Original Article

Nutritional status of the Iranian children with physical disability: a cross-sectional study

Tirang R Neyestani PhD[1], Monireh Dadkhah-Piraghaj MSc[1], Homa Haydari BSc[1], Telma Zowghi BSc[1], Bahareh Nikooyeh MSc[1], Anahita Houshyar-Rad MSc[1], Mohsen Nematy PhD[2], Mohsen Maddah PhD[3]

[1]*National Nutrition and Food Technology Research Institute, Shaheed Beheshti University of Medical Sciences, Tehran, Iran*
[2]*Meshed University of Medical Sciences, Meshed, Iran*
[3]*Guillan University of Medical Sciences, Rasht, Iran*

Background: Malnutrition can potentially prone a disabled child to further morbidities thus imposing further suffering to the affected child and his/her family. This is the first report on the nutritional status of physically disabled children from Iran. Methods: A total of 290 physically disabled children aged 6-12 yeas old, of both sexes, and from all specialized schools in Tehran, Meshed and Rasht were enrolled in a descriptive cross-sectional study. Dietary assessment was performed for disabled children using 24hr and food-frequency questionnaires. Weight and height were assessed and body mass index (BMI) was calculated for all subjects. Results: In disabled children, while the mean energy intake was more than 90% of the amount required, mean calcium and iron intakes were 75.8% and 58.7% of the corresponding required amounts. Despite absence of significant difference in energy and fat intake, the intakes of protein, calcium and riboflavin were significantly lower in girls than in boys. Z score of weight showed that over 40% of disabled girls and boys were underweight. Comparison with anthropometric data from other studies showed that low weight was more prevalent in disabled than in non-disabled children ($p<0.001$). Moreover, both disabled boys and girls had significantly shorter statures than their non-disabled counterparts. Conclusions: Malnutrition (low weight and stunting) is quite prevalent among Iranian children with motor disabilities and it is more prevalent in girls than in boys. It seems that poor food composition is a more important contributing factor than total low calorie intake. These data warrants further studies.

Key Words: nutritional assessment, disabled child, anthropometry, malnutrition, diet

INTRODUCTION

A disabled child needs proper nutritional care as much as, if not more than, a non-disabled child. Malnutrition can potentially prone a child to further morbidities,[1] and thus imposes further suffering to the affected child, his/her family and the whole community, both emotionally and financially. However, many factors may predispose a child (disabled or non-disabled) to malnutrition even in developed countries with high health standards.[2,3] In developing countries with various degrees and forms of malnutrition being common among the whole population,[4,5] prevalence of nutritional problems in disabled children could be inevitably even higher.

Evaluation of the occurrence of malnutrition in physically disabled children could be technically problematic. Current anthropometric methods, though usually very informative and easy to use in non-disabled children, are not always feasible in physically disabled children. Height, for instance, cannot be measured correctly in vertebral or lower limbs malformations.[6] For this reason, other body measures like arm length (AL),[7] tibia length (TL),[8] arm span (AS),[9] knee length (KL),[10] demispan (DS),[11] and halfspan (HS),[12] have been used as the predictors of actual height in physically deformed as well as hospitalized subjects. Dietary data, on the other hand, is needed to furnish a sound basis for developing and implementing nutritional care plans for disabled children. There is a convincing body of evidence for nutritional problems in disabled children.[3,12] Nutritional deficiencies in a disabled child may emanate from feeding problems[12-14] but this is not the whole story as many children with physical disability may have no feeding problem but may still have some degrees of nutritional deficiencies for some other reasons.[3]

In Iran, many of the mentally and/or physically disabled children are taken care of in boarding centers mostly associated with the Iranian Ministry of Health. However,

Corresponding Author: Dr Tirang R Neyestani, Laboratory of Nutrition Research, National Nutrition and Food Technology Research Institute, Shaheed Beheshti University of Medical Sciences, Tehran, Iran.
Tel: (+9821) 22 37 64 71; Fax: (+9821) 223 60 660
Email: t.neyestani@nnftri.ac.ir; neytr@yahoo.com
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there are still some disabled children who were not abandoned and live with their families. While proper nutritional care of institutionalized children pose many barriers to the caregivers to overcome (sufficient staff and budget among others), families can provide very good nutritional care for their disabled child if they are well informed.

It is noteworthy that living with family does not necessarily guarantee being safe from nutritional deficiencies. This is the first report on the nutritional status of children with physical disability from Iran. In this study, almost all children with some sort of motor dysfunction, who lived with their families from three main cities in Iran were assessed both by dietary and anthropometric methods.

