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Original Article

Determinants of Nutritional Status in Children living in Mashhad, Iran

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Abstract

Introduction:
Children are one of the most vulnerable groups to sub-optimal nutritional intake in most societies. We have investigated some of the potential determinants of malnutrition in children of 2-5 years of age.

Methods and Materials:
A cross sectional study was conducted to determine the relationship between nutritional status (weight for age, height for age and weight for height) and dietary and socioeconomic factors in 671 children (24-59 months of age) from selected health centers in Mashhad city, Iran. Children were assessed for weight and height and the care givers were interviewed and a questionnaire was completed by the interviewers. The data were analyzed using SPSS13 software and the Z-scores were calculated using the WHO anthropometric software package.

Results:
The study showed that 24.4% of children were mildly underweight, 4.3% were underweight, 13% were mildly stunted, 23.6% of children were mildly wasted and 3.1% were stunted. Educational attainment, whether the children had been breast feed, average daily consumption of milk, feeding practices and type of first food were found to be the main factors determining nutritional status in our study.

Conclusion:
A higher daily consumption of milk, lower age at which first solid food was started; lower age for consumption of meat and good feeding practices may resolve malnutrition in this population. These findings support the need for a family-based prevention program that focus on guiding parents to foster appropriate feeding practices as well as to promote healthy food intake in the children. Future research should determine the cost-effectiveness of both short- and long-term interventions for child malnutrition.

Keywords:
Malnutrition Prevention, Nutritional Intake, Nutritional Status, Preschool Children.

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Introduction

Child malnutrition is a serious concern in developing countries due to the high mortality and morbidity with which it is associated. Preschool-age children under the age of 5 are particularly susceptible to the adverse effects of malnutrition as they are in a vulnerable growth period with high growth requirements (1). Child under-nutrition is estimated to be the largest contributor to global burden of disease, killing millions of children in the developing countries and causing substantial health expenditures (2-4). It is estimated that 54% of deaths in children under 5 years are associated with malnutrition (5), and that approximately 5 million children die each year due to causes that are directly or indirectly related to malnutrition (6). Indicators of malnutrition include wasting, stunting and underweight, which represent different aspects or measurements of malnutrition (7). Wasting as measured by low weight for- height represents lower than expected body mass (tissue or fat) and is a good indicator of existing nutritional deficits. Stunting, or low height-for-age is an indicator of a reduced linear growth rate and represents a chronic state of malnutrition as it takes longer for impaired skeletal growth to become apparent. Underweight, which is measured by low weight-for-age,represents a combina- tion of both wasting and stunting. A review of the literature has identified infections, diet, child and family demogra- phics, and household characteristics as risk factors for malnutrition in preschool-age children (8–13). Both stunting (low height-for-age (HAZ)) and underweight (low weight-for-age (WAZ)), in comparison with healthy reference populations, can be used as indicators of malnutrition. Stunting, in particular, is thought to be a good indicator of malnutrition (14) and often represents a state of chronic nutritional stress. It can lead to both short-and long-term adverse events in childhood and adulthood, including effects on health, cognition and educational outcomes (15-19). Although results from these previous analyses are useful as guides to studies in Iran, regional data collection is required to capture factors that may be unique to a specific population. Furthermore, the findings can be used to address such risk factors at nutritional and regional level with the aim of early identification and prevention to reduce the problem of malnutrition. Although substantial developments have taken place in Iran, there are districts where one in four children is malnourished (20), and this situation calls for serious action. Volkmann (21) for example has reported that nearly 11% of Iranian children are still underweight.

Whilst there have been several studies in other cities in Iran (22-24) there are no studies examining the causes of malnutrition in two to five years old children in Mashhad. Breastfeeding, first food and socio-demographic determinants play an important role in child growth, but the contribution of these factors to malnutrition has not been examined. Analysis of underlying causes including factors thought to influence growth and food intake such as weaning practices or maternal education has not been reported.

Therefore, the objective of the present study was to determine the prevalence of three indicators of malnutrition (wasting, underwe- ight and stunting) using the new WHO Child Growth Standards and associated risk factors in a population of preschool-age children living in Mashhad, Iran.

