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Prevalence and Risk Factors for Stunting among Children Less than Five Years: a Community Based Study in North-Western Iran

Hamidreza Farrokh-Eslamlou[1], Alireza Eshghi[2], Rohollah Valizadeh[3], Tahereh Omidi[4], *Maasoumeh Mahdi Akhgar[5]

[1] Professor of Mother and Child Health, Reproductive Health Research Center, Urmia University of Medical Sciences, Urmia, Iran.
[2] Assistant Professor of Pediatric Pulmonology, Department of Pediatrics, School of Medicine, Hazrat-e Ali Asghar Pediatrics Hospital, Iran University of Medical Sciences, Tehran, Iran.
[3] Student Research Committee, Department of Epidemiology, School of Public Health, Iran University of Medical Sciences, Tehran, Iran.
[4] MSc in Biostatistics, Hamadan University of Medical Sciences, Hamadan, Iran.
[5] MSc in Biostatistics, Department of Biostatistics and Epidemiology, Hamadan University of Medical Sciences, Urmia, Iran.

Abstract

Background: Children under five years of age are the primary victims of malnutrition. This study aimed to investigate risk factors of stunting among children less than 5 years in North-Western Iran.

Methods: This cross-sectional study was performed on 3300 children under 5 years of age in West Azerbaijan province. Selected households were visited by fifteen trained teams. Collected data were consisted of name, date of birth, height, weight, sex, breastfeeding status, age, stunting status (Without stunting, moderate, severe), place of residence, care quality, completion of growth curve and knowledge of mothers about heath cares. The data were analyzed using STATA version 20. Chi-square, binary logistic, and ordinal regression were used. P-values less than 0.05 were considered significant.

Results: Among 3300 children, a total of 436 individuals (13.2%) had stunting (moderate: 302 children/severe: 134 children). The Mean weight, height, BMI, month of birth and breast feeding duration in children were 11.89±3.76, 86.26±15.05, 15.88±2.44, 6.23±3.47 and 4.13±5.20, respectively. No significant independency was found among children with/without stunting regarding having breast feeding or cow milk, using baby pacifier and number of under-5-year children in each family ($p>0.05$). Other qualitative variables were not homogenous ($p<0.05$). In binary logistic regression analysis, age and weight were presented as risk factors in the model, that is, by increasing one unit of the age, provided that the other variables remain constant in the model, the risk of stunting increases for approximately four times, because the odds ratio (OR = 4.034) is significant (p = 0.021). Weight variable also produced such a situation (OR = 4.437, p = 0.007). Assuming that other variables remain constant in the model, the risk of shifting to the higher order of the stunting variable is roughly doubled in the model, because the odds ratio (OR = 2.285) is significant (p = 0.005). Height was a preventive variable in the model for developing stunting (OR = 0.204, p = 0.002). In ordinal regression analysis, weight was presented as a risk factor in the model (OR = 2.285, p = 0.005) and height was a preventive variable (OR = 0.450, p = 0.001).

Conclusion: According to the results of the study, prevalence of stunting is high indicating the necessary measures in this regard. Weight, height and age are appropriate predictors to predict stunting in children.

Key Words: Children, Malnutrition, Prevalence, Stunting.

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**** Corresponding Author:***

MSc in Biostatistics, Department of Biostatistics and Epidemiology, Hamadan University of Medical Sciences, Urmia, Iran, MSc in Biostatistics, Department of Biostatistics and Epidemiology, Hamadan University of Medical Sciences, Urmia, Iran. Email: maasoumehakhghar@gmail.com

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1- INTRODUCTION

Growth is regulated by both genetics and environmental factors but the second ones is more operant (1, 2). Due to growth velocity, childhood is a period with high vulnerability and growth requirements. Therefore, children under five years are the primary victims of malnutrition. Malnutrition is a state in which a deficiency or excess of micro/ macro nutrients causes growth imbalance which is well recognized as a major underlying factor for children morbidity and mortality (3). Malnutrition in childhood is the main threat to present and future health of the victims globally because of faltering growth, weak physical status, lowered resistance to infection, fragile cognitive development and diminished learning ability (4-6). Of the various anthropometric indices that can be used to assess child growth status, stunting (linear growth faltering due to chronic under-nutrition) is using to assess environmental, general health status, socioeconomic and especially poverty in community level and accumulation of chronic under-nutrition outcome in the personal level. It is estimated that 7.2% of under-five year's children in developed and 26.9% in developing countries were stunted in 2012. Global trends from 2000 to 2012 show a decline of 75.7% in stunting (7).