MATERIALS AND METHODS

A total of 290 children from both sexes with physical disability, aged 6-12 yeas old, from all special schools in Tehran (n1=163, from 4 schools), Meshed (n2=85, from one school) and Rasht (n3=42, from 5 schools) were enrolled in a descriptive cross-sectional study during March to May, 2009. The children were not institutionalized and were living with their families.

Anthropometry

Height was measured using a measuring tape to the nearest of 0.1 cm (for non-disabled and some of the disabled children). For those disabled children whose height could not be measured for any reason, arm length (AL) was used to estimate their height. However, there were eight disabled children (2.7%) whose ALs could not be measured properly either because of hand spastic problems. In those children tibia length (TL) was used to estimate height. The following equations, which are applicable to both genders in this age group, were used for height estimation:[15]

$Ht = 38.152 + (AL \times 2.646)$, $R^2=0.733$

$Ht = 43.657 + (TL \times 2.134)$, $R^2= 0.751$

These measures have been shown to be reliable proxies of height.[16] Weight was measured using a digital scale to the nearest of 0.1 kg (Seca 840, Germany). For those children who could not stand, a caregiver was weighed alone and then with the disabled child held in his/her arms. The child's weight was then calculated by subtracting the caregiver's weight from caregiver with child's weight. Body mass index (BMI) was calculated using the formula BMI = weight (kg)/height^2 (m).

Dietary assessment

Data on food consumption was collected using 24 hour dietary recall for two days (including a weekend) and a semi-quantitative food frequency questionnaire (FFQ, including 92 food items). These questionnaires have been validated and used successfully in a national survey before.[17] Dietary forms were completed by a trained nutritionist after interviewing the children's mothers and/or other caregivers. Food intakes were translated into energy and nutrients using Iranian food composition tables.[17] Intake data was compared to dietary reference intake tables.[18,19]

Statistical analyses

Data was expressed as mean ± standard deviation (SD). Normality of data distribution was evaluated using Kolmogrov-Smirnov. Z-scores were calculated using Epi Info (version 3.5.1). Means were compared between two groups using Student *t* test (normal distribution) or Mann-Whitney U test (when distribution was not normal). Comparison of means between more than two groups was done using ANOVA (normal distribution). Proportion of malnutrition between two groups was compared using chi-square test. Differences were considered as significant whenever $p<0.05$. All statistical analyses were carried out using Windows/SPSS ver. 14.

RESULTS

Subjects

Of all children, 48% (n1=139) were between 6-8.9 yrs and 52% (n2=151) were between 9-12 yrs with 53.8% (n1=156) boys and 46.2% (n2=134) girls. The most prevalent cause of motor disability was neurological problems (mostly poliomyelitis, head and spinal injuries) (79%) followed by musculoskeletal disorders (muscular dystrophies, congenital problems) (21%). About 29% of the disabled children in Tehran and Meshed and some 74% of the children in Rasht were able to walk. Swallowing problems were observed in 25.8%, 20.5% and 8.2% of the disabled children in Tehran, Rasht and Meshed, respectively.

Dietary data

Table 1 shows mean energy and some selected nutrient intakes in physically disabled children. Mean daily intakes of vitamin A, iron and calcium in over half of the disabled children were less than 50% of the required

Table 1. Mean and different percentiles of energy and selected nutrient intakes in children with physical disability

Variable	Mean±SD	Percentile					
		5th	15th	25th	50th	75th	95th
Energy (kcal)	1646±532	853	1102	1254	1613	1946	2658
Protein (g)	53.3±18.9	26.7	34.1	40	50.4	63.5	88.8
Fat (g)	58.6±27.5	21.8	29.4	36.9	55.3	72.6	115.0
Carbohydrate (g)	227±71	129	155	169	220	266	366
Calcium (mg)	696±332	261.6	369.1	448.8	658.1	844.9	1351.3
Iron (mg)	8.4±3.2	3.8	4.8	6	7.7	10.7	14
Vitamin A (RE)[†]	713±485	160	264	324	604	976	1657
Vitamin C (mg)	89.7±55.5	20.9	36.2	45.0	76.5	121	209
Vitamin B2 (mg)	1.2±0.5	0.5	0.7	0.9	1.2	1.6	2.2

