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Dietary Intake of Macro- and Micronutrients in children: Comparison with Reference Values

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Abstract

Background: One of the most important factors in maintaining and improving children's health is the quality of diet.

Objectives: The aim of this study was to determine the micro and macro nutrient intakes in children aged less than five years old with malnutrition.

Methods: This cross-sectional study included 75 under-five children referring to the primary health care center in Taft, Iran. The children were classified into two groups by nutritional status according to a variety of anthropometric indicators. Food intake was assessed using 24-hour food recalls and then was compared to the recommended daily amount (RDA). Anthropometric measures of age, height/length, weight and head circumference measurements were obtained and compared with reference anthropometric indices to assess nutritional status.

Results: The subjects consisted of 41 boys and 34 girls who were 36 (48%) in the malnourished group and 39 (52%) in another group. The dietary intake of micronutrients was evaluated; only calcium, iron, zinc, and folate intake were significantly lower than the RDA. (P<0. 05). The intake of macronutrients was above recommendations and energy intake was at the appropriate level.

Conclusion: The findings of the study indicated an appropriate level of macronutrients intake in the target group and the problem was mainly in the consumption of micronutrients. Based on the results we recommended planning for nutrition education program.

Key Words: Children, Dietary intake, Malnutrition, Nutrition recommendations.

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1- INTRODUCTION

Malnutrition can be defined as an imbalance between the need and intake of essential nutrients. Both under nutrition and excess weight can impact health throughout the life, and affects economic, social, educational, and occupational development in the future life (1-3). Remarkable progress was made in reducing child malnutrition during the last two decades, but it is still a global public health issue, especially in developing countries (4-6). According to the published papers, changes in the eating habits of children may replace the over intake of high calorie and high density food with less nutrients. Many studies, related to family nutrition pattern, have shown that family tables had major deficiencies qualitatively while they were adequate quantitatively; some of such studies have pointed to micronutrient and macronutrient deficiencies in children's diets in Iran (9-11) as well as inappropriate food group patterns in the meals they received (12, 13). In other words, the quality of Iranian's diet needs to be improved. This present study was conducted to evaluate the dietary intake of under five children in Yazd, Iran, and its relationship with RDA recommended values.

2- METHODS

This cross sectional study was conducted on children aged less than 5 years referred to health centers of Taft during 2015-2016. Taft town is located in southwest of Yazd Province, Iran, with a population of about 45,000 people (14).

Therefore, this sample can be considered as a representative sample of urban children of Taft. The study protocol was approved by the Ethics Committee of Yazd University of Medical Sciences. Informed consent was obtained from mothers or other caregivers before the interviews. Baseline information on demographics such as age in years, place of residence, parents' education, occupation, and type of diet was collected from all parents using a validated and pretested questionnaire. Anthropometric measures (weight, height, waist circumference (WC)) were measured by trained technicians. Using a SECA digital scale (Germany), weight was measured with the accuracy of 100 g, with no shoes and minimum clothing. Those children who couldn't stand, were weighed with their mothers and the mother's weight was subtracted. The height of children under two years was measured in probe state. The height of children over two years was measured standing without shoes, cap and pin with a resolution of 0.5 cm. To eliminate personal errors, all the measurements were carried out by one person. Moreover, the scales were calibrated before every weighing, using 2 and 5 Kg weights. The patients were divided into 2 nutrition groups according to their height/weight ratios. World Health Organization (WHO) has recommended the use of three indices; height for age z score; weight for age z score; and weight for height (W/H) z score with a cutoff of less than −2 to define malnutrition and to compare prevalence data. To evaluate the nutritional status of children, height, weight and age are traditionally used according to WHO standards. Dietary intake was assessed by the 24-h dietary recall method (3 dietary recall in one weekend and 2 week days) (15). Two experienced nutritionists obtained the information from the parents, and analyzed it using Nutritionist 4 software (First Databank Inc., Hearst Corp., San Bruno, CA) updated based on Iranian food composition table (16). The intake of proportional food items and various macronutrients and micronutrients were compared with the Recommended Dietary Allowance (RDA). All statistical analyses were performed using the SPSS version 20. P-values less than 0.05 were considered as significant.