Methods and Materials

A cross sectional study was conducted to identify the determinants of nutritional status (weight for age, height for age and weight for height) in 671 children (24-59 months) from selected health centers in Mashhad city, recruited from an urban population, using a stratified-cluster method Mashhad, Iran. Children were measured for weight and height. In addition, the caregivers were interviewed for their socioeconomic, demographic, health characteristics, history of breast feeding information, when first food was introduced and solid food consumption. Ethics approval for carrying out this research was obtained from the Ethics committee of Mashhad University of Medical Sciences.

The interviewers used in the study were given specific training on interview techniques and the use of the socio-demographic status questionnaire, which enquired about feeding behaviors, and how to make the anthropometric measurements. In order to avoid measurement bias, anthropometry measurement of the children were undertaken by researchers who attended the health clinics every day. In this study care givers of the children were asked to complete the consent form.

Fourteen health centers were chosen from 28 urban health centers by simple random sampling. The sample size was determined based on the fact that the prevalence of underweight children in Iran was estimated as 11% according to UNICEF report (21) and the fact that the rate of obesity and overweight in 5 years old in Iran has been reported to be 20% (25).

Nutritional status was measured using standardized growth indices as general indicators. Indicators of extreme health outcomes such as stunting, wasting and being underweight were used in this analysis. Since, the prevalence of under-nutrition varies in different studies in Iran, the work presented in this study, aimed to identify nutritional problems and the relationship with health and dietary determinants.

Children whose weight for age, height for age and weight for height were less than two standard deviations (SD) below the median are classified as underweight, stunted or wasted, respectively (26). In addition, children whose weight for age, height for age and weight for height were less than one standard deviations (SD) below the median and higher than -1SD, are classified as mildly underweight, mildly stunted or mildly wasted, respectively, according to NCHS Reference (26). Moreover, children whose weight for age, height for age and weight for height were less than two standard deviations (SD) below 2SD median and higher than -1SD, are classified as normal, according to NCHS Reference (26). Furthermore, children whose weight for age, height for age and weight for height were less than two standard deviations (SD) higher than 2SD median are classified as high, according to NCHS Reference (26).

Statistical Analysis

The method of Green et al. (1997) was used to interpret the magnitude of relationship. The data analysis was done using SPSS (Statistical Package for the Social Sciences) software. In addition, the Z-scores were calculated using the WHO anthropometric software package. P-values less than 0.05 were considered to be statistically significant.

Results

The percentage of male and female children recruited into the study was 51.56% and 48.43%, respectively. Moreover, 87% of the children had birth weight between 2.5-5 Kg. The gestational age for 95.2% of children was 38-42 weeks, and 61% of children were born by normal delivery.

We found that 24.4% of children were mildly underweight (<-1SD), 4.3% of them were underweight (<-2SD) and 1.8% were overweight. In addition, 13% of children were mildly stunted (<-1SD), 3.1% of them were stunted (<-2SD) and 7% were high. Furthermore, 23.6% of children were mildly wasted (<-1SD), 4.3% of them were wasted (<-2SD) and 0.4% of them were overweight (Table 1).

Malnutrition in boys was more severe than in girls in the age range of 24 to 35 months. But, malnutrition in girls was more severe than in boys in the age range of 36 to 59 months (Table 2).

Table 1: Prevalence of Severity of Malnutrition by age group.

Age (Month)	Underweight N(%)	Mildly Underweight N(%)	Normal N(%)	Overweight N(%)	Total N(%)
24-35	10 (4.7)	49 (23.1)	148 (69.8)	5 (2.4)	212 (31.6)
36-45	12 (5.3)	51 (22.4)	161 (70.6)	4 (1.8)	228 (34.0)
46-59	7 (3.0)	64 (27.7)	157 (68.0)	3 (1.3)	231 (34.4)
Total	29 (4.3)	164 (24.4)	466 (69.4)	12 (1.8)	671 (100)
	Stunted	Mildy Stunted	Normal	High	Total
24-35	5 (2.4)	18 (8.5)	159 (75.0)	30 (14.2)	212 (31.6)
36-45	8 (3.5)	26 (11.4)	185 (81.1)	9 (3.9)	228 (34.0)
46-59	8 (3.5)	43 (18.6)	172 (74.5)	8 (3.5)	231 (34.4)
Total	21 (3.1)	87 (13.0)	516 (76.9)	47 (7.0)	671 (100)
	Wasted	Mildy Wasted	Normal	Overweight	Total
24-35	11 (5.2)	58 (27.4)	143 (67.5)	0 (0.0)	212 (31.6)
36-45	8 (3.5)	51 (22.4)	168 (73.7)	1 (0.4)	228 (34.0)
46-59	10 (4.3)	49 (21.2)	170 (73.6)	2 (0.9)	231 (34.4)
Total	29 (4.3)	158 (23.6)	481 (71.7)	3 (0.4)	671 (100)

The data were achieved using Z scores and NCHS Reference classification.

