An intervention Program to Improve the Nutritional Status of Children Aged 2-6 Years in Day Care Centers of East Azerbaijan Province of Iran

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Abstract

Introduction: Child health is very important in all societies which is influenced by the interaction of multiple factors. Good nutrition for children is one of the most important and influential factors in the health of children in this study to evaluate the effectiveness of one meal warm food for the rural kindergarten of the East Azerbaijan Province of Iran on anthropometrics indices of children have been carried out.

Methods: In this cross-sectional study, anthropometric z scores of 7116 children were measured by using WHO Anthro and Anthro plus software based on WHO 2007 standards and analyzed using SPSS.

Results: Based on the present findings, 8% of children showed moderate to severe lower weight for height. Also, girls showed more severe underweight than boys. BMI-for-age children from approximately 5% of moderate to severe underweight has decreased to about 3%. The frequency of normal children increased from 85% to about 86%. The prevalence of overweight and obesity were observed after the intervention reduced slightly. Also, the percentage of overweight of children in the study was lightly changed to obese. Between the two genders, male and female, overweight and obesity in boys found higher than girls, and relatively similar trends have continued after the intervention. This project was successful to lower moderately severe wasting in children based on body mass index from 7% to about 5%. The slight increase in the scale of overweight and obesity and a half percent of overweight children after the program was shown. Even though boys showed a higher increase of obesity and overweight than girls, reduction of moderate and severe underweight found similarly in both genders.

Conclusion: Due to the relative success of the present intervention plan, nutritional education along these kinds of projects may improve the nutritional status of children in society and prevent pediatric malnutrition.

Keywords: *Obesity, Overweight, Pediatric, Malnutrition, Underweight*

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Introduction

Early childhood growth and development is indispensable to a healthy body and mind later in life[1]. While there are guidelines for the average expected weight and height growth during the early childhood years, many children grow at their own rate. It is normal for children to have growth spurts during their youth, most often at diverse times than other children. Children grow and develop in a unique, individualized manner[2]. There is no doubt that sufficient dietary intake and respectable nutritional status are the most key factor for healthy growth, and development of children, which could also influence adult health. Undernutrition is one of the most important public health problems and contributes to nearly half of all deaths in children under 5 and is widespread in Asia and Africa. This translates into the excessive loss of about 3 million young lives a year. Undernutrition puts children at greater risk of dying from common infections, increases the frequency and severity of such infections, and contributes to delayed recovery. In addition, the collaboration between undernutrition and infection can create a potentially fatal cycle of aggravate illness and deteriorating nutritional status[3]. Children with subclinical deficiency of micronutrients are more vulnerable to develop frequent and more severe common day-to-day infections[4]. Malnutrition is not only in charge of the utmost mortality

rate in children and has long-lasting physiologic effects, including an increased susceptibility to fat accumulation mostly in the central region of the body, lower fat oxidation, lower resting and postprandial energy expenditure, insulin resistance in adulthood, hypertension, dyslipidemia and a reduced capacity for manual work, among other impairments[5].

Undernutrition, including vitamin and mineral deficiencies, conduces to about one-third of all child mortality, and ruins healthy development and life-long productivity. At the same time, growing rates of overweight are linked to a rise in chronic diseases. The result is a double burden of malnutrition[6].

Thus, childhood diet needs to be taken seriously in order to improve a nation's health as well as producing bright and active children. Moreover, low nutritional status in childhood can affect the brain development that control the fine motor functions[7]. This effect can be seen after several years of undernutrition. Furthermore, the poor nutritional status of the children also can become a risk for them to develop obesity as it has shown that most of the obese adults that had metabolic syndrome were found to have lower weight and BMI during their childhood aged compared with those who did not develop the syndrome[8]. Recent reviews of how infant size and growth related to later risk of obesity focused on heavy rather than undernourished children and included very few studies of adults or people from low-income and middle-income countries[9–11]. In nearly all studies, larger size and growth rates were directly associated with increased risk of obesity in later life. By contrast, linear growth retardation in the first 2 years of life is associated with lower lean body mass in adulthood. The wasting rate in Southern Asia is approaching a critical public health emergency.

