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Effect of Nutrition Intervention on Indices of Growth in Day Care Centers of the City of Birjand, Iran

Bahareh Sasanfar[1,2], Abolghassem Djazayery[3], Azin Nahvijou[2], Ariyo Movahedi[1], Seyyede Somayye Asghari[5], Ahmad Reza Dorosty[3], Mina Minaie[4], Zahra Abdollahi[4], Fatemeh Toorang[2,3*]

[1]*Department of Nutrition, Science and Research Branch, Islamic Azad University, Tehran, Iran.*
[2]*Cancer Research Center, Cancer Institute of Iran, Imam Khomeini Hospital Complex, Tehran University of Medical Sciences, Tehran, Iran.*
[3]*Department of Community Nutrition, School of Nutritional Sciences and Dietetics, Tehran University of Medical Sciences, Tehran, Iran.*
[4]*Department of Nutrition, Ministry of Health and Medical Education, Tehran, Iran.*
[5]*Faculty of Health, Birjand University of Medical Sciences, Birjand, Iran.*

A B S T R A C T

Background: Childhood malnutrition is the main risk factor for impaired mental and physical growth and several diseases and leads to premature death worldwide. Therefore, reducing childhood malnutrition is a top priority in most countries. In this regard, several studies have explored the effects of nutritional intervention on reducing childhood malnutrition, although mostly in controlled conditions and with small sample sizes. Data on community-based interventions are limited. In this study, we investigated the effects of providing hot meals at lunchtime on the growth of children in day care centers in rural areas of the city of Birjand, Iran.

Methods: This was a quasi-experimental study. Hot meals were offered for 6 months to all the children (n = 1809) in day care centers of rural Birjand. Height and weight of the children were measured before and after the intervention. Z-score indicators were calculated using WHO Anthro and Anthro plus software packages. SPSS was used for data analyses.

Results: Prevalence of wasting and stunting decreased after the intervention in both sexes. The decrease in stunting prevalence was significantly greater in boys than in girls. However, proportions of various categories of height-for-age Z-score (HAZ) did not change significantly in either sex. In both sexes, weight, height, body mass index, and weight-for-age improved significantly after the intervention. The prevalence of obesity and overweight did not change after the intervention.

Conclusion: Based on the findings, providing hot food at lunchtime in day care centers can reduce wasting and stunting in children in rural regions of Birjand, Iran.

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Introduction

The health of children is a top priority in human development because they make up a large percent of the world population [1]. Moreover, their health is an important factor in the development of a country, as they are its future workforce. Children are extremely sensitive to nutrition as they need a balanced diet to achieve their normal physical and mental growth [2]. Malnutrition is defined as deficiency, imbalance, or excess of macronutrition and micronutrients that affect body shape and clinical profile [3]. All age categories could experience malnutrition, but due to the rapid semi-linear growth of infants and children, they are more affected by or sensitive to malnutrition [4]. Hence, decreasing childhood malnutrition has been noted in two of the United Nations Millennium Development Goals, namely, "eradicate extreme poverty and hunger" and "reduce child mortality" [5-6]. Malnutrition is a

*Corresponding author.
E-mail address: f.toorang@gmail.com

major cause of death in children under 5 years [7], meaning that 5 million deaths could be prevented worldwide if malnutrition were controlled in this age group. Nutritional status of children is determined by stunting (low height-for-age), underweight (low weight-for-age), or wasting (low weight-for-height), which are indicators of chronic, severe acute, and the coincidence of acute plus chronic malnutrition, respectively [3].

The annual report of UNICEF in 2014 showed that the worldwide prevalence rates of stunting, wasting, and underweight were 25%, 8%, and 15%, respectively, [8]. While the World Health Organization (WHO) estimated that about half of the 161 million stunted children in 2013 lived in Asia, the World Bank placed Iran among countries with low prevalence of stunting (4%) in its 2013 report [9]. In Iran, a meta-analysis showed 10.5%, 7.8%, and 12.4% of Iranian children were underweight, wasted, and stunted, respectively [10].

Several studies have shown that nutritional intervention is effective in the prevention and control of malnutrition in a controlled situation in several regions of the world [1, 11-14]. However, it is not clear whether nutrition intervention can be effective in all populations, as cultural and environmental factors can modify the effects. Moreover, most of the studies have used small sample sizes and were not community-based. The results of the limited number of community-based studies have been contradictory. For example, in Mexico, despite the implementation of such programs for a long time (40 years), stunting and anemia are still highly prevalent [15]. In contrast, a program involving giving fortified food and nutrition supplements to children, pregnant women, and lactating women resulted in enhanced growth and reduction of anemia rates in rural children of Mexico [16]. A large community-based study investigated the effects of an intervention program in 8274 children with severe acute malnutrition children in India and resulted in decreased mortality and increased cure rates in children [17].

