

Cause of malnutrition in pediatrics by using logistics regression

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Abstract

To assess the nutritional status and to determine potential risk factors of malnutrition in children under 3 years of age. The study carried out in November 2016, a total of 383 child/mother pairs were selected around city of Patna (Bihar) in rural and urban areas by using a 2-stage cluster sampling methodology. A structured questionnaire was administered to mothers in their home settings. Anthropometric measurement was defined as being underweight (weight for age), wasting (weight for height) and stunting (height for age) on the basis of reference data from the National Center for Health Statistics (NCHS) / World Health Organization (WHO). Logistic regression analysis was used to account the hierarchical relationships between potential determinants of malnutrition. The mean Z-score for weight-for-age was -1.51 (95% CI -1.64, -1.38), for height-for-age was -1.51 (95% CI -1.65, -1.37) and for weight-for-height was -0.63 (95% CI -0.78, -0.48). Of the children, 103 (27.7.8%) were underweight, 135 (36.3%) were stunted and 38 (10.2%) were wasted. Region of residence, ethnic, mother's occupation, household size, mother's BMI, number of children in family, weight at birth, time of initiation of breast-feeding and duration of exclusive breast-feeding were found to be significantly related to malnutrition. The findings of this study indicates that malnutrition is still an important problem among children under three years of age. Socio-economic, environmental factors and feeding practices are significant risk factors for malnutrition among under-three.

Keywords: Child, nutrition, malnutrition

Introduction

Child malnutrition is one of the serious health issues in India. The 2000 Mother and Child Nutrition Survey of the National Institute of Nutrition (NIN) noted that 16 million people were malnourished accounting for 22 percent of the population in 2000. The situation was worse in mountainous areas and the countryside than in the urban areas.

Children accounted for 2.5 million of the 16 million malnourished population (United Nations Population Fund, 2007) [14]. Research design: This study was a cross-sectional population based study. We know that the nutritional status of children clearly have an impact on a child's health and development - physical, mental and social, nutritional status of children and determinants of child malnutrition should be periodically studied to monitor the situation and it is important to give appropriate interventions to prevent malnutrition (Adel *et al.*, 2007; Kariuki *et al.*, 2002) [1, 8]. However, to our knowledge until now few studies on nutritional status of children under-three has been published. The aims of this study is to assess the nutritional status and to determine potential risk factors of malnutrition in children under three years of age.

Materials and Methods

This study was a cross-sectional descriptive survey using a structured questionnaire in November 2016 around the city of patna and measurements of weight and height to determine the nutritional status of children aged 6-36 months and to examine the impact of child feeding practice, also as socioeconomic and demographic factors on nutritional status of children.

The sample size was calculated based on the formula for a population survey. The considerations for sample size calculation were: the total about of 150.000 children under three years, 95% confidence level, confidence interval of 5%,

power of 50% true positives (the worst case percentage). An optimum sample size of 382 children was calculated. The sample was selected using a two-stage cluster design. At the first stage of sampling, in each district, we selected one to 3 villages randomly, a total of 30 villages were selected with a probability proportional to population size.

Mothers of selected children who were willing to participate in the study were interviewed for collecting the desired information. Because causes of malnutrition in children are complex, ranging from biological and social to environmental factors (Wamani *et al.*, 2005). To handle the complex hierarchical inter-relationships between these variables which are risk factors of ill health in children, particularly in less developed countries, Victora *et al.* have proposed the use of frameworks and models for studying and predicting the risk factors of health outcomes (Victora *et al.*, 1997) [15].

Base on previous research about the causes of malnutrition, we constructed a conceptual framework. In this model (Fig. 1) we divided variables into 3 groups: Distal factors were indicated by the socioeconomic variables (region of residence, ethnic, mother's education, mother's occupation and per capita family income), Intermediate factors included environment variables (household size, house structure kind of latrine and source of water) and maternal variables (mother's age at birth, mother's BMI, number of children) and Proximal factors which included weight at birth, child health status (diarrhea), time of initiation of breast-feeding and duration of exclusive breast-feeding. According to the conceptual model, socioeconomic factors (the distal determinants) may affect, directly or indirectly, all other groups of risk factors with the exception of sex and age. These may include environmental factors (such as household size, house structure, kind of latrine and source of water) and maternal factors (such as age at childbirth, mother's BMI,

number of children), child’s birth weight, feeding practices and child health status. These variables, in turn, may affect the

nutritional status of children.