Table 2: Distribution of Mean Z-scores for weight and height, by Gender and Age.

Gender	Age (Month)	Weight for Age (SD)	Height for Age (SD)	Weight for Height (SD)
Male	24-35	-0.29 (1.04)	0.62 (1.22)	-0.60 (0.57)
	36-47	-0.29 (1.03)	0.17 (1.05)	-0.35 (0.93)
	48-59	-0.28 (1.05)	-0.13(1.10)	-0.23 (0.98)
Female	24-35	-0.28 (1.10)	0.47 (1.32)	-0.48 (0.89)
	36-47	-0.50 (0.93)	-0.06 (1.07)	-0.37 (0.90)
	48-59	-0.54 (0.89)	-0.07 (1.15)	-0.59 (0.84)
All Children	24-35	-0.28 (1.07)	0.55 (1.27)	-0.55 (0.93)
	36-47	-0.39 (0.99)	0.06 (1.06)	-0.36 (0.92)
	48-59	-0.41 (0.98)	-0.10 (1.12)	-0.40 (0.93)

Association of Feeding Determinants with Child Nutritional Status

In their first week of life 98.5% of the children were breast fed, 0.3% was fed on cow's milk and 1.2% using formula milk. Only 58.9% of the children were breastfed alone. The reasons for stopping breast feeding were their mothers running out of breast milk (14.6%), the child's refusal to continue with breast feeding (10.2%), pregnancy (7.8%), the mother's work obligation (3.7%) and other unspecified reasons (4.8%). From the age of 6 months or above children were introduced to their first complementary foods. Almond porridge was consumed by 50.4% of the children. This is usually prepared by straining ground almonds cooked in diluted syrup of water/ milk and sugar), rice flour porridge by 36.5%, soup by 7.5% and other types of foods including yoghurt and some traditional and local foods.

Solids were introduced to complementary foods from 6 months of age for 86.7% of children in the form of soup and puree softened in butter. The consumption percentages of solids at the age of 6 months were as following: 50.7% vegetables, 22.2% fruits, meat 46.9%, egg 35.9%, fish 5.5%, potato 42.2% and rice 28.5% (Table 3).

Pearson's correlation coefficients between feeding practices and child's nutritional status were calculated. In this study nutritional status is measured by weight for age Z score (WAZ), height for age Z score (HAZ) and weight for height Z score (WHZ). These are shown in Table 4; the results show the age at the introduction of first solid food had little relationship with WAZ, (r=-0.187). The average amount of milk consumed per day was positively correlated to WAZ (r=0.266), HAZ (r=0.228) and WHZ (r=0.227). Age at which children started eating fruit had negative correlation with HAZ (r=-0.107). The age at which eggs were consumed was negatively related to WAZ (r=-0.198) and HAZ (r=-0.202). The age at which feeding with meat was started was positively related to WAZ (r=0.200). Age of beginning feeding potato had little negative correlation with HAZ (r=-0.179). A low consumption of milk was one of the major determinants of malnutrition in the children in our sample population. In addition, the age of beginning feeding meat was another important reason for malnutrition.

Table 3: Percentage of Children who wereIntroduced to Complementary Foods by the specified age.

Types of	Age in months							
Complementary Food	1	3	6	9	12	15	18	Mean Age
First Solid Food	0.7%	3.3%	86.7%	97.2%	98.2%	99.0%	99.4%	6.48
Vegetables	0.2	1.5	50.7	90.6	97.1	97.2	98.3	7.90
Meat	0.3	1.6	46.9	87.4	96.9	97.5	98.1	8.10
Potato	0.0	1.1	42.2	88.9	97.4	97.8	98.5	8.19
Egg	0.2	0.3	35.9	84.8	97.2	98.0	99.1	8.52
Fruit	0.0	1.4	22.2	65.1	92.9	94.7	97.4	9.87
Rice	0.0	1.1	28.5	78.7	95.9	96.3	97.7	9.0
Fish	0.0	0.3	5.5	14.2	51.3	56.0	59.5	16.61

Table 4: Pearson Correlation Coefficient between Feeding Practices and Child Nutritional Status.