One of the strongest decreasing trends in children stunting among all countries of the Middle East and North Africa (MENA) region were detected in Iran. While the average rate of stunting among children under 5 years old in the MENA is 25.4%, and in the South-East Asia 34.4%, the figure of Iran (4%) is very remarkable (8). Iran is among the countries having less than 5% of hunger population based on the Global Hunger Index (GHI) developed by the International Food Policy Research Institute (IFPRI) in 2013 (9). Several anthropometric studies at national level have described the decreasing trend of stunting among under-five-year-old children, from 15.4% in 1998 to 4.7% in 2005 and in 2009 in Iran (10).

However, there are significant differences in the prevalence of stunting in different provinces and also in different socioeconomic contexts. The issue of socioeconomic inequalities in health outcomes in developing countries like Iran is a new era in research (11, 12). The significant association of socioeconomic inequality with child stunting has been reported in eighteen developing countries (13). According to the UNICEF's Conceptual Framework of Malnutrition, the causes can be classified into three groups: A) basic causes such as social, economic, cultural and political elements, B) immediate causes refer to the infectious diseases and inadequate dietary intake and C) underlying causes such as household food insecurity, inadequate care, and lack of health services. The causes of stunting could be varying in different settings, which have not yet been explored in Iran. Despite the few studies conducted to determine the prevalence of malnutrition indices, no previous community based study attempts to address the broad causes of stunting in Iran. The aim of this study is therefore to estimate the prevalence of malnutrition using anthropometric reference curves recommended by World Health Organization 2007 for the first time in Iran and to identify the determinants of stunting among under-five children in West Azerbaijan province, Iran. We included 0-5-month-old infants in assessments of child stunting, because excluding 0-5-month-old infants has a negligible effect on the prevalence of stunting among children less than 5 years of age (14).

2- METHODS AND MATERIALS

2-1. Subjects and data collection

This study is a cross-sectional community based survey. During the

summer of 2011, a representative group of under-five-year-old children of the West Azerbaijan province, located in the northwest of Iran, were enrolled in a study by the authors to survey their nutritional health and growth. The study area comprised of 14 district and more than 2.8 million inhabitants, 40% of whom lived in rural areas according to the government census of 2008. A random sample of sufficient size for statistical analysis with a stratified, multistage sampling as described by Ogden was selected (15). The parents were informed about the objective of the study; and approval permission and written consent were obtained from them before the study. Permission to carry out the study and ethical clearance were obtained from the ethical committee of the Urmia University of medical sciences. Selected households were visited by a trained team. Careful selection and training of field workers took place. Fifteen teams, each consisting of three individuals, were trained to administer the survey in one session lasting six hours. Each individual received training on all anthropometric measures and completing the questionnaires. Each family was visited by 2 members of the research team, who collected data (name, date of birth, and sex) and performed the measurements (weight and height) of the child. Team leaders were responsible for overseeing their teams (e.g., ensuring data quality while on the field). Supervisors held standardization visits and about 5-10% of examinations were repeated twice to assess reliability.

2-2. Sampling methodology and the sample size

The size of the sample population required for the study was calculated on the basis of a previous survey entitled "Geographical distribution of nutrition deficiency among children under five years olds in the West Azerbaijan province, Iran", which had revealed that approximately 8.7% of the children living in the area were affected by stunting. Allowing for a margin of error of 2.5% and a 95% confidence interval (95% CI), it was calculated that the sample population should consist of 250 children for each of the 14 cities (3). Proportional to the urban and rural population of each city, 25 clusters each consisting 10 under-five children were chosen using a random numbers table. However, survey teams began measuring children in the cluster and a comprehensive sample was taken until the required 10 children were identified. Information on the date of birth, sex, body weight, length/height and data regarding quality and quantity of child care services were collected for 10 children in each cluster.