Birjand is the capital of South Khorasan province in Iran, with a population of 187,020 (2013) and mainly of low socioeconomic status. Birjand is one of the most deprived cities in Iran. It is important to know that health and economic status of Iran's provinces are markedly different [18-19]. Studies have reported that household socioeconomic status is the main factor affecting children's nutritional status; therefore, most studies have attempted to implement nutrition programs in areas of low socioeconomic status.

Considering the high prevalence of undernutrition in Birjand, particularly in rural areas, the Ministry of Health and Medicinal Education implemented intervention programs in Birjand. The aim of this study was to assess the effectiveness of a food intervention in the form of providing a hot meal at lunchtime to children aged 2-5 years in rural day care centers of Birjand.

Methods

This quasi-experimental study was jointly funded by the Ministry of Cooperatives, Labor, and Social Welfare and the Ministry of Health and Medicinal Education. The intervention consisted of serving a mixed dish (hot meals) at lunchtime for 6 months in day care centers in rural areas of Birjand.

The hot meals provided 395 ± 50 kcal and 19.4 ± 4 grams of protein. A nutritionist supervised the program at each center, and the meals were cooked and served hot at the centers. Meals included macaroni with meat or soya, legumes, chicken soup, or rice and stews. Fruits were served only once a week and yogurt was served twice a week. The caregivers observed the children to make sure they finish their meals. However, some children did not eat the food completely, and unfortunately we have no data on the amount of food eaten by children.

As we could not exclude any child in a day care center, we included all the children from all day care centers in Birjand. The study included 1809 children aged 2-5 years old. As the intervention was carried out at day care centers, and as the idea of a hot meal was attractive to the parents, nobody withdrew from the study. Weights and heights of the participants were measured using a Seca scale with a precision of 0.1 kg and a Seca body meter with a precision of 0.1 cm before and after the intervention. Anthropometric assessments were done in the morning, as the children entered the center, and before eating anything. Weight was measured in light clothing, without shoes, hats, or bags, and height was measured without shoes. Height-for-age, weight-for–age, and body mass index (BMI)-for-age were calculated using WHO Anthro V.3.2.4. All data were stratified according to the WHO Child Growth Standards [20]. Z-scores were interpreted as defined in (Table 1).

Height-for-age Z-scores (HAZ), weight-for-age

Z-scores (WAZ), and BMI-for-age Z-scores (BAZ) were calculated for all the children, while weight-for-height Z-scores (WHZ) were calculated for 698 children at baseline and 479 children after the intervention.

Ethics: All parents of the children signed an informed consent letter before the intervention started. Data were kept private and would not be used except for research purposes.

Statistical analysis: Outcomes were analyzed using IBM SPSS statistics software (V.24, Chicago, IL). Changes in the indicators of nutritional status over the intervention period were evaluated using the McNemar test at a 5% significance level.

Study power: Assuming a 15% change in frequencies, a type I error (α) of 5%, a design effect of 1.5, and a power of 80%, about 1809 children were allocated in two sex groups.

Results

Totally, 1809 children (881 boys and 928 girls) aged 2-6 took part in this intervention, and nobody withdrew from the study. (Table 2) shows the nutritional status of the children based on WHZ. About 10% of the participants were moderately to severely underweight at baseline, which decreased to 7.1% after the intervention. As shown in (Table 3), malnutrition was more prevalent in girls than in boys. Girls showed a rather higher prevalence of moderate to severe wasting at baseline, but they achieved better growth after the intervention.

Based on WAZ, the percentage of children with moderate to severe underweight was almost 14%, which decreased to 12% after the intervention. However, the prevalence of obesity and overweight did not change after the intervention (Table 4). As (Table 5) shows, the overweight prevalence was higher in boys than in girls.

There were no significant changes in HAZ after the intervention (Table 6).

With regard to BAZ criterion, the prevalence of moderate to severe wasting decreased from 9.62% to 6.85%, but the prevalence rates for obesity and overweight did not change significantly (Table 7).

Table 1. Interpretation of Z-scores

Z-score	Height for Age	Weight for Age	Weight for Height	BMI for Age
Above 3	Tall	Obese	Obese	Obese
2 to 3	Normal	Overweight	Overweight	Overweight
1 to 2	Normal	At risk of overweight	At risk of overweight	At risk of overweight
1 to -2	Normal	Normal	Normal	Normal
-2 to -3	Stunted	Underweight	Wasted	Wasted
Below -3	Severely stunted	Severely underweight	Severely wasted	Severely wasted

Based on WHO recommended interpretation guidelines

Table 2. Weight-for-height Z-scores of 2- to 5-year old children based on WHO indicators in Birjand day care centers before and after the intervention

