

Nutrient intake and growth indices for children at Kindergartens in Shiraz, Iran

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Abstract

Objective: To evaluate energy and nutrient intake and determine growth indices for pre-school children in Iran.

Methods: The study was conducted from June to September 2010 and included 150 children aged between 3 and 5 years who attended kindergartens in Shiraz, Iran. Following a measurement of the participants' height and weight, three 24-hour dietary recalls were completed based on interviews with their parents. The data was entered into various computer softwares. The prevalence of underweight, stunting, wasting, at-risk-of-overweight and overweight children was then calculated, and energy and nutrient intake was compared with the recommended values.

Results: The mean intake of energy, calcium and iron for the children were less than the recommended values. In contrast, the mean intakes of carbohydrate, protein, zinc and vitamin C were higher than the recommendations. Fat intake, however, was within the Acceptable Macronutrient Distribution Range. In addition, the rates of prevalence of the underweight, stunting, wasting, and overweight or at-risk-of-overweight were found to be 27 (18.6%), 37 (25.5%), 18 (12.4%) and 34 (23.4%), respectively. Finally, underweight children had lower intake of energy, carbohydrate, protein, fat, iron and zinc, while overweight or at-risk-of-overweight ones had higher intake of protein, calcium and zinc.

Conclusion: There is a need for children in kindergartens of Shiraz to improve their mean intake of energy, calcium and iron. Moreover, about one-fourth of the children were stunted and about the same proportion were either overweight or at the risk of being so.

Keywords: Pre-school children, Malnutrition, Growth, Iran. (JPMA 64: 316; 2014)

Introduction

The first years of life form the most significant developmental period of man's life.¹ The role of undernutrition and vitamin deficiencies during this period in creating developmental problems (e.g. poor growth and mental dysfunction) has already been established.² Appropriate nutrition over this time is therefore crucial if children are to attain full growth. Since lifestyle and dietary habits that originate in childhood can extend into adulthood, improving the quality of nutrition is of great importance from a larger perspective.^{1,3}

One aspect of nutrition is the provision of the energy the human body requires. This can be supplied by carbohydrate, protein and fat. Insufficient energy intake can in the long run lead to malnutrition.⁴ No less important for growth are minerals. Calcium, for instance, is vital for mineralisation and maintenance of the growing bone.⁵ Another essential mineral is iron, a

deficient intake of which being the most common nutritional disorder in the world as well as the main cause of anaemia, especially during infancy and childhood.⁶ Vitamin C and zinc are still other examples of micronutrients that are vital to children's full growth, development and immunity. Unfortunately, there have been reports of alarming deficiencies in these two micronutrients among Asian and Latin American children.⁷

Chronic undernutrition among children in developing countries has long been one of the main causes of morbidity and mortality.⁸ Admittedly, the prevalence of underweight children in these regions is estimated to drop to 19.3% by 2015 from the 30.2% pertaining to the 1990s.⁹ This falling trend was observed in a study of Iranian children.¹⁰ Nonetheless, regular monitoring of children's health status in those countries seems to be of major importance, given the serious consequences of malnutrition for a child's development.

On the other hand, the rate of childhood obesity is rising in developing countries. This is expected to lead to a socioeconomic and public health burden before long.¹¹ Within the context of Iran, a survey done on pre-school children indicated that the prevalence of overweight and obesity was unexpectedly high. During the 1990s a rapid

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nutrition transition was experienced in Iran that was along with decrease in physical activity and elevating energy and fat intake. The incidence of obesity is therefore expected to be on the rise.¹² Here again, this is a condition to be closely monitored.

The present study has been done in the context of Shiraz, a city in Iran. There have been other studies of children's nutritional indices in this city. For instance, a study on primary school children determined the prevalence of underweight and overweight.¹³ However, such studies have typically attended to age groups other than pre-schoolers, leaving the latter group under-investigated. The aim of the present study was to determine energy and nutrient intake (carbohydrate, protein, fat, calcium, iron, zinc and vitamin C) as well as the growth indices (those addressing underweight, stunting, wasting and overweight) in 3 to 5-year-old children in kindergartens within the city of Shiraz, Iran.

Subjects and Methods

The cross-sectional, descriptive and analytical study was conducted in kindergartens of Shiraz, Iran, from June to September 2010, after approval by the Student Research Committee, Shiraz University of Medical Sciences, Iran.