Variables	WAZ	HAZ	WHZ
Age at which breast feeding stopped	-0.044	-0.063	-0.004
Age at introduction of first solid food	-0.187*	-0.072	-0.044
Average amount of milk consumed per day	0.266*	0.228*	0.227*
Age began feeding the following food			
Rice	-0.062	-0.075	-0.019
Fruits	-0.040	-0.107*	0.030
Vegetables	-0.067	-0.043	-0.053
Juice	-0.021	-0.021	0.014
Egg	-0.198*	-0.202*	-0.046
Meat	0.200*	-0.037	-0.036
Fish	0.035	-0.019	0.069
Potato	-0.051	-0.179*	0.008

*Correlation is significant at the 0.05 level (2-tailed).
WAZ=weight for age Z score; HAZ = height for age Z score, WHZ= for weight for height Z score.

Association of Socio-demographic and Health Factors with child's Nutritional Status

Pearson's correlation coefficients between socio-demographic, health factors and child's nutritional status were calculated. There was a negative correlation between child's age in months and HAZ (r=-0.341) (P<0.01) (Table 5).

Table 5: Pearson Correlation Coefficient between Socio-demographic factors and Child Nutritional Status.

Variable	WAZ	HAZ	WHZ
Child's Age (months)	-0.057	-0.341**	0.069
Mother's Age	0.187*	0.193*	0.031
Mother's Education	0.206**	0.284**	-0.017
Father's Education	0.179*	0.249**	-0.18
Total Income	0.198*	0.238**	-0.008
Number of children	-0.011	-0.009	-0.016
Gestational Age	-0.27	-0.020	-0.007
Birth Weight	0.355**	0.331**	0.246**

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).
WAZ= weight for age Z score; HAZ = height for age Z score and WHZ = for weight for height Z score.

There was positive correlation between mother's age and WAZ (r=0.187) ($P<0.05$) and HAZ (r=0.193) ($P<0.05$). In addition, there was positive correlation between mother's education and WAZ (r=0.206) ($P<0.01$) and HAZ (r=0.284) ($P<0.01$). Moreover, there was positive correlation between father's education and WAZ (r=0.179) ($P<0.05$) and HAZ (r=0.249) ($P<0.01$). Also, there was positive correlation between total income and WAZ (r=0.198) ($P<0.05$) and HAZ (r=0.238) ($P<0.01$). Furthermore, the results showed positive correlation between birth weight and WAZ (r=0.355) ($P<0.01$), HAZ (r=0.331) ($P<0.01$) and WHZ (r=0.246) ($P<0.01$). According to the results, mother's age, mother's education, father's education, total income and birth weight were determinants of malnutrition in children.

Birth weight ($P<0.001$), gestational age (P=0.002), father's occupation (P=0.048), mother's age (P=0.012) and mother's education ($P<0.001$) were significant socio-demographic determinants for nutritional status in children.

Discussion

Most developing countries have experienced a significant fall in childhood mortality rates largely due to successful vaccination programs (27-28) However, while childhood mortality rates have declined, many children face chronic health problems such as malnutrition, anemia and parasitic infections that compromise their physical development, school attendance and ability to learn (29-31). Children who lack certain nutrients in their diet, or suffer from protein–energy malnutrition, hunger, parasitic infections or other diseases do not have the same capacity for learning as healthy, well-nourished children (32-33).

Several factors may influence the nutrition of children: political factors (governmental social support, energy intake per capita, gross national product and distribution of income), social factors (female educational and social status, family size and child population), economic factors (availability of food, purchasing power and utilization) and health factors (infant mortality rate, access to safe water, access to health services and parasitic diseases)(34) .There is substantial variability in these factors within regions, among nations within regions, and among provinces within nations (34).

This is the first study on nutritional status and its factors, socio-demographic and feeding factors in children aged 2-5 years old from Mashhad, Iran. The data indicated that boys had lower z scores of height and weight for age than girls, in agreement with other cross-sectional studies in Ghana, Tanzania, Vietnam and Indonesia (35-36).