3- RESULTS

From among the 75 children participants, 41 (54.6%) were boys and 34 (45.3%) were girls. Forty-eight percent of the participants were malnourished and 52% were healthy (their age means were 37.5 ±13.5 and 39.76 ±14.5 months, respectively). 50.7% of the children came from urban areas, and 49.3% from rural areas in Taft. Additionally, 54.7% of the children's fathers had less than a high school degree, while 60% of their mothers had a senior high school or higher education degrees. And, 92% of the children's mothers were housewives. No significant difference was reported between the two groups in terms of the demographic characteristics. **Table 1** represents the energy and macronutrient intake of children with respect to the Recommended Dietary Allowance (RDA).

Table-1: Minerals and vitamins intake by children compared to RDA

Variables	Age month	RDA (Mg/day)	Well-nourished children *n* = 39 Mean ± SD	P-value*	Malnourished children n = 36 Mean ± SD	P-value*
Iron (mg/day)	≥36	7	8.1±8.8	0.615	6.63±3.52	0.003
	36<	10	7.9±5.15	0.004	5.5±2.11	0.001
Calcium (mg/day)	≥36	700	374.3±245.2	0.001>	265.3±184.5	0.001>
	36<	1000	384.8±274.3	0.001>	322.8±288.9	0.001>
Zinc(mg/day)	≥36	3	3.8±2.3	0.138	3.2±1.6	0.001>
	36<	10	3.5±2.2	0.001>	3.37±1.24	0.001>
Vitamin B1 (mg/day)	≥36	0.5	0.88±1.1	0.168	0.69±0.37	0.07
	36<	0.6	0.8±0.69	0.172	0.56±0.22	0. 69
Vitamin B2 (mg/day)	≥36	0.5	1.02±0.92	0.032	0.63±0.47	0.24
	36<	0.6	0.87±0.56	0.036	0.72±0.45	0.26
Vitamin B3 (mg/day)	≥36	6	10.28±11.4	0. 14	7.4±3.5	0.16
	36<	8	9.1±7.1	0.468	5.7±2.09	0.01
VitaminB6 (mg/day)	≥36	0.5	0.97±1.36	0.174	0.53±0.33	0.74
	36<	0.6	0.6±0.29	0.98	0.5±0.21	0.231
Folate µg/day	≥36	150	105. 8±180.8	0.32	111.4±116.2	0.53
	36<	200	59.5±48.3	0.001>	73.9±59.7	0.001>
Magnesium (mg/day)	≥36	80	155.3±210.8	0.169	89.9±58.9	0.53
	36<	130	121. 8±82.5	0.587	91.3±32.5	0.007

Significant level P<0.05, * *Mann–Whitney* test was performed for comparisons between the two groups

In the area of macronutrient intake, except for the mean intake of carbohydrate which was lower than RDA in malnourished children (P=0.017), all other macronutrients were apparently higher than RDA. When compared energy consumed with recommendations for both gender and age range, no significant differences were observed between the perceived intake for energy and

recommendations, while the mean energy intake in healthy boys (age>36 months) was significantly lower than their requirement. The daily intake of micronutrients (5 vitamins, 4 minerals) compared to the reference intake values are shown in **Table 2**. There were no significant difference between their vitamin intake and recommended values, while folate was significantly lower than recommendations in children>36 months (P=0.001). Their consumed Fe, calcium and Zn were significantly lower than recommendations; however, the mean intake of Fe and Zn was slightly higher than the RDA values in healthy children aged less than 36 months.

4- DISCUSSION

Macronutrients and micronutrients deficiency is a global challenge reflecting the nutritional problems of children. The American
Academy of Pediatrics recommends foods that supply the critical nutrients for brain development during particularly important times. These include protein, zinc, iron, folate, long-chain polyunsaturated fatty acids and vitamins A, D, B6, and B12 (17) (**Table 3**).