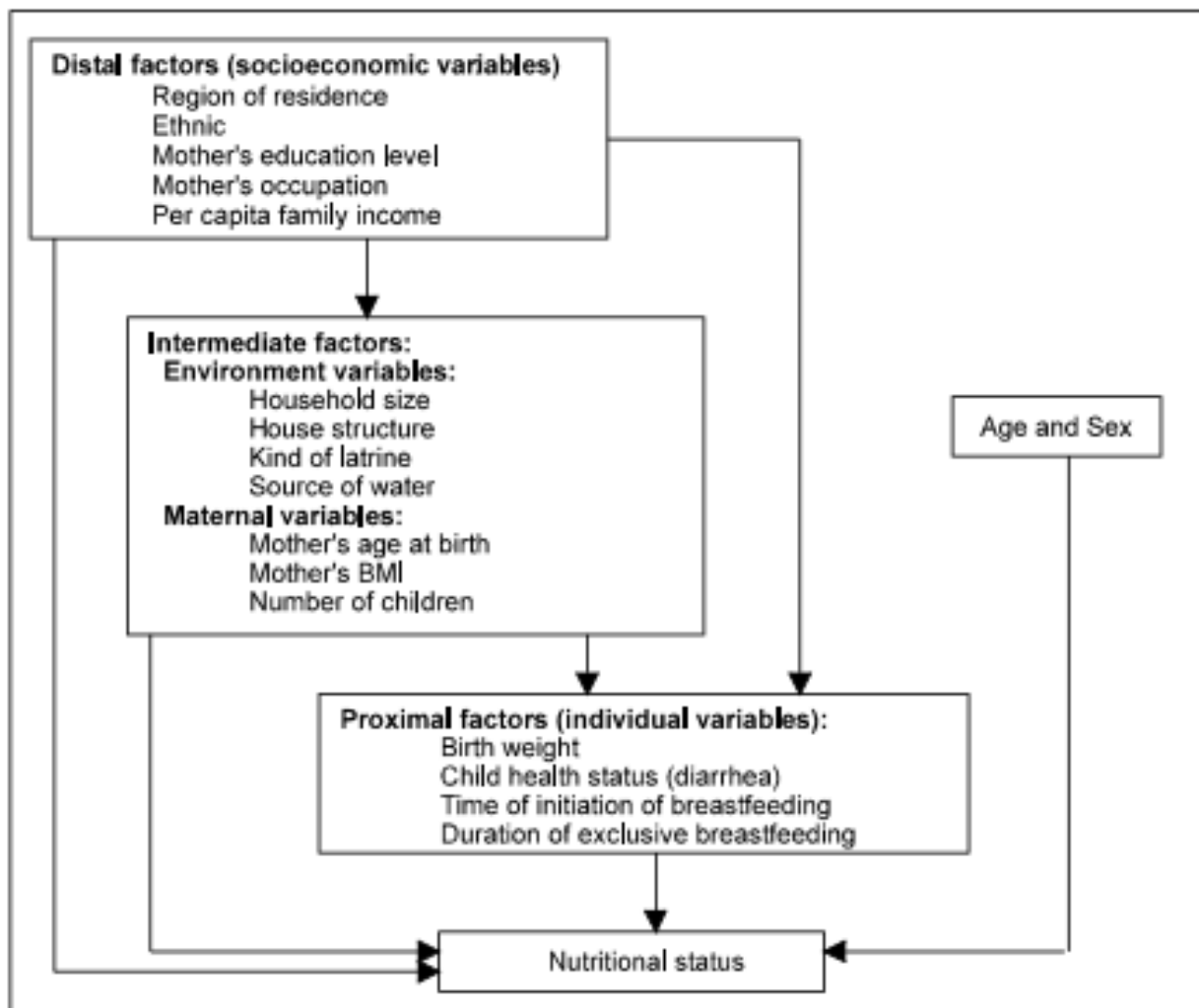


Fig 1: Conceptual hierarchical framework of the determinants of nutritional status

Statistical analysis: The Epi-Info 2000 program was used for analysis of anthropometric measures. Weight, height and age data were used to calculate weight-for-age and weight-for-height z-scores based on the National Center for Health Statistics/WHO reference data (Center for Disease Control and Prevention and National Center for Health Statistics, 2002) [2].