[†]RE = retinol equivalent

Table 2. Daily intake of selected nutrients in children with physical disability

Nutrient	Intake	
	≤ 50% of Requirement	≤ 75% of Requirement
Vitamin A	41.5%	45.5%
Vitamin B_2	25.2%	34.0%
Vitamin C	12.2%	18.4%
Calcium	57.8%	93.8%
Iron	59.2%	97.3%

Table 3. The amounts of daily intake of and daily needs to energy and selected nutrients in children with physical disability

Variable	Intake	Need	Percent of need
Energy (kcal)	1646±532	1795±813	91.7%
Protein (g)	53.3±18.9	38.8±18.0	137%
Vitamin A (RE)†	713±485	493±65	145%
Vitamin B2 (mg)	1.2±0.5	1±0.2	129%
Vitamin C (mg)	89.7±55.5	36.3±3.4	247%
Calcium (mg)	696±332	918±306	75.8%
Iron (mg)	8.4±3.2	14.3±9.4	58.7%

†RE: retinol equivalent

amounts and for the two latter nutrients, 90% of disabled children received less than 75% of the amounts recommended (Tables 2 and 3). While mean energy intake was more than 90% of the amount required. Mean calcium and iron intakes were 75.8% and 58.7% of the corresponding required amounts. By plotting different intake percentiles versus the recommended intakes it appeared that by receiving 120% of the required energy, only 75% of needed iron would be provided (Figure 1). To receive 100% of the required iron, a disabled child must receive about 1.5 times his or her needed energy! The energy need of a disabled child may be lower than the amount needed for a non-disabled child with the same age and gender though it may increase due to spasticity, convulsions or recurrent infections.[20]

Table 4. Comparison of mean energy and certain selected nutrient intakes between boys and girls with motor disability

Variable	Mean±SD		
	Boys	Girls	*p* value
Energy (kcal)	1709±543	1575±513	0.13
Protein (g)	56.2±19.6	49.9±17.4	0.04
Fat (g)	61.7±27.8	55.0±26.9	0.14
Calcium (mg)	755±324	630±330	0.02
Iron (mg)	8.6±3.4	8.1±3	0.27
Vitamin B_2 (mg)	1.3±0.5	1.1±0.5	0.01
Vitamin C (mg)	89.6±62.8	89.8±46.3	0.98
Vitamin A (RE)†	729±474	695±500	0.60

†RE = retinol equivalent

Comparison of mean dietary intakes between disabled boys and girls revealed that despite absence of significant difference in energy and fat intake, the intakes of protein (p=0.04), calcium (p=0.02) and riboflavin (p=0.01) were significantly lower in girls than in boys (Table 4).

Anthropometry

Mean age, weight, height and BMI of disabled children did not show any significant difference between three cities (Table 5). Only 11.2% of disabled girls' weights were between 3 and 95 percentiles and none of them were above percentile 95. The situation of disabled boys was more or less similar with 73.5% of them under the 3 percentile. However, weight of 2% of them was above 95 percentile. Z score of weight showed that over 40% of disabled girls and boys were underweight while this proportion was previously found to be less than 6% in non-disabled children[16] (Chi square, p<0.001). Very low calorie intake especially in lower percentiles of energy intake in disabled children (table 1) is in good accord with this rather high prevalence of low weight.

Evaluation of height revealed that over 70% of disabled children were below 3rd percentile. However, z-score for height indicated that over 42% of disabled chil-

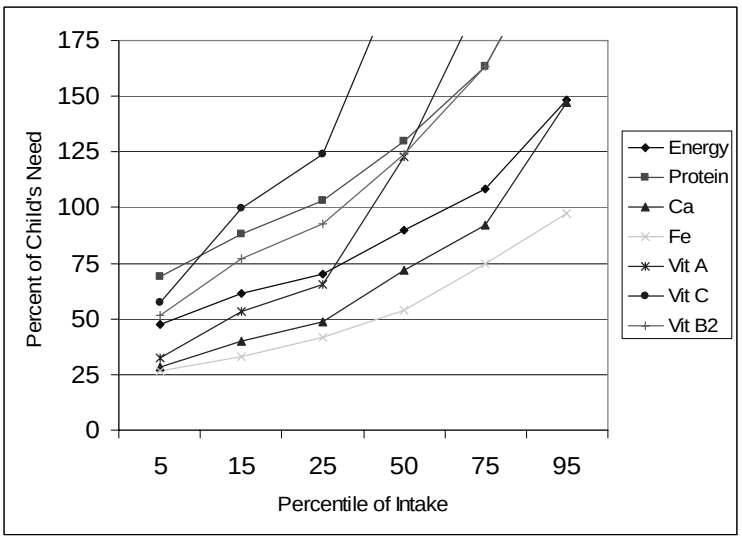

Figure 1. Different percentiles of energy and certain selected nutrient intakes in children with physical disability. To receive 75% of all the nutrients, a disabled child must receive over 100 percent of the calorie needed.

