweight and overweight were defined as BMI between 85th and 95th and greater than 95th percentiles, respectively [10] For the purpose of simplicity, the CDC's between 85th and 95th percentile is referred to as overweight and the greater than 95th percentile is referred to as obesity in this article.

Food and nutrient intake

Data of energy and nutrient intake was collected with the 24-hour dietary recall and food record questionnaires. In the 24-hour dietary recall questionnaire, the participants were asked to recall and report all the nutrients, drinks, and dietary supplements they had in the past 24 hours.

Nutrition models, measuring cups, spoons and other tools were used to estimate the correct amount of consumed food. In the food record questionnaire, the students were asked to report their food consumption on a specific day based on the number of spoons, cups and other common measuring tools. The advantage of the 24-hour dietary recall questionnaire is that it is completed without any prior notice. Hence, the respondents do not change their food intake. However, because it relies on the individual's memory, the participants may not remember all the foods they have. The food record questionnaire could minimize this error. None of these questionnaires was sufficient enough for determination of the amount of consumed foods; this was the reason why both questionnaires were used to gain more accurate results [11]. The ingredients of the food during the two days were categorized and their values were measured and coded. The data were then analyzed using the locally developed Dorosty Food Processor (DFP) software; this software is based on Iranian food habits and used for the assessment of macronutrient and micronutrient intakes.

Comparison of energy and nutrient intake with DRI

Recommended Dietary Allowance (RDA) (2002) for proteins is based on reference proteins. Therefore, to correct the protein need based on the

WHO guideline, protein digestibility of the diet and amino acid scoring were required. To calculate amino acid scoring, the intake of protein and four limiting amino acids (lysine, tryptophan, threonine, methionine+ cysteine) were calculated using the DFP software. After calculating the amount of each amino acid (as mg) in 1 g of dietary protein divided by the amount of the same amino acid (as mg) in 1 g of reference protein, the score of the amino acid was determined and the limiting amino acids were identified. Since according to WHO, protein digestibility for the countries without a known digestibility coefficient is 0.85, the protein need was corrected based on the following formula [12, 13]:

$$\text{Corrected protein need} = \text{need}.(1/\text{ amino acid scoring}).(1/\text{ protein digestibility})$$

The amounts of energy and other nutrients intake were compared with DRI.

Statistical analyses

Data were collected and stored on a computer database. Epi-info 2002 (Centers for Disease Control and Prevention, Atlanta, Georgia) was used to calculate BMI percentiles. All other statistical analyses were completed using SPSS11.5 (SPSS Inc., Chicago, IL). he Chi-square and Fisher exact test was used to assess the association between categorical variables. ANOVA was used to compare mean of quantitative variables. Coefficient correlation was used to observe if there is any correlation between quantitative variables and BMI for age percentiles. One sample T-Test was used to compare mean of energy and nutrient intake with DRI. Statistical significance was achieved when the p value was less than 0.05.

RESULTS

Anthropometric measurements

256 female students aged 14-18 years participated in this study. Table 1 presents the mean of age, weight, height and BMI of the students. Table 2 shows that the prevalence of underweight, overweight and obesity was 5.9%, 11.7% and 4.7%, respectively. Underweight was slightly higher (9.4%) among 17.5-18.5 years old students. The highest percentage of obesity (6.3%) was in 16.5-17.4 age groups, but these differences were not significant.

Comparison of energy and nutrient intake with DRI

According to the WHO, when 20% of the participants in a study receive a nutrient less than 75% of the recommended, it is addressed as a nutritional health problem in that society [13]. Hence, nutrient intake was evaluated from this viewpoint (Table 3) and the results showed that the daily intake of vitamin B12, vitamin A, folate, calcium, and zinc was less than 75% DRI recommended in 83.9%, 45.3%, 81.2%, 70.7%, 94.9%, and 90.6% of Semnan adolescent girls, respectively. Therefore, the studied population was at risk of the deficiency of the mentioned nutrients. It should be mentioned that vitamin B6 intake of all students was sufficient.