A key indicator of chronic malnutrition is stunting - when children are too short for their age group compared to the WHO child growth standards. Stunting, low weight and low birth weight (LBW) are together responsible for 2.2 million deaths among children (<5 y) worldwide and for 21% of disability-adjusted life years (DALYs)[12]. One DALY is equivalent to the loss of one year of healthy life. Apart from the serious consequences on a person's health, the economy is also affected by undernutrition, because the high prevalence of this condition hinders economic development and perpetuates poverty, both directly, through a loss of productivity due to poor physical condition, and indirectly, through poor cognitive function and learning deficits. Furthermore, undernutrition increases health expenses[13]. On the other hand, the worldwide prevalence of obesity has been increasing in countries with a low per capita income, a state that coexists with undernutrition[14]. In the past, obesity was found only in affluent societies with an abundant energy intake, whereas obesity is now frequently linked to stunted in countries with a low per capita income and high food insecurity[15]. The co-existence of low body weight and/or stunting and obesity in poor populations has been described in Asia, China, Africa and, above all, in Latin America[14].

Figure 1- Worldwide prevalence of wasted children under 5, by United Nations sub-region, 2015

Adapted from UNICEF, WHO, World Bank Group joint malnutrition estimates, 2016 edition

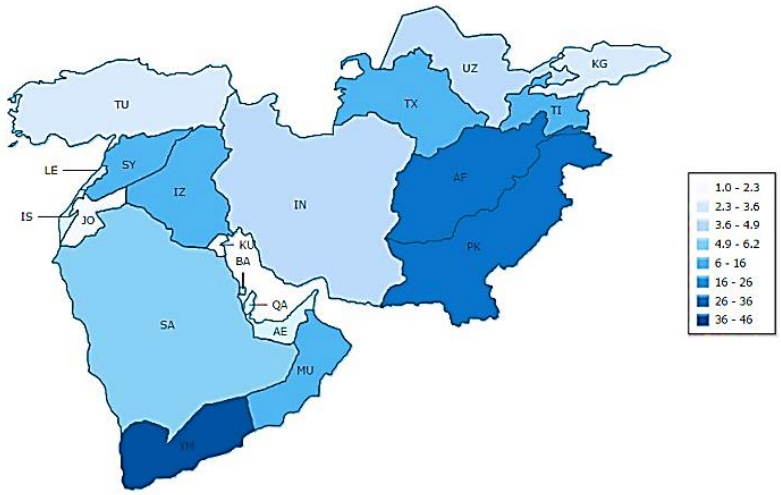

Figure 2- Prevalence of underweight children under 5 years old in the middle-east countries

Adapted from CIA World Factbook, Jan. 2014

Due to all above mentioned importance of pediatric malnutrition, most countries have coped programs and strategies to prevent childhood malnutrition, which was supported either nationally or internationally through WHO, UNICEF and so on. For instance, in Alexandria, Egypt, an intervention program has done to improve nutritional status of children aged 2-5 years[16]. A package of interventions was proposed to reduce undernutrition and micronutrient deficiencies useful under different epidemiological contexts in Mexico[17]. Fortunately, the South Asia and Middle East and North Africa regions have both achieved more than a one-third reduction in stunting prevalence since 1990[18].

Apart undernutrition situation, rates of overweight continue to rise across all regions. Overweight was once associated mainly with high-income countries, but in 2011, 69% of the global burden of overweight children under 5 years old were in low- and middle-income countries. However, the prevalence of overweight stays higher in high-income countries (8%) than in low-income countries (4%)[18].

In this study, the effectiveness of food aid baskets in child day care centers of the rural area of West Azerbaijan province of Iran on anthropometrics indices of children has been carried out.

Materials and Methods

In this cross-sectional study, the Ministry of Health and Medicinal Education of Iran has done an intervention through financial support from the Welfare Organization of Iran (WOI) in a period of 6 months. All the rural day care centers were asked to serve a warm food dish for their children at the centers, which was founded by WOI and planned by a nutritionist in each center.