Ten kindergartens in Shiraz were selected, using the cluster sampling method. Data was obtained from 150 children aged between 3 and 5 years. The sample size was calculated according to mean $\pm$ standard deviation (SD) of energy intake obtained in a similar study,¹⁴ adopting a precision of 10 and a design effect equal to 2. Simple random sampling was performed for sample selection. The selected children were healthy as far as congenital and metabolic disorders were concerned.

Once the parents/caregivers had filled in the written consent forms, anthropometric data, including weight and height, of the children was collected. Weight was measured using a digital scale (HOMEFEC.T) at an accuracy of 100g, while the participants had light clothing and no shoes on. Data on height was obtained by means of a measuring tape with an accuracy of 0.1 cm. During the measurements, the participants stood barefoot on a flat surface, with their feet parallel, their heels touching one another, and the head, the back and the heels touching the vertical board. Subsequently, information on the weight, height and age of 36- to 48-month-old children were entered into the Anthro software (version 3.1.0).¹⁵ Similar information pertaining to 48- to 60-month-olds were fed into the AnthroPlus software (version 1.0.3).¹⁶ These

software determined the participants' weight for age z-scores (WAZ), height for age z-scores (HAZ), weight for height z-scores (WHZ) and the body mass index (BMI) for age percentiles. These were to represent the prevalence of underweight, stunting, wasting and overweight status, respectively. Since the data of WAZ was not defined in the AnthroPlus software, the Centers for Disease Control and Prevention (CDC) 2000 standards were used. WAZ, HAZ and WHZ values below -3, between -3 and -2, and between -2 and -1 were categorised into severe, moderate and mild malnutrition groups respectively. Values more than -1 were considered normal. Moreover, the children were classified as at-risk-of-overweight or overweight depending on whether their BMI for age ranked in the range of 85th to 95th percentile or greater than 95th percentile, respectively.

Three 24-hour dietary recalls were completed for each child over the two weeks following the interviews, which were all carried out over a single summer. The parent/caregiver was asked to recall the type and quantity of all foods and beverages consumed by the child during the preceding 24 hours. The information was collected through a face-to-face interview for the first questionnaire, and through phone calls for the other two questionnaires. One out of three dietary recalls concerned the weekend and two for the week days. The dietary recalls were then entered into Nutritionist IV software (version 3.5.2), which converted the data into daily energy and nutrient intakes of carbohydrate, protein, fat, calcium, iron, zinc and vitamin C. Subsequently, their energy and nutrient intakes were compared with Estimated Energy Requirement (EER) and with Recommended Dietary Allowance (RDA) respectively.

Statistical analyses were performed using SPSS version 11.5. Quantitative data were presented as mean $\pm$ SD and frequencies and percentage. Duncan's test was used to compare nutrients between age groups, while t-test was applied to compare nutrient intakes with both weight for age and BMI for age statuses. The level of statistical significance was set at $p < 0.05$.

Results

Of the 150 children selected, 5 (3.33%) had to be excluded owing to problems in contacting them. The study size, as such, was 145 (96.66%). Of them, 77 (53%) were boys and 68 (47%) were girls.

The mean energy intake was 1325 ± 247 kcal (93% of EER), and the average intakes of carbohydrate, protein and fat were 172 ± 38 gr (133% of RDA), 50 ± 12 gr (301% of RDA)

Table-1: The observed and required nutrient intakes of children in the kindergartens of Shiraz.

Nutrient	Age	Mean SD	p-value	Requirements +	Mean percent of adequacy
Energy (kcal/d)	3	1289 227	0.02*	1344	96
	4	1301 254		1459	89
	5	1437 240		1503	97
	Total	1325 247		1428	93
Carbohydrate (gr/day)	3	166 31	0.01*	130	128
	4	169 42		130	130
	5	191 38		130	147
	Total	172 38		-	133
Protein (gr/day)	3	48 12	0.30	13	369
	4	49 13		19	260
	5	52 10		19	275
	Total	50 12		-	301
Fat (gr/day)	3	51 13	0.22	ND ++	-
	4	50 11		ND	-
	5	54 12		ND	-
	Total	51 12		ND	-
Calcium (mg/day)	3	639 312	0.53	700	91
	4	196 ±598		1000	60
	5	654 242		1000	65
	Total	624 251		-	72
Iron (mg/day)	3	7 2	0.004*	7	94
	4	7 2		10	71
	5	8 2		10	80
	Total	7 2		-	81
Zinc (mg/day)	3	6 2	0.45	3	200
	4	6 1		5	124
	5	6 1		5	130
	Total	6 2		-	152
Vitamin C (mg/day)	3	60 36	0.09	15	400
	4	51 29		25	204
	5	68 43		25	271
	Total	58 35		-	287

* p<0.05

+: The energy requirements are calculated according to EER formulas and the other nutrient requirements are the RDA values.