Table1: Subject characteristics according to age and weight status

	Weight Status				
	Underweight n=15	Normal n=199	Overweight n=30	Obese n=12	Total
	Mean(±SD)	Mean(±SD)	Mean(±SD)	Mean(±SD)	Mean(±SD)
Age (year)	16.62±1.44	16.33±1.12	16.73±1.01	16.64±1.07	16.58±0.17
Height (m)	158.90±17.17	159.08±20.67	157.31±25.25	159.41±29.25	158.67±0.93
Weight (kg)	43.43±5.59	52.38±7.23	62.75±9.92	74.29±14.9	58.21±13.31
BMI (kg/m^2)	17.17±1.9	20.67±2.43	25.25±3.16	29.25±5.6	23.08±5.27

Table 2: Prevalence of underweight, overweight and obesity by age group in Iranian adolescent girls

Age group(years)	Weight Status									
	Underweight		Normal		Overweight		Obese		Total	
	n	%	n	%	n	%	n	%	n	%
14.5-15.4[a]	4	6.3	55	85.9	3	4.7	2	3.1	64	100
15.5-16.4	2	3.1	49	76.6	10	15.6	3	4.7	64	100
16.5-17.4	3	4.7	50	78.1	7	10.9	4	6.3	64	100
17.5-18.5	6	9.4	45	70.3	10	15.6	3	4.7	64	100
Total	15	**5.9**	199	77.7	30	**11.7**	12	**4.7**	256	100

[a] Categorization according to the educational grade of high school

Table 3: Distribution percentage of Iranian adolescent girls according to micronutrients intakes compared to DRI

	Adequate intake [a]		Deficient intake [b]	
	n	%	n	%
Vit. B_1(mg)	248	96.8	8	3.1
Vit. B_2(mg)	212	82.8	44	17.1
Vit. B_6(mcg)	256	100	0	0
Vit. B_{12}(mcg)	41	16	215	83.9
Vit. A (mcg)	140	54.6	116	45.3
Vit. C (mg)	244	95.3	32	12.5
Folate (mcg)	48	18.7	208	81.2
Iron (mg)	247	96.4	9	3.5
Calcium (mg)	75	29.2	181	70.7
Zinc (mg)	13	5	243	94.9
Fiber (g)	24	9.3	232	90.6

[a] nutrient intake ≥75% DRI
[b] nutrient intake < 75% DRI

According to Table 4, comparison of the mean energy and nutrients intake with DRI recommended values showed that energy, vitamin B12, folate, calcium, and zinc intake among adolescent girls in Semnan was significantly lower than the normal range (p<0.0001).

Table 4: Comparison of the mean energy and nutrients intake with DRI in Iranian adolescent girls

	DRI	Mean (±SD) intake	
		Mean	SD
Energy (kcal) [a]	2365	1957.4	485.8
Carbohydrate (g)	130	257.2	71.3
Protein (g)	46	62.7	19.8
Vit. B_1 (mg)	1	1.5	0.47
Vit. B_2 (mg)	1	2.3	0.4
Vit. B_6 (mcg)	1.2	8.6	4.3
Vit. B_{12} (mcg) [a]	2.4	1.1	0.31
Vit. A (mcg)	700	985.7	527.8
Vit. C (mg)	65	158.2	102.38
Folate (mcg) [a]	400	100.4	73.8
Iron (mg)	15	21.7	9.1
Calcium (mg) [a]	1300	805.8	321.3
Zinc (mg) [a]	9	3.8	1.6
Fiber (g) [a]	26	12.3	5

[a] Significant P.value (P<0.0001)

DISCUSION
Anthropometric measurements

The results showed that the prevalence of underweight, normal weight, overweight, and obesity was 5.7%, 77.7%, 11.7%, and 4.7% in Semnan adolescent girls, respectively. In a similar study undertaken by Djazayery and Poormoghim in 1999 among high school girls in Tehran (districts 3 and 16), the results showed that the prevalence of being underweight in the two regions was 0.82% and 2.4%, respectively. Also, the prevalence of obesity in the above-mentioned districts was 14.2% and 12.3%, respectively. The chi-square test results showed that the prevalence of being underweight was significantly higher in Semnan adolescent girls. However, the prevalence of obesity was significantly higher among school students in the mentioned districts in Tehran [14]. In comparison with the female students in Lahijan, the prevalence of being overweight (1.5%) or obese (0.5%) was significantly higher in Semnan adolescent girls [15].