Weight and height of all registered kids were measured before and after intervention. The weight was measured using the Seca weighing scale to the nearest 0.1 kg. The height was measured using the Seca Bodymeter to the nearest 0.1 cm. For under 5 years children anthropometric Z scores, including weight for age (WAZ), height for age (HAZ), and BMI for age (BAZ) were added by using Anthro V.3.2.4 and for above 5 years old using Anthro Plus V.1.04 software of the World Health Organization. All of these data categorized based on WHO child growth standards guideline[19].

Body fat percentage of above 5 years old children and lean body mass was calculated based on Deurenberg[20] and Peters *et al.*[21] formulas respectively.

Statistical analysis

Data were expressed as Means±SEM and Frequencies, by using IBM SPSS Statistics Software (V.23, Chicago, IL). Statistical differences between "Before" and "After" intervention were determined by using McNemar and independent sample T-tests. Differences between groups were considered significantly different when the P value was less than 0.05.

Results

As Figure 3 shows, close to 90% of children had a normal BAZ score and overweight/obese or underweight children were almost similar among them. Among overweight/obese children, boys showed a higher rate of obesity than girls which is illustrated in Figure 4.

Body fat percentage revealed interesting results. As Figure 5 shows about 5% of ≥5 years old boys had higher body fat while less than 1% of girls showed high body fat. Based on Figure 6, despite a smooth increase in body

fat percentage after intervention in both genders, the number of lower body fat among boys was increased slickly as well.

As Table 1 shows, based on the present findings, about 3% of 7116, 2-6 years old children showed moderate to severe lower weight for age Z score. Also, girls showed more underweight than boys. Fortunately, after intervention, promising result was found and this range declined to half ($p<0.0001$). In the same time, the numbers of children with overweight risk were increased smoothly ($p>0.05$). BMI-for-age children from approximately 5% of moderate to severe underweight has decreased to about 3% ($p<0.05$).

No significant change was found in the frequency of normal children ($p>0.05$). As Table 2 shows, severe stunting was decreased and normal HAZ was gently increased.

As Table 3 shows, the prevalence of both Sever/Moderate Lean and overweight/obese children was changed positively. Overweight/obese children were higher among boys than girls, and relatively similar trends have continued after the intervention. This project was successful to lower moderately severe wasting in children based on body mass index from 7% to about 5%. The slight increase in the scale of overweight and obesity and a half percent of overweight children after the program was shown.

Even though boys showed a higher increase of obesity and overweight than girls, reduction of moderate and severe underweight found similarly in both genders.

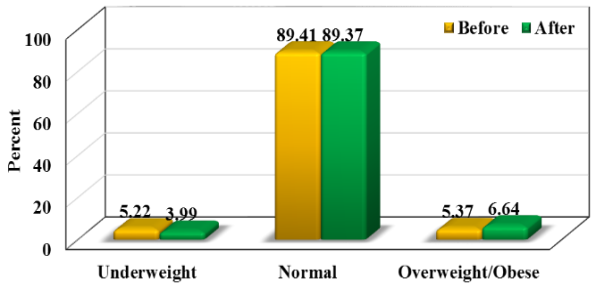

Figure 3- Gender-based comparison of the BAZ of Studied Children

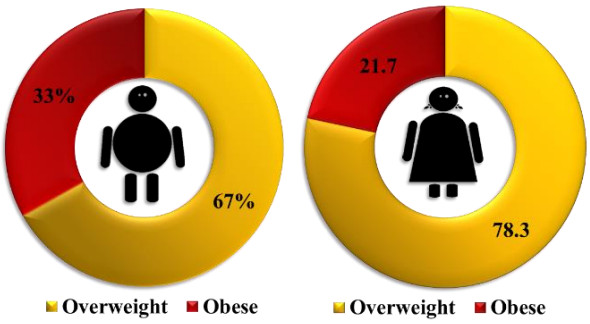

Figure 4- Gender Based Comparison the Prevalence of Overweight and Obesity among at Risk Children