Weight status	Before (N = 698)		After (N = 479)		P value
	Frequency	%	Frequency	%	
Severe wasting	17	2.44	6	1.25	0.07
Moderate wasting	56	8.02	28	5.85	0.07
Normal	549	78.65	370	77.24	0.28
At risk of overweight	64	9.17	51	10.65	0.20
Overweight	8	1.15	19	3.97	0.0007
Obese	4	0.57	5	1.04	0.18

Table 3. Changes in weight-for-height Z-scores of 2- to 5-year-old children after the intervention in Birjand day care centers, by sex

Nutritional Status	Before				P value	After				P value
	Boys		Girls			Boys		Girls		
	Frequency	%	Frequency	%		Frequency	%	Frequency	%	
Severe wasting	11	3.08	6	1.76	0.12	2	0.78	4	1.79	0.16
Moderate wasting	21	5.88	35	10.26	0.01	12	4.69	16	7.17	0.12
Normal	285	79.83	264	77.42	0.21	201	78.52	169	75.78	0.23
At risk of overweight	34	9.52	30	8.80	0.37	26	10.16	25	11.21	0.35
Overweight	5	1.40	3	0.88	0.25	12	4.69	7	3.14	0.19
Obese	1	0.28	3	0.88	0.14	3	1.17	2	0.90	0.38
Total	357	100.00	341	100.00		256	100.00	223	100.00	

Table 4. Changes in weight-for-age Z-scores of 2- to 5-year-old children in Birjand day care centers after the intervention

Weight Status	Before (N = 1809)		After (N = 1809)		P value
	Frequency	%	Frequency	%	
Severe underweight	55	3.04	40	2.21	0.05
Moderate underweight	196	10.83	170	9.40	0.07
Normal	1458	80.60	1502	83.03	0.02
At risk of overweight	82	4.53	79	4.37	0.40
Overweight	10	0.55	12	0.66	0.33
Obese	8	0.44	6	0.33	0.29

Table 5. Changes in weight-for-age Z-scores of 2- to 5-year-old children after the intervention in Birjand day care centers, by sex

Nutritional Status	Before				P value	After				P value
	Boys		Girls			Boys		Girls		
	Frequency	%	Frequency	%		Frequency	%	Frequency	%	
Severe underweight	29	3.29	26	2.80	0.27	23	2.61	17	1.83	0.12
Moderate underweight	98	11.12	98	10.56	0.35	83	9.42	87	9.38	0.48
Normal	697	79.11	761	82.00	0.06	725	82.29	777	83.73	0.20
At risk of overweight	47	5.33	35	3.77	0.05	40	4.54	39	4.20	0.36
Overweight	6	0.68	4	0.43	0.23	5	0.57	7	0.75	0.31
Obese	4	0.45	4	0.43	0.47	5	0.57	1	0.11	0.04
Total	881	100.00	928	100.00		881	100.00	928	100.00	

Table 6. Changes in height-for-age Z-scores of 2- to 5-year-old children after the intervention in Birjand day care centers, by sex

Height Status	Before				P value	After				P value
	Boys		Girls			Boys		Girls		
	Frequency	%	Frequency	%		Frequency	%	Frequency	%	
Severe stunting	58	6.58	61	6.57	0.49	58	6.58	53	5.71	0.22
Moderate stunting	102	11.58	105	11.31	0.42	101	11.46	109	11.75	0.42
Normal	702	79.68	745	80.28	0.37	705	80.02	749	80.71	0.35
Tall	19	2.16	17	1.83	0.30	17	1.93	17	1.83	0.43
Total	881	100.00	928	100.00		881	100.00	928	100.00	

Table 7. Changes in BMI-for-age Z-scores of 2- to 5-year-old children after the intervention in Birjand day care centers, by sex

BMI status	Before (N= 1809)		After (N= 1809)		P value
	Frequency	%	Frequency	%	
Severe underweight	48	2.65	33	1.82	0.04
Moderate underweight	126	6.97	91	5.03	0.007
Normal	1472	81.37	1476	81.59	0.43
At risk of overweight	128	7.08	158	8.73	0.03
Overweight	24	1.33	38	2.10	0.03
Obese	11	0.61	13	0.72	0.34
Total	1809	100.00	1809	100.00	

BMI, body mass index

Discussion

This study illustrated that the prevalence of malnutrition in children aged 2-5 years decreased following a nutrition intervention in Birjand day care centers. The frequencies of severe and moderate wasting decreased after the intervention. Although the percentage of severe and moderate underweight decreased, the rate of stunting did not change significantly.

Surprisingly, despite the improvement in most nutritional indicators, the frequency of moderate stunting increased and severe stunting had a small improvement after the intervention. However, it is known that low height-for-age (stunting) is an indicator of chronic malnutrition, therefore insufficient dietary intake over a long period will result in stunting. A meta-analysis showed that protein-based interventions implemented after age 24 months had a desirable effect on stunting [21]. Generally, it is assumed that an improvement in this indicator needs more than 6 months of intervention, hence our intervention was too short to affect the stunting status of the population.