2-3. Anthropometric variables

Standard anthropometric measurement methods were used. Body weight was measured using a portable electronic weighing scale (Seca model 826, Bradford, UK) with a precision of 0.1 kg. Children were measured at their houses while dressed in light clothes and without shoes. The lengths of children younger than 24 months were measured using a wooden stadiometer coupled with an inextensible measuring tape (1-mm precision), while the heights of children older than 24 months were obtained to the closest 0.1 cm using a portable stadiometer (Seca) mounted on a platform. BMI (kg/m^2) was calculated, based on these measurements. Age was calculated using the birth date obtained from the Child Health cards of the Iranian Ministry of Health. Data collection began on August 10, 2011, and was completed on September 1, 2011.

2-4. Anthropometric indicators

Data on age, weight, and height were combined to yield the anthropometrical indexes height-for-age (HA), weight-for-age (WA), weight-for-height (WH) and BMI-for-age. The Z-scores for HA, WA, WH and BMI-for-age were computed

based on the children`s age and gender using a software developed at the Reproductive Health Research Center, Urmia University of Medical Sciences, Iran. The cutoff values for anthropometric reference curves recommended by World Health Organization 2007 (WHO-2007) were used with the following classification: a *Z* score of

< −2 indicated low weight-for-age (underweight), low height-for-age (stunting), low weight-for-height (wasting) and low BMI-for-age as moderate and a *z* score of < −3 standard deviations (SD) defined severe under nutrition. A *z* score of < −2 showed that a child's HA, WA, WH and BMI-for-age is 2 SDs below the age and gender-specific median of the normal population.

2-4. Data Analysis

Data were initially entered on Epi-info version 6 (CDC, Atlanta, GA, USA) and imported into the SPSS version 15 (Chicago, IL, USA). All variables were normally distributed. The level of significance of P value was set at less than .05. Weight-for-age z-scores, height-for-age z-scores, weight-for-height z-scores and BMI-for- age z-scores for children up to 60 completed months were generated. Overweight and obesity in 2-5-year-old children were determined using the absolute age and sex specific cut-offs for body mass index (BMI) recommended by the International Obesity Taskforce (IOTF) (4). Patterns of the prevalence of moderate and sever stunting, underweight, wasting and also overweight and obesity by age and sex were determined. Comparison of anthropometric variables between the urban and rural children was done for boys and girls stratified by age using univariate analysis of variance (ANOVA). Prevalence of stunting, wasting, underweight, and overweight were estimated by calculating the proportion of children below or above the cutoff system described above. Chi square was used to determine the associations between SES and underweight, as well as overweight and stunting in boys and girls. The relationships between sex, puberty, or SES and stunting, underweight, or overweight were investigated using binary logistic regression. Pearson correlations between anthropometric variables were computed. The Student t-test was used to test the differences between the means of the age-sex groups, and the chi-square test for differences among the proportions based on age and sex.

3- RESULTS

Out of 3300 children, a total of 436 individuals (Prevalence: 13.2 %) had stunting (moderate/severe), in such a way that 302 children (9.2 %) had moderate stunting and the rest of 436 children had severe stunting (4%). There were not significant independency among children with/without stunting regarding having breast feeding or cow milk, using baby pacifier and number of children less than 5 years in each family ($p>0.05$). Other qualitative variables including weight for height, weight for age, height for age, gender, completion of growth curve and age group were not homogenous among children with/without stunting and the distribution of stunting was significantly different regarding these variables ($p<0.05$) (**Table 1**). The Mean weight, height, BMI, month of birth and breast feeding duration in children were 11.89±3.76, 86.26±15.05, 15.88±2.44, 6.23±3.47 and 4.13±5.20, respectively (**Table 2**).

To prevent estimation bias, the variables with significance levels less than of 0.1 were entered in the logistic model. Link function was logit with significant fitting ($p<0.05$) and large goodness of fit ($p>0.05$). In binary logistic regression analysis, age was presented as a risk factor in the model, that is, by increasing one unit of the age, provided that the other variables remain constant in the model, the

risk of stunting increases for approximately four times, because the odds ratio (OR=4.034) is significant (p=0.021). Weight variable also produced such a situation (OR=4.437, p=0.007). Height was a preventive variable in the model for stunting. In other words, with one unit increase in the height assuming that other variables are constant, the odds of stunting development decrease by about 0.8 times (OR=0.204, p=0.002). Other variables were not significant (p>0.05) (**Table 3**).