Table-2: Intake of energy and macronutrients in children compared to RDA

			RDA (Mg/day)	Well-nourished children n Mean ± SD	P-value	Malnourished children n = 36 Mean ± SD	P-value
Carbohydrate (% kcal)			130	141.8±101.9	0.4	103.1±49.7	0.017
Lipids (% kcal)			30	58.8±45	0.001>	55.1±27.1	0.001>
Protein (% kcal)	≥36		13	29.7±18.3	0.001>	24.6±11.4	0.002
	36<		19	30.1±19.2	0.003	25.1±10.9	0.13
Energy (kcal)	Boy	≥36	992	1251.8±803.4	0.3	856.6±263.5	0.22
		36<	1642	1075.6±375.5	0.001>	1264.6±416.8	0.07
	Girl	≥36	1046	1154.6±961.4	0.74	1081.8±374.8	0.8
		36<	1742	1349.3±797.5	0.07	781.6±506.1	0.08

Significant level P<0.05, * Mann–Whitney test was performed for comparisons between the two groups

Table-3: Nutrients that particularly affect early brain development

Macronutrients	Micronutrients	Vitamins and cofactors
	Zinc a	B vitamins
Protein a	Copper a	Vitamin A
	Iodine a	Vitamin K
Specific fats (LC-PUFAs) a	Iron a	Folate a
	Selenium	Choline a
Glucose		

LC-PUFAs: long-chain polyunsaturated fatty acid.
[a] Nutrients that meet the principles for demonstrating a critical or sensitive period during development

Results from this study indicated that most micronutrients were within recommendations, except for calcium, zinc, iron and folate. The intake of macronutrients was above the recommended values. These findings are in line with the cross-sectional study among adolescent girls that reported a substantial excess in their protein intake and inadequate intake of some micronutrients including iron and calcium (18). A review done on the dietary intake of children and adolescents in developing countries revealed that the majority of micronutrients (calcium, iron, zinc, folate, vitamin B6, niacin, riboflavin, and vitamin C) in their diet were found to be less than the RDA value. They also reported that fat and protein intake was more than recommended for the majority of children and adolescents. These findings were supported with the results of the present study(18). Our findings are also consistent with those of Tarighat et al., who reported deficiency of folic acid, calcium, zinc and magnesium intake (19). There were some previous reports regarding the dietary intake of children worldwide. In one survey in England low intake of calcium, iron, zinc and vitamin A was reported among the secondary school adolescents (20). Another study on Japanese students showed that calcium and iron intake was lower than the recommended values (21). A cross sectional study on dietary intake of adolescent girls in India revealed a higher intake of protein more than recommended, and inadequate intake of various micronutrients including iron and calcium (18). Some studies on food consumption pattern indicated that poor quality of the habitual diet and the lack of dietary diversity may contribute to micronutrient deficiencies (22).Our findings were contradicted by a study which was conducted on the dietary pattern and nutrition among 270 adolescent (age 10-19 years). It had revealed that more than two third of the subjects had inadequate intake of calorie, protein, and fats (23). Diatary patterns that include high energy content foods are usually rich in fat, but are accompanied by a lower intake of fruits, vegetables, and other sources of fiber such as whole grains, legumes and high fiber cereals (24-26). According to some published papers, low intake of fruits and vegetables, inappropriate compositions of fat and excessive amounts of free sugars is likely to be increased, by Iranian children (27-29). Kelishadi et al. also showed that a high percent of Iranian children and adolescents (73.8% of families) consumed hydrogenated fats based on the results of the CASPIAN study (30). Salehi et al (31) in accordance with some other studies showed that a high intake of energy is not necessarily accompanied by more consumption of nutrients, and may be associated with overweight and obesity and yet, a shortage of micronutrients remains (32, 33). It is, however, noteworthy that different life styles and nutrition patterns exist in different districts. Cultural and economic factors heavily influence nutritional status, and micronutrient and energy intake in all areas (34). A study on food security in Isfahan showed that the intake of folate, iron, calcium and fiber is lower than RDA despite the increased consumption of energy (34). Another study in Tehran province showed that, despite the high energy intake of the South and the West zones, micronutrient deficiency is quite prevalent, which might be related to the economic factors. As a result, in the poorer regions despite abdominal satiety, people suffer from micronutrient deficiencies (31).

5- CONCLUSION

The key findings of the current report revealed that the amount of folate, calcium, iron and zinc was lower than the amounts recommended by RDA. Therefore, the consumption of important dietary groups that are major sources of

micronutrients such as dairy, fruit, vegetable, and nuts should be increased in this group of individuals.

6- LIMITATION

The main limitation of this study was the difference between the standard digital scales by which the food intakes were weighed. Moreover, various methods have been mentioned in nutritional reference books to determine micronutrients and macronutrients contained in different foods; this makes it difficult to consider which food exactly causes the mentioned deficiency.

7- CONFLICT OF INTEREST

Authors declare no conflict of interest related to this work.

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