Our results also showed statistically significant improvements in WHZ and WAZ post intervention, with the improvement in WHZ

being greater than in WAZ. A study in 2011 estimated an underweight prevalence of 3.6% (severe underweight 3.1% and moderate underweight 5%) in Birjand [22]. Our study is similar to Payandeh et al [23], who showed a high risk of stunting in children in Iran. Overall, all scores improved after the intervention.

Ghodsi et al [24] assessed the effectiveness of a national program in improving nutritional status in children under 5 years old in Iran. They found that the nutritional status of children improved after the intervention and that most of the children became malnourished after exclusion from the program. Food baskets were given to low-income families in that program. A meta-analysis assessed the impact of nutrition-based interventions on the growth of children aged ≥2 years [25]; they could not exactly demonstrate the effect of nutritional intervention on growth because of heterogeneity of the interventions including Pediasure (which is a balanced nutritional powder used for complete or supplement nutrition), fat, ready-to-use therapeutic foods, additional meals, or the addition of sorghum to the diet. They found that the majority of interventions did not have a proper design. They also found that interventions including iron, calcium, or iodine supplements did not improve linear growth, whereas an intervention based on zinc, vitamin A, multiple micronutrients, and protein had a significant positive effect on height. Each type of macronutrient or micronutrient has a critical role in normal growth. Nutritional deficiencies may have different effects. For example, iron deficiency affects immunity and appetite, zinc deficiency affects linear growth, vitamin A deficiency increases the risk of infection and diarrhea, etc. Nutrient deficiencies do not occur in isolation usually. Therefore, improving children's growth is achieved when nutritional interventions take into account all macronutrient and micronutrient needs of children.

In our study, the baseline prevalence of overweight and obesity was 1.15% and 0.57%, respectively, while another cross-sectional study of 500 children aged 2-5 years reported the prevalence of overweight at 10.6% and obesity at 7.6% in Birjand [26]. In Tehran, the capital of Iran, the results have been different. A cross-sectional study with 4656 Tehrani children in 2012 showed that the prevalence of overweight and obesity was 12% and 23.7%, respectively [27]. However, we studied the rural part of Birjand. It is clear that obesity is more common in urban areas. This indicates the importance of socioeconomic conditions to the growth of children. Even after the intervention, the overweight and obesity prevalence was 3.97% and 1.04%, respectively.

In our study, the prevalence of wasting was 10.46% and of underweight was 13.87% respectively, while the corresponding proportions in Mashhad were 4.3% and 4.3%, respectively [28]. Although Birjand is near Mashhad, the health status of the population is not similar to that in Mashhad. Underweight, stunting, and wasting were more prevalent in Birjand [23], but stunting was more prevalent than wasting and underweight in both studies. The socioeconomic status of the Birjand population is worse than the Mashhad population, which may explain these differences.

Studies have shown that interventions during early infancy and early childhood have a greater impact as regards the prevention of childhood malnutrition [29]. In Iran, studies have indicated that the risk of malnutrition increases from the age of starting complementary feeding. This is because of mothers' insufficient knowledge about complementary feeding and nutritional needs of children. In this regard, educational programs and interventions for low-income households can be effective in decreasing malnutrition prevalence in this group. As regards the relative success of these intervention programs, it might have been more successful if food intervention had accompanied nutrition education. On the other hand, many studies have reported the success of micronutrient interventions involving vitamin A, zinc, calcium, iron, iodine supplements, or fortified foods in enhancing children's growth [30-35]. Prevention of malnutrition in the first two years of life can reduce the risk of malnutrition beyond the age of 2, so efforts to reduce it in the early years of life can be more beneficial.

A limitation of this study was the absence of a control group. Studies like this should have a control group in order to be able to explain the changes in measured outcomes related to the variation of the effect factors. For example, the socioeconomic status of a family or the economic condition of the population could affect child growth independent of nutritional interventions. Of course, the indicator weight-for-height, which was calculated in this study, may compensate for the absence of a control group in our study. The strength of this study was providing children with hot food in day care

centers because a food basket might have been shared with other members of the household or even sold.

Malnutrition in earlier years of life could affect health in the entire life span; therefore, comprehensive programs for preschool children might have a preventive effect. The prevalence of all forms of malnutrition (wasting, stunting, and underweight) is high in this region of Iran, hence policymakers should plan suitable supportive programs, such as food donations to at-risk children, particularly those 2 to 6 months old. The foods should be rich in macronutrients and micronutrients [36-39].

In summary, this intervention resulted in a 3% and 2% improvement in weight-for-height and weight-for-age indices, respectively. Although wasting was more common among girls before the intervention, it showed greater improvement after the intervention.

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Conflict of interest

None of authors have conflict of interests.

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