Table-1: Qualitative demographic characteristics of children

Variable		Without stunting		With stunting		P value
		Frequency	Percent	Frequency	Percent	
Child No. < 5 years	1	2019	70.5	286	65.6	0.09
	2	738	25.8	128	29.4	
	≥3	107	3.7	22	5	
Age group	0-5	366	12.8	34	7.8	0.001
	6-11	324	11.3	17	3.9	
	12-23	592	20.7	81	18.6	
	24-36	635	22.2	125	28.7	
	37-59	947	33.1	179	41.1	
Gender	Male	1428	49.9	251	57.6	0.003
	Female	1436	50.1	185	42.4	
Weight for height	NORMAL	1715	59.9	201	46.8	0.001
	Underweight 1	440	15.4	30	6.9	
	Underweight 2	164	5.7	11	2.5	
	Underweight 3	99	3.5	8	1.8	
	Overweight 1	329	11.5	97	22.2	
	Overweight 2	79	2.8	53	12.2	
	Overweight 3	38	1.3	33	7.6	
Weight for age	NORMAL	1954	68.2	183	42	0.001
	Underweight 1	482	16.8	162	37.2	
	Underweight 2	73	2.5	54	12.4	
	Underweight 3	16	0.6	23	5.3	
	Overweight 1	273	9.5	14	3.2	
	Overweight 2	47	1.6	0	0	
	Overweight 3	19	0.7	0	0	
Height for age	NORMAL	1630	56.9	0	0	0.001
	Underweight 1	701	24.5	0	0	
	Underweight 2	0	0	302	69.2	
	Underweight 3	0	0	134	30.7	
	Overweight 1	340	11.9	0	0	
	Overweight 2	110	3.8	0	0	
	Overweight 3	83	2.9	0	0	
Breast feeding	Yes	575	73.1	62	68.9	0.235
	No	212	26.9	28	31.1	
Growth curve	Yes	1260	44	146	33.5	0.001
	No	1604	56	290	66.5	
Baby pacifier	Yes	133	15.8	15	15.3	0.517
	No	708	84.2	83	84.7	
Cow milk	Yes	3	1.6	1	9.1	0.207
	No	183	98.4	10	90.9	

Table-2: Quantitative demographic characteristics of children

Variable	Mean	Std. Deviation	Minimum	Maximum
Weight (kg)	11.89	3.76	1.60	34.00
Height (cm)	86.26	15.05	41	122
BMI (kg/m2)	15.88	2.44	6.80	67.80
Month of birth (month)	6.23	3.47	1	12
Breath feeding duration (month)	4.13	5.20	0	23

In ordinal regression analysis, test of parallel lines was used for proportional odds ratio (p>0.05) and weight was presented as a risk factor in the model. That is, by increasing one unit weight, assuming that other variables remain constant in the model, the risk of shifting to the higher order of the stunting variable is roughly doubled in the model, because the odds ratio (OR=2.285) is significant (p=0.005). Height, in the model, was a preventive variable for stunting. That is, with an increase in height unit, assuming that other variables are constant, the odds of shifting to a higher level of stunting is reduced up to 0.5 times (OR=0.450, p=0.001). Other variables were not significant (p> 0.05) (**Table 4**).

Table-3: Predictive variables for the development of stunting (as a dichotomous variable: with/without stunting) using binary logistic regression

Variable	Odds ratio	Std. error	P value	Lower limit	Upper limit
Age	4.034	2.440	0.021	1.232	13.202
Sex (level 2)	0.198	0.234	0.170	0.019	1.998
Weight	4.437	2.459	0.007	1.497	13.147
Height	0.204	0.104	0.002	0.075	0.557
Month of birth	1.520	0.330	0.054	0.993	2.326
Breast feeding duration	0.884	0.091	0.235	0.722	1.083
Growth curve (level 2)	6.893	10.503	0.205	0.347	136.57
Baby pacifier (level 2)	0.738	0.757	0.768	0.099	5.505
Breast feeding (level 2)	0.001	0.016	0.500	1.620	18449

Table-4: Predictive variables for the development of stunting (as a categorical variable: Without stunting, moderate, severe) using ordinal regression