Results from this study, indicate that a high proportion of children in Mashhad have malnutrition, are mildly to severely growth stunted or underweight and are experiencing poor growth. The prevalence of severe mildly underweight was 24.4%.

According to the results, mother's age, mother's education, father's education, total income and birth weight were determinants of malnutrition in children. Maternal illiteracy had a negative effect on children's mean z scores of height and weight for age. This result was confirmed by other studies which indicate that women's educational and social statuses are important underlying determinants of the nutritional status of children (37-39).This may be due to the fact that illiterate mothers may be unaware about the nutritive value of feeding and hygiene practices. They may fail to prepare breakfast or lunch, and only send their children to school with bread and pepper sauce. Many reports have indicated that schoolchildren who suffered undernutrition underachieve scholastically, cannot benefit fully from formal education, and do not develop skills and abilities. Consequently, these children suffer further in terms of productivity and employment prospects, with implications for the economic development of the community (28,30,40). Illiteracy among fathers means that they cannot find skilled jobs and tend to have lower incomes (41). Poor purchasing power leads to poor living conditions and poor sanitary facilities, aggravating children's malnutrition and parasitic infections (41). Both maternal and paternal illiteracy are a consequence of non-enrolment, absenteeism or early drop out from school (28). However, primary education is compulsory in Iran, and parents must enroll their children in primary school at 7 years of age.

Any health programme aiming to improve the socioeconomic development of a community should begin with the education of female children who will become mothers in the future. It is expected that the school health programmes will promote a dialogue with local community members, and that as a result, parents may become more strongly motivated to send their daughters to school.

In this regards, Christiaensen and Alderman (42) and Glewwe (43) have also investigated the mechanisms by which education may result in better child nutrition and concluded that parental education, especially which of mothers, is a key element in improving children's nutritional status. Children may not get adequate and balanced food required for their growth and development as the number of family size increase (44). Thus, larger family size has adverse effect on the nutritional status of a child. Moreover when economically inactive members in a household increases relative to the number of economically active members of a household, the limited available food resources will be depleted without satisfying the required nutrition (44). As it can be seen from the results a lower age for the introduction of formula milk, higher daily consumption of milk, lower age at first solid food, lower age at introduction of meat and vegetables will reduce the percentage of malnutrition. Hence, the results illustrates that nutritional practices are important throughout childhood. Appropriate national guidelines should be developed to aid care givers in choosing nutritious local foods in correct combinations and amounts to feed their children in order to maintain optimal growth in later childhood. According to the results the low consumption of milk per day was one of the main reasons for malnutrition in children. In addition, the age of beginning feeding meat was another important reason for malnutrition.

Ibrahim and colleagues have made similar observations in Egypt as we have; that deficiency of several nutrients, including proteins, is seen in stunted children and the combined effect of these deficiencies might have a role in the retardation of growth in height (45).

To detect the effect of this combined effect, the 'dietary pattern' approach might be more relevant to dietary aetiology of stunting than that of nutrients (46).

The dietary pattern approach that includes food behaviors of individuals may provide greater information on nutritional aetiology of stunting. Using such a multivariate approach would overcome the problems of collinearity among nutrients, unknown dietary confounders as well as interactions between foods and nutrients. In addition, based on this holistic approach, dietary interventions will be easier and more thorough (47,48). On the whole, results of our dietary pattern analysis are in the same direction with earlier studies on the significant difference in dairy consumption between stunted and non-stunted children. As stunting is an indicator of long-term malnutrition, monitoring the growth and nutritional status of children since birth should be considered to prevent stunting and its adverse consequences.

The strengths of this study include a large sample size of pre-school children, the selection of children from a large number of homes and representative area of Mashhad, a high participation rate of children. However, a longitudinal cohort study would be necessary to provide information about a community's social, educational, economic and behavioral characteristics. Though, this survey provided baseline information about demographic and socio-economic factors impacting on children's nutritional.

Conclusion

The present study provides a recent and accurate picture of the prevalence of wasting, underweight and stunting in preschool- age children in Mashhad and highlights the importance of both individual and family-based risk factors associated with malnutrition. This information can be used by the health authorities in the area to target appropriate health and education interventions, as a minimum, to pregnant women, new mothers and infants. Therefore, this study support the need for urgent family-based prevention programs that are focused on guiding parents to foster correct child feeding patterns as well as to promote child's food intake in Mashhad.

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