Table 5. Comparison of mean age, height, weight and body mass index of boys and girls with physical disability in Tehran, Meshed and Rasht

	Boys				Girls			
	Tehran (n=77)	Meshed (n=55)	Rasht (n=24)	*p* value	Tehran (n=86)	Meshed (n=30)	Rasht (n=18)	*p* value
Age (yrs)	9.4±2.4	10.4±2.4	10.1±3.2	0.068	9.4±2.2	10.3±2.1	9.6±2.7	0.177
Height (cm)	128±12	133±12	132±19	0.097	125±17	126±14	123±17	0.824
Weight (kg)	26.0±13.8	25.0±8.1	28.7±11.5	0.457	23.0±7.8	23.8±5.8	28.6±12.7	0.062
BMI (kg/m^2)	15.2±6.2	14.6±6.2	17.6±9.4	0.591	18.5±6.2	15.4±6	20.9±12	0.245

Table 6. Comparison of the z scores for weight, height and body mass index between physically disabled and non-disabled children[†]

City	Boys			Girls		
	Non-disabled	Disabled	*p* value	Non-disabled	Disabled	*p* value
Weight						
Tehran	0.2±1.1	-1.6±2.0	<0.001	0.2±1.1	-2.7±1.8	<0.001
Meshed	0.2±1.1	-2.3±1.9	<0.001	0.2±1.1	-2.3±1.9	<0.001
Rasht	-0.4±1.1	-1.2±2.2	0.072	-0.4±1.1	-1.2±2.2	0.072
Total	0.0±1.2	-1.7±2.0	0.001	0.1±1.2	-2.1±1.8	0.001
Height						
Tehran	0.07±1.1	-1.2±1.0	<0.001	0.2±0.9	-1.7±1.4	<0.001
Meshed	-0.5±1.9	-2.2±1.2	0.001	-0.5±2.1	-2.5±2.1	0.010
Rasht	0.0±1.4	-1.4±1.3	0.006	1.6±2.1	-1.8±2.4	<0.001
Total	-0.2±1.3	-1.5±1.2	<0.001	0.3±1.4	-2.0±1.9	<0.001
Body Mass Index						
Tehran	0.2±1.4	-0.6±1.1	0.001	0.2±1.0	-0.6±1.0	<0.001
Meshed	-0.1±1.2	-0.7±1.1	0.070	-0.3±1.0	-0.07±0.7	0.440
Rasht	-0.5±1.1	0.1±1.3	0.077	-0.7± 1.3	0.3±1.3	0.016
Total	0.07±1.1	-0.53±1.2	<0.001	0.05±1.1	-0.21±1.1	0.140

[†]Non-disabled children data were obtained from other study[16]

dren had low height for age and secondly stunting was more prevalent in girls than in boys (46.3% vs. 38.5%, respectively). Prevalence of stunting in physically disabled children was higher in Meshed than in the other two cities. Disabled children in Tehran showed highest prevalence of low weight.

Comparison of these findings with the anthropometric data obtained from other study on determination of height predictors in 730 non-disabled children of the same age group from both sexes from Tehran (n1=543), Meshed (n2=87) and Rasht (n3=100),[15] revealed that (1) the proportion of non-disabled girls whose weights were between 3 and 95 percentiles was dramatically higher compared to disabled girls (64.6% vs. 11.2%, respectively) with 1.9% of non-disabled girls above 95 percentile: (2) Both disabled boys and girls had significantly shorter statures than their non-disabled counterparts (p<0.001); and (3) both disabled boys and girls in Tehran, compared to their non-disabled controls, had significantly lower z scores for BMI (p<0.001). However, when data of the three cities was pulled together, only disabled boys showed lower z scores for BMI compared to their non-disabled counterparts (p<0.001, Table 6).

DISCUSSION

In the current study, anthropometric assessment showed higher prevalence of malnutrition in disabled children compared to non-disabled children. Higher prevalence of under-nutrition, especially in girls, is of great concern. This finding is in accord with lower intakes of protein, calcium and riboflavin in disabled girls than in boys. Protein and calcium are both essential nutrients for many vital processes like growth and bone formation.[21] This finding may indicate lower dietary quality in disabled girls than in boys.