+ -: Not Determined

and 51±12 gr respectively. The average intake of calcium, iron, zinc and vitamin C were 624±251, 7±2, 6±2 and 58±35mg (72%, 81%, 152% and 287% of RDA), respectively (Table-1). Since RDA has not been determined for fat intake, the percentage of energy derived from fat was compared with the acceptable macronutrient distribution ranges (AMDR). The findings revealed that the intake rates for fat, carbohydrate and protein were within the AMDR (34.69 5, 52.01 6 and 15.00 3 respectively).

The mean intake of macronutrients increased with age, but the only significant difference observed was between the 5-year-old children and the intake of the younger ones concerning their energy and carbohydrate intake (p=0.02, 0.01). Concerning micronutrients, it was in the case of the iron intake where the 5-year-old group

significantly outweighed all the other age groups (p=0.004).

Analysis of anthropometric data revealed that the rates for the mild underweight, stunted and wasted children were 25 (17.2%), 30 (20.7%) and 14 (9.7%), and those for the moderately underweight, stunted and wasted were 2 (1.4%), 7 (4.8%) and 4 (2.7%), respectively (Table-2). While 1 (0.6%) child was severely wasted, none were severely underweight or stunted. Moreover, the results indicated that among the underweight children, 63% (n=17) were stunted. Since the number of children with moderate and severe malnutrition was very low, these cases were categorised together. With regard to the overweight status, 11% (n=16) of the population was at-risk-of-overweight, and 12.4% (n=18) were overweight.

Table-2: Distribution of the growth indices of children in the kindergartens of Shiraz.

Growth indices	Growth status*	Frequency	Percent
Weight for age	Normal	118	81.4
	Mild underweight	25	17.2
	Moderate & severe underweight	2	1.4
Height for age	Normal	108	74.5
	Mild stunted	30	20.7
	Moderate & severe stunted	7	4.8
Weight for height	Normal	127	87.6
	Mild wasted	14	9.7
	Moderate & severe wasted	4	2.7
BMI for age	Normal	111	76.6
	at-risk-of-overweight	16	11
	Overweight	18	12.4
Total		145	100

* Z> -1, -1 > z > -2, and z < -2 were defined as normal growth, mild malnutrition and moderate-to-severe malnutrition, respectively. Body Mass Index (BMI) for age percentiles <85, 85-95 and > 95 were classified as normal, at-risk-of-overweight and overweight, respectively.

Table-3: The relationship between mean intakes of nutrients with weight for age and with BMI for age status of children in the kindergartens of Shiraz.

Nutrient	Mean SD+	P- value	Mean SD ++	P-value
Energy (kcal/day)	1361 206	0.007*	1320 261	0.7
	1166 339 #		1339 193 # #	
Carbohydrate (gr/day)	177 34	0.03*	173 40	0.51
	154 50 #		169 31 # #	
Protein (gr/day)	51 11	0.02*	48 13	0.03*
	44 15 #		53 10 # #	
Fat (gr/day)	53 11	0.001*	51 12	0.31
	43 14 #		53 11 # #	
Calcium (mg/day)	634 240	0.29	590 232	0.003*
	578 293 #		738 282 # #	
Iron (mg/day)	7 2	0.02*	7 2	0.57
	6 2 #		7 2 # #	
Zinc (mg/day)	6 1	0.047*	6 2	0.02*
	5 2 #		7 1 # #	
Vitamin C (mg/day)	59 34	0.46	58 36	0.87
	53 41 #		57 32 # #	

+ Mean intakes of nutrients regarding weight for age z-scores. Weight for age z-score > -1 are presented in regular typeface while weight for age z-score < -1 are boldfaced and followed by #.

++ Mean intakes of nutrients regarding Body Mass Index (BMI) for age percentiles BMI for age percentiles < 85 are presented in regular typeface, while BMI for age percentiles > 85 are boldfaced and followed by # #.

*p < 0.05.