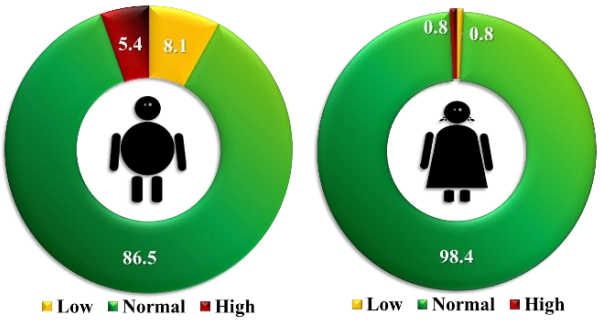

Figure 5- Gender Based Comparison the Prevalence of Body Fat of 5-6 Years Old Studied Children before Intervention

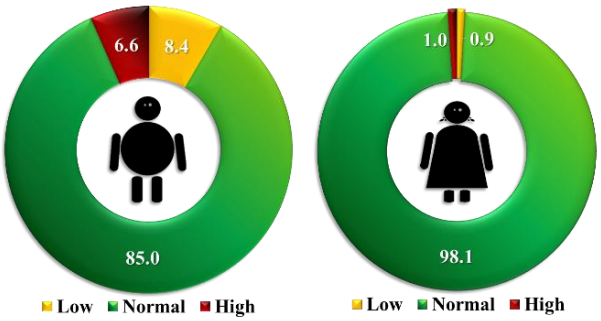

Figure 6- Gender Based Comparison the Prevalence of Body Fat of 5-6 Years Old Studied Children after Intervention

Table 1- Gender Based Comparison of Weight for Age Status Before and After the Intervention

Status	Before						After					
	Boy		Girl		Total		Boy		Girl		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Severe Underweight	16	0.46	6	0.17	22	0.31	12	0.34	3	0.08	15	0.21
Moderate Underweight	68	1.94	86	2.38	154	2.16	53	1.51	54	1.50	107	1.50
Normal	2948	83.99	3125	86.66	6073	85.34	2908	82.85	3102	86.02	6010	84.46
Possible Weight Risk	478	13.62	389	10.79	867	12.18	537	15.29	447	12.4	984	13.83

Table 2- Gender Based Comparison of Height for Age Status Before and After the Intervention

Status	Before						After					
	Boy		Girl		Total		Boy		Girl		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Sever Stunted	55	1.57	30	0.83	85	1.19	42	1.20	27	0.75	69	0.97
Stunted	166	4.73	177	4.91	343	4.82	169	4.81	180	4.99	349	4.90
Normal	3256	92.76	3363	93.26	6619	93.02	3275	93.30	3370	93.46	6645	93.38
Tall	33	0.94	36	1.00	69	0.97	24	0.68	29	0.80	53	0.74

Table 3- Gender Based Comparison of BMI for Age Status Before and After the Intervention

Status	Before						After					
	Boy		Girl		Total		Boy		Girl		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Sever Lean	56	1.60	47	1.30	103	1.45	55	1.57	31	0.86	86	1.21
Moderate Lean	130	3.70	138	3.83	268	3.77	90	2.56	108	3.00	198	2.78
Normal	2533	72.17	2838	78.70	5371	75.48	2418	68.89	2750	76.26	5168	72.63
At risk of overweight	532	15.16	459	12.73	991	13.93	624	17.78	567	15.72	1191	16.74
Overweight	200	5.70	107	2.97	307	4.31	246	7.01	130	3.61	376	5.28
Obese	59	1.68	17	0.47	76	1.07	77	2.19	20	0.55	97	1.36

Table 4- Gender Based Comparison of Tested Variables Before and After the Intervention