Children with physical disability in Tehran showed the highest prevalence of wasting, based on BMI data and z-score. In this study, only 2% of disabled boys (but not girls) were over-weight while in a cross-sectional study on 278 Egyptian disabled subjects aged 6-24 yrs both under- and over-weight were prevalent.[22] However, in that study children with mental disabilities, Down's syndrome and autism were also included. Obesity has been shown prevalent in children with Down's syndrome.[23,24]

Evaluation of a disabled child's weight may not be as simple as it appears initially as there is no adjusted weight charts available and that is why studies done on disabled children have almost all used non-disabled healthy children's standards.[12,22,25] Though underweight and wasting both indicate poor nutritional status, a child with physical disability with very limited range of motion has a much lower lean body mass (LBM) compared to his or her non-disabled counterpart. Fat mass would inevitably comprise the greater part of the weight gained in a disabled child than in a non-disabled child. The extra weight imposed on disabled child's weak limbs would even more restrict his or her movements. To have a better understanding of a

child's weight status, more precise methods based on body fat mass seems to be necessary.

Remarkable higher prevalence of stunting in physically disabled children (especially in girls) compared to their non-disabled counterparts well indicates chronic nutritional deficiencies. The importance of stunting lies in its late morbidities, including over-weight,[26] and poor psychological functioning.[27]

Eating and swallowing disorders have been reported as common underlying causes of malnutrition in disabled children.[13,28] In the current study only 20% of disabled children were found to have eating problems, but 42% of them had some degrees of stunting. Other factors, notably dietary quality and composition, may have some role.

Comparison of mean intakes and needs to energy and some selected nutrients showed that intake of two essential nutrients, iron and calcium, was less than 75% of the amount needed in 90% of disabled children. On the contrary, further analysis of data from another study on the dietary pattern of school children in Tehran demonstrated that non-disabled children would receive 100% (and often more) of their needs for the nutrients by taking just 75% of their energy need (Figure 2).[29] Meanwhile, comparison of the percentiles of energy and some nutrient intakes between disabled and non-disabled children revealed that dietary intakes in disabled children were significantly (by 20-30%) lower than in non-disabled children ($p<0.01$) (Figure 3). One of the major limitations of this study was that the food composition data bank used did not include zinc, but as zinc and iron share common sources and concomitant deficiency of these two elements occur in most cases,[30,31] it is likely that physically disabled children had some degrees of zinc deficiency. High prevalence of stunting in disabled children well supports this speculation.

Lower intakes of iron, zinc and calcium than the RDA were also reported in Egyptian disabled children.[32] Composition of the child's diet (especially of a disabled one) is highly influenced by his of her caregivers' dietary culture and knowledge as, for instance, in British children with cerebral palsy, intake of micronutrients was good and protein intake in 96% of the subjects was above estimated average requirement (EAR) while only 20% of children were taking enough dietary energy. In other words, nutrient density of their diets was good while en-

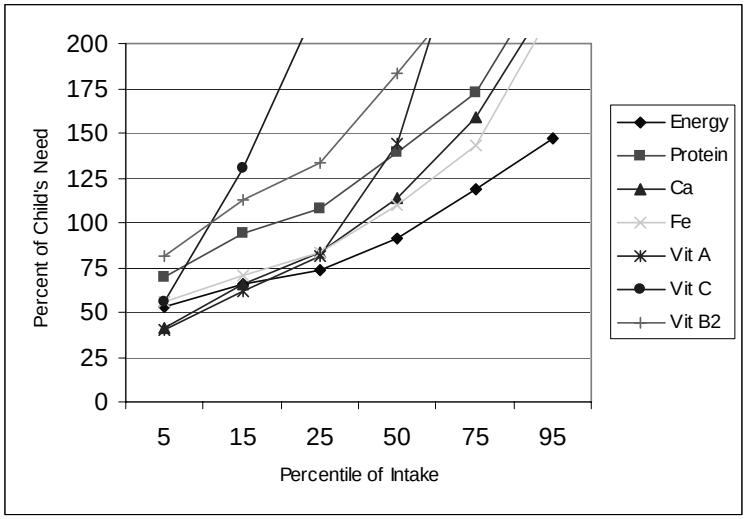

Figure 2. Different percentiles of energy and certain selected nutrient intakes in non-disabled school children in Tehran. By receiving 75% of the energy needed, a child's intake of nutrients will be 100 percent. (Crude data from[30])