Besides, underweight children had lower intake of energy, carbohydrate, protein, fat, iron and zinc among the group (p=0.007; 0.03; 0.02; 0.001; 0.02 and 0.047, respectively). On the other hand, those who were overweight or at the risk of overweight had higher intake of protein, calcium and zinc compared to the rest of the group (p=0.03; 0.003 and 0.02) (Table-3).

Discussion

In the present study, the percentage of energy obtained from macronutrient sources was in agreement with the AMDR. This is similar to the results found in some other studies. Bollella et al, for example, assessed dietary intake in 3 to 5-year-old children in New York. Results showed rates for the contribution of carbohydrate, protein and fat to the percentage of energy intake that corresponded to the rates as suggested by AMDR.¹⁷

On the other hand, the deficiency of the nutrients of concern to this study seems to be a global phenomenon. In several studies done worldwide, the same micronutrients have been found to be deficient, though in varying degrees. In a study done in kindergartens in Saudi Arabia, for instance, the mean intakes of energy, calcium, iron and potassium were found to be less than the RDA, as was the percentage of energy derived from carbohydrate.¹ This is congruent with the mean intakes of energy, calcium and iron as found in the present study, which were less than the recommendations. Elsewhere, LaRowe et al, determined dietary intakes of rural American Indian pre-school children. Their findings revealed that although the mean intake of nutrients was adequate, several children had insufficient intake of key nutrients, including fibre, calcium, vitamin D and vitamin E.¹⁸ The study of Barquera et al. on 1 to 4-year-old Mexican children is another case in point, where it was indicated that the estimated median intakes for energy, carbohydrate, fat, calcium, iron, folate and vitamin A were lower than their requirements.¹⁹ Finally, evaluating the health status of children aged 3 to 6 years in one of the cities of South Korea, Yu reported that the intake of energy was lower than EER of Dietary Reference Intakes for Koreans (KDRIs). Although the intakes of all of the nutrients were above the KDRIs, but fat, calcium and folate were below the recommended values.²⁰

In this study, the prevalence of underweight, stunted, wasted and overweight or at-risk-of-overweight children were measured. In two other studies, one conducted on the children of South Khorasan, a province in Iran, and another on the children of western Kenya, indicated that the prevalence of moderate and severe underweight, stunting and wasting were higher than those found in this study. This difference can be explained in terms of the prevalence of poverty and inappropriate dietary intake in these two settings.^{21,22}

Another investigation, done on Mexican pre-school children, showed a higher percentage of underweight

and stunted children than that in the present study, while the prevalence of the overweight and wasting was less.¹⁹ Still, a study carried out in a provincial population of Canadian pre-school children reported a high prevalence of at-risk-of-overweight and overweight children; results that are similar to those found in the present study.²³ Such variations in the obtained values can be accounted for by different lifestyles, socio-economic status and the presence of a wide variety of staple foods. The variations would also call for the necessity of running studies in as many societies as possible to get a deeper insight into the nutrition-related growth problems around the globe.

Concerning the relationship between the intake of nutrients and growth indices, this study showed that underweight children had lower intakes of energy, carbohydrate, protein, fat, iron and zinc. This finding is concordant with the expectations for the underweight group. Moreover, overweight or at-risk-of-overweight children had higher intakes of protein, calcium and zinc. Unexpectedly, the overweight ones did not have a significantly higher intake of energy as compared to others. An explanation for this observation is that the parents of some overweight children might have restricted their children's intake as a means of managing this condition and also to reduce the risk of overweight complications during adulthood. Higher intake of protein and calcium in this group might also show more intake of dairy products, which might have been encouraged by their parents as a means of reducing the consumption of junk foods.

This study had certain limitations that should be considered while interpreting the findings. First, despite the fact that 24-hour dietary recalls are still one of the strongest dietary measurement techniques currently in use, there were only a limited number of such recalls employed in this study for every participant. This might have somewhat affected the results. In addition, parents might have failed to provide complete information, or might have been tempted to alter it somewhat, out of embarrassment or an urge to please or impress the researcher.²⁴

Conclusion

The study demonstrated that children in kindergartens of the city of Shiraz had mean intakes of dietary components that were below the optimal levels. It showed that about 25% of the children were stunted and about the same proportion were either overweight or at the risk of being so. The situation calls for interventions by nutritionists. These could take the form

of regular and basic nutritional training for parents and the kindergarten staff, as well as measures to ensure that children's daily requirements of the lacking nutrients are regularly met in their meals.

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