A study by Hedley et al. that was conducted on American children and adolescents between 1999-2000 and 2001-2002 showed that the prevalence of being overweight was 29.9% and 31.5% and the prevalence of obesity was 15%, and 16.5% respectively in the aforementioned age groups[16] which indicated that Semnan girls were less overweight and obese when compared to American adolescents..

In a similar study by Mageray et al. conducted in 1995, evaluation of Australian girls aged 16 to 18 showed that 13.7% of them were overweight [17]. The findings suggested no significant difference in the prevalence of being overweight between Semnan and Australian girls of the same age range.

Another study conducted by Madriaga et al (1998) on Filipino girls aged 13-18 showed that the prevalence of being underweight, overweight, and obese (based on BMI percentile for age) was 12.9%, 4.7%, and 0.5%, respectively [18]. The Chi-square test results showed that the prevalence of being underweight in Semnan girls was significantly lower than Filipino girls while the prevalence of being overweight or obese was significantly higher (p<0.05).

In reference to the weight status of the adolescent girls in Semnan, it can be concluded that the prevalence of being underweight in the

high school girls of Semnan was higher than other cities of the country, but lower than developing countries. Also, when compared to the results of the studies in other countries and other cities of the country, the prevalence of obesity and being overweight was either equal or higher. However, it was less than developed countries like the United States, which could be the result of different lifestyles and eating habits.

Comparison of energy and nutrient intake with DRI

Considering the fact that the daily intake of vitamin B12, vitamin A, folate, calcium, zinc, and fiber was less than 75% of the recommended DRI in 83.9%, 45.3%, 82.1%, 70.7%, 94.9%, and 90.6% of Semnan adolescent girls respectively, the study population suffered from the deficiency of the aforementioned nutrients.

However, it should be noted that lower than recommended intake of a nutrient does not indicate its insufficiency but expresses the higher risk of its inadequate intake. Therefore, it is wrong to conclude that individuals without a DRI recommended diet necessarily suffer from malnutrition. This is because DRI has a margin of safety for different people. For this reason, the border of 75% of DRI is considered as an increased risk of low nutrient intake [19].

In a study on adolescent girls aged 14-18 years in district 3 of Tehran in 1994, 66%, 32.7%, 47.7%, and 24.2% of the female students had calcium, zinc, vitamin B12, and iron deficiency, respectively. Moreover, the same study reported that 73.3%, 42.6%, 67%, 40.9%, and 32% of the students in district 16 had calcium, zinc, vitamin B2, vitamin A, and vitamin B12 deficiency, respectively [14]

According to Table 2, vitamin A and calcium intake of adolescent girls in Semnan and Tehran (district 16) were similar. However, a greater number of Semnan female high school students

had calcium intake insufficiency. The intake of vitamin B2 in Semnan female students was better than its intake in female students of both districts of Tehran. The iron intake was also better in Semnan versus Tehran female students (district 3). However, more Semnan girls (94.9%) suffered from zinc deficiency in comparison with girls in district 3 (32.7%) and district 16 (42.6%) of Tehran. Also, compared to Tehran district 16 female students (32%), a higher percentage of girls in Semnan (84.3%) had vitamin B12 deficiency.

In the study on high school girls in Babol, 51.8%, 31%, 42.4%, 39.8%, 33.6%, and 92.7% of the students had vitamin A, vitamin B1, vitamin B2, vitamin C, iron, and calcium intake insufficiency, respectively[20, 21]. Regarding vitamin A intake, high school girls in Semnan (45.3%) and Babol had a similar status.

Regarding vitamins B1, B2, iron and calcium intake, a few number of high school girls in Semnan had insufficient intake as compared with high school girls in Babol.

Evaluation and comparison of dietary intake with recommended DRI values among 1385 American girls aged 12-18 years by Ashima in 2002 showed that intake of vitamin C, vitamin A, folate, vitamins B6, B12, iron, and zinc was less than DRI recommended values in 23%, 44%, 40%, 74%, 28%, 27%, and 39% female adolescents, respectively [22]. In another study on Northern Greece adolescents, Hassapidou et al. reported that iron, vitamin A, and folate intake were lower than recommended values [23].

CONCLUSION

Malnutrition (underweight and overweight) is higher than the expected rate. Findings of our study showed that micronutrients deficiency among adolescent girls is a major problem among adolescent girls in Semnan and prevention measures are necessary to induct.

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