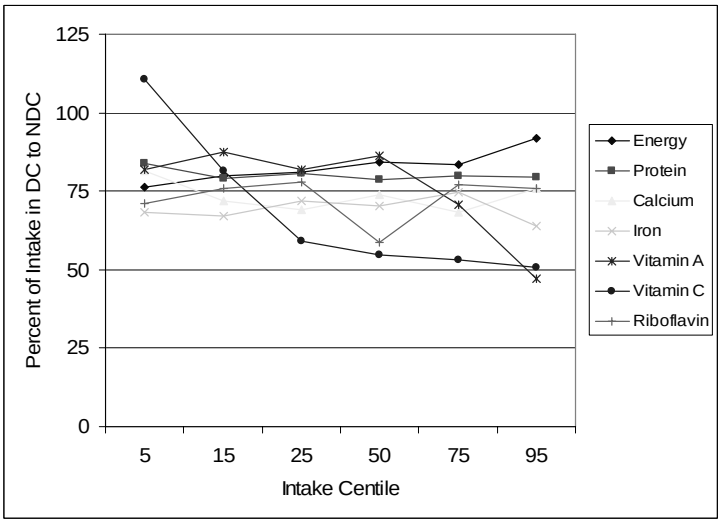

Figure 3. The ratio of different percentiles of dietary intake of energy and certain nutrients in disabled children compared to non-disabled children (crude data on non-disabled children from[30])

ergy intake was poor.[33] Very high intake of vitamin C, also reported by others,[32] was mostly due to fruit juice intake. Juices, though very nutritious, if given to a child in an unsuitable time, e.g. in a short time before meal, may cause early satiety and poor dietary intake. Nutritional education seems necessary for caregivers of disabled children.

It was concluded that malnutrition (low weight and stunting) is quite prevalent among Iranian children with motor disabilities and it is more prevalent in girls than in boys. It seems that food composition is a more important contributing factor than total low calorie intake. These data warrants further study.

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AUTHOR DISCLOSURES

We do not have any duality or conflict of interest.

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Original Article

Nutritional status of the Iranian children with physical disability: a cross-sectional study

Tirang R Neyestani PhD[1], Monireh Dadkhah-Piraghaj MSc[1], Homa Haydari BSc[1], Telma Zowghi BSc[1], Bahareh Nikooyeh MSc[1], Anahita Houshyar-Rad MSc[1], Mohsen Nematy PhD[2], Mohsen Maddah PhD[3]

[1]*National Nutrition and Food Technology Research Institute, Shaheed Beheshti University of Medical Sciences, Tehran, Iran*
[2]*Meshed University of Medical Sciences, Meshed, Iran*
[3]*Guillan University of Medical Sciences, Rasht, Iran*

伊朗肢體障礙兒童的營養評估：橫斷性研究

背景：營養不良可能使肢障兒童更易於患病，因此對孩童本身與其家人更造成痛苦。這是第一篇有關於伊朗肢體障礙兒童之營養狀況的報告。方法：共有 290 名 6-12 歲的男生與女生，來自於德黑蘭、麥什得、雷什特的所有特殊學校的肢障兒童，參與這個描述性的橫斷性研究。飲食的評估是使用 24 小時飲食回憶及飲食頻率問卷。對所有對象評量其身高及體重，並計算出身體質量指數。結果：這些肢障兒童，雖然攝取的平均能量大於 90%的需要量，然而鈣及鐵的攝取只符合需要量的 75.8%和 58.7%。儘管能量及脂肪攝取在男女生之間沒有顯著性差異，但蛋白質、鈣及核黃素的攝取，則是女生顯著低於男生。體重的 Z 分數顯示，超過 40%的男生和女生是體重過輕的。和其他研究的體位測量資料比較，顯示肢體障礙兒童其低體重的情形，比起無障礙兒童更普遍(p<0.001)。此外，有肢體障礙的男生及女生比起無障礙同儕，其身高顯著較矮。結論：營養不足(低體重及矮小)在伊朗肢體障礙兒童是相當普遍的，並且女生比男生更嚴重。造成這個情形，比起低能量攝取，不佳的飲食組成似乎是個更重要的因子。這個數據顯示有需要更進一步的研究。

關鍵字：營養評估、肢體障礙兒童、體位測量、營養不足、飲食