Variable	Boys			Girls			Total		
	Before	After	P	Before	After	P	Before	After	P
Weight	19.15±3.20	20.36±3.37	0.0001	18.53±3.14	19.71±3.27	0.0001	18.84±3.19	20.03±3.34	0.0001
Height	110.67±7.85	113.23±7.84	0.0001	109.79±7.71	112.34±7.69	0.0001	110.23±7.79	112.78±7.78	0.0001
BMI	15.61±1.84	15.86±1.93	0.0001	15.34±1.78	15.60±1.85	0.0001	15.47±1.81	15.73±1.90	0.0001
Body fat (%)	17.23±0.05	17.39±0.05	0.034	20.50±0.05	20.64±0.05	0.059	18.88±0.04	19.02±0.04	0.016
Lean body mass	4.37±0.01	4.62±0.01	0.0001	4.25±0.01	4.50±0.01	0.0001	4.31±0.007	4.51±0.008	0.0001
Weight for Age	-0.03±1.04	0.06±1.03	0.001	-0.15±0.96	-0.05±0.93	0.0001	-0.09±1.00	0.00±0.98	0.0001
Height for Age	-0.18±1.23	-0.21±1.20	0.382	-0.19±1.20	-0.20±1.16	0.569	-0.18±1.22	-0.21±1.18	0.307
BMI for Age	0.11±1.34	0.25±1.35	0.0001	-0.07±1.16	0.08±1.14	0.0001	0.02±1.25	0.16±1.25	0.0001

Based on Table 4, despite insignificant changes of body fat percentage among girls (p=0.059), it has significant change among boys (p=0.034). Fortunately, lean body mass has increased in both genders (p=0.0001). After intervention, both WAZ and BAZ has improved significantly (p=0.0001) while HAZ did not change (p=0.307). Overall, food aid support in this study showed significant improvement in children's growth.

Discussion

Substantial global development has been made in dropping child deaths since 1990. The number of under-5 deaths worldwide has declined from 12.7 million in 1990 to 5.9 million in 2015–16000 every day compared with 35000 in 1990. Since 1990, the global under-5 mortality rate has fallen 53%, from 91 deaths per 1,000 live births in 1990 to 43 in 2015[3,22]. Therefore, malnutrition is the most lethal form of malnutrition.

Nutritionally-related health patterns in the Middle East have changed significantly during the last two decades. The main forces that have contributed to these changes are the rapid changes in the demographic characteristics of the region, speedy urbanization, and social development in the absence of steady and significant economic growth[23]. These changes are mirrored in nutritional and health upshots. Rising obesity rates and high levels of chronic and degenerative diseases are observed. These pressing factors that include the nature and changes in the food eating pattern, globalization of the food supply, and the inequity in health care will be debated. While several countries of the region have obesity rates exceeding 30%, rates of undernutrition, particularly stunting, among under-five children in low- and middle-income countries remain high[24]. The present study, likewise global data, stunting was the major risk. Payandeh *et al.* also found high risk of stunting in Iranian children[25]. Prevalence estimations for stunting and overweight are relatively robust. It is, therefore, possible to track global and regional changes in these two conditions over time[26]. A key indicator of chronic malnutrition is stunting based on the WHO child growth standards. Weight and height both reflect the size of the individual. However, weight by itself is a poor indicator of thinness or obesity. Moreover, despite the benefits of BMI in this issue, due to the effect of height on BMI for age of children, reports about obesity and overweight could be a false alarm in some of studies due to low HAZ. Even in normal WAZ for children, low HAZ lead to higher BAZ.

The prevalence of underweight in the studied population was much lower than a whole country (2.5 *vs* 4.9) which might be due to the better economic situation of this provenience of Iran. East Azerbaijan has many industries and land farms in which make people in a better economic situation than some other proveniences. A similar explanation could be used for differences between the present study and a recent study in Bandar Turkmen district[27–29].

Body fat always has shown a strong relation with BMI[30,31]. Lower WAZ and BAZ of girls as compared to boys describe the reason of lower body fat percentage in this gender, which needs to be noted by public health policy makers. Although in the present study both LBM and body fat were calculated indirectly based on mathematical equations, the results could be used as screening alarm for the future studies. Using body image analyzer (BIA) for coming studies is recommended.

Due to the relative success of the present intervention plan, nutritional education along these kinds of projects may improve the nutritional status of children in society and prevent pediatric malnutrition. It should be noted that preschool age and specifically the first three years of life are most vital and vulnerable to the hazards of undernutrition which could affect the whole health of the person. All efforts should be prepared so that preschool children are given a balanced and nutritious home-based diet[4].

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