Variable	Odds ratio	Std. error	P value	Lower limit	Upper limit
Age	1.382	0.370	0.226	0.818	2.337
Sex (level 2)	0.330	0.241	0.130	0.078	1.385
Weight	2.285	0.678	0.005	1.276	4.089
Height	0.450	0.078	0.001	0.320	0.634
Month of birth	1.156	0.127	0.187	0.931	1.435
Breast feeding duration	0.955	0.078	0.579	0.813	1.122
Growth curve (level 2)	1.189	0.881	0.815	0.278	5.079
Baby pacifier (level 2)	1.225	0.903	0.783	0.288	5.202
Breast feeding (level 2)	0.047	0.107	0.178	0.001	3.979

4- DISCUSSION

Children under five years of age are the primary victims of malnutrition due to genetic and environmental factors. Malnutrition is a state in which a deficiency or excess of micro/macro nutrients causes growth imbalances such as stunting (1-3). Malnutrition results in faltering growth, weak physical status, lowered resistance to infection, fragile cognitive development, and diminished learning ability (4-6). This study aimed to investigate risk factors of stunting among under-5-year-old children in North-West of Iran.

In the present study, the prevalence of stunting was high. There was no significant independency among children with/without stunting regarding having breast feeding or cow milk, using baby pacifier and number of children less than 5 years in each family. Age and weight were presented as a risk factor in the prediction model of stunting development. Height was a preventive variable for developing stunting. In a study conducted by Hosseinian et al., in 2010, stunting in children under the age of five years was investigated in the center of Tabriz. NCHS growth curves were used to study growth parameters. There was a significant relationship between height of parents and the height of children; and positive family history was reported as a risk factor in stunting (16).

Also, the results of Sarah et al. showed that the mean height of the children was 1.47 m with a standard deviation of 1. 57 and the mean height of the mothers of these children was 1.50 (17). In another study, the mean height of the children was 84.5 cm, which is consistent with the results of the study conducted by Porak et al. and those of the present study (18). In a study by Nouri Saeidlouand et al. in 2014, the prevalence of malnutrition in Salmas city was determined. In this study, malnutrition based on underweight, stunting and wasting loss in Salmas were 2.3, 7.3 and 1.4 percent, respectively. There was no significant difference between nutritional indices in the two sexes (19).

Given the differences between provinces and regions of the country due to differences in the level of development of these areas, it is necessary to design and implement targeted strategies for different areas of necessity on four main factors including family income, improving access to food, education and nutrition, access to health services, and disease control. In the study carried out by Davoodi et al. in 2015, the rate of stunting prevalence in primary school children and its relationship with the educational level of parents, economic situation and the number of children were examined. The results of this study showed that the level of education of parents influences the stunting of children. In this regard, it is suggested that the mass media, health center personnel and interventional education programs should increase their parents' awareness (20) .In a study by Delvarianzadeh in 2007, the prevalence of malnutrition was 8.1% based on the A/H index (21). In 1999, UNICEF reported that, in developed countries, acute malnutrition A/W and chronic malnutrition A/H in children were 24% and 36%, respectively. In the study of Rezazadeh et al. in 2009, stunting was the most common problem among primary school children (22).

In a study by Khabazkhoob et al., in 2008, the results of a logistic regression model indicated the effect of factors indirectly estimated from the economic situation (23). Yip et al., in 1997, showed that among American children with low family income, stunting prevalence is high and a decrease in height and weight can be observed (24). In a study on children aged 2-6 years, the rural areas of Mexico and the economic situation were determined based on the possession of some household

appliances. The results indicated that, the low socioeconomic status significantly increased the risk of stunting (25); additionally, in children aged 2-6 years in rural areas of Mexico, low school education was associated with overweight and stunting (26).

5- CONCLUSIONS

The results of this study revealed that the prevalence of stunting is high (13.2%), indicating the necessity of providing appropriate measures by policy makers working in this field. Weight, height and age are appropriate predictors to predict stunting in the children in future. In this regard, cohort studies with long follow-ups can be wholesome to achieve generalizable results.

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5-2. Authors' contribution

All the authors have contributed towards conducting the paper and preparation of the manuscript and they all have approved the latest version of the article.

5-3. Conflicts of interest: None

5-4. Ethical considerations

Ethical issues, including plagiarism, data fabrication, double publication have been completely observed by the authors.

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