The SPSS version 13.0 program was used to descriptive statistics, statistical significance was set. Hierarchical logistic regression was used to analyze the effects of child feeding practice, also as socioeconomic and demographic factors on nutritional status of children. In the 1st step of the hierarchical logistic regression analyses, the age and gender variables and all distal factors (socioeconomic variables) were added into the model (model 1). In the second step of the analysis (model 2), all intermediate factors (environment and maternal variables), together with the socioeconomic variables that were significant in the 1st step and child’s age and sex, were added. Likewise, intermediate variables that were significant in the 2nd step, all distal variables included in the previous model (model 2), child’s age and sex and all variables of proximal factors (individual variables) were added into the final model (model 3).

Results

From 383 children under three years participated in the study, eleven of children were excluded because of incomplete questionnaires. Of the studied children (372), 179 (48.1%) were boys and 193 (51.9%) were girls. The mean (±SD) of the children’s age was 20.96 months (±8.94). The living areas was distributed as follows: urban area 18.3% and rural area 81.7%. The numbers of family members ranged from 3-10 (mean 4.47±1.31) and the average number of children in each family was 1.76±0.80. The mother’s age at birth ranged from 19-45 years (mean 27.78±5.1). The distributions of maternal educational levels was 11.8% for primary school or lower and 88.2% for high school or higher. The 80.1% of children in the study from households with per capita family income of under RS 2000 per month. 72% children’s mothers in the study were farmer, 11.6% of them were housewives and 16.4% were personals.

Table 1 present nutritional status (mean Z-scores) of children under three years of age. The mean Z-score for weight-for-age was -1.51 (95% CI -1.64, -1.38), for height-for-age was -1.51 (95% CI -1.65, -1.37) and for weight-for-height was -0.63 (95% CI -0.78, -0.48). The mean Z-score differences between boys and girls were statistically significant for weight-for-age.

A total of 372 children were included in the study, there were 103 (27.7%) cases of underweight, 36.3% (135) was stunting and 10.2% (38) was wasting. The highest proportion of underweight and wasting was 32.6 and 16.0%, respectively, in the age group 25-36 months and the highest proportion of stunting was 48.1% in the age group 13-24 months.

To identify the determinants of malnutrition, hierarchical logistic regression was performed. In the first step of logistic regression analysis, the results in Table 2 indicated that the risk factors found to be significantly related to underweight were region of residence and mother's occupation. And only the children of farmers mother were significantly related to stunting of all the socioeconomic variables.

Table 1: Nutritional status (mean z-scores) of children under 3 years of age

Age group (months)	Mean Z-scores (95% CI)		
	Weight-for-age		
	Girls	Boys	All
6-12	-0.60 (-0.90, -0.29)	-1.23 (-1.63, -0.82)	-0.82 (-1.07, -0.57)
13-24	-1.48 (-1.77, -1.19)	-1.99 (-2.28, -1.69)	-1.73 (-1.94, -1.52)
25-36	-1.57 (-1.87, -1.28)	-1.93 (-2.20, -1.69)	-1.77 (-1.97, -1.56)
All	-1.23 (-1.41, -1.05)	-1.82 (-2.00, -1.63)	-1.51 (-1.64, -1.38)

Age group (months)	Mean Z-scores (95% CI)		
	Weight-for-height		
	Girls	Boys	All
6-12	-1.14 (-1.50, -0.79)	-1.80 (-2.27, -1.33)	-1.38 (-1.66, -1.10)
13-24	-1.48 (-1.81, -1.14)	-1.97 (-2.30, -1.63)	-1.72 (-1.96, -1.48)
25-36	-1.49 (-1.83, -1.15)	-1.33 (-1.64, -1.03)	-1.40 (-1.63, -1.17)
All	-1.37 (-1.57, -1.18)	-1.66 (-1.86, -1.45)	-1.51 (-1.65, -1.37)

Age group (months)	Mean Z-scores (95% CI)		
	Weight-for-height		
	Girls	Boys	All
6-12	0.50 (0.16, 0.84)	0.10 (-0.34, 0.56)	0.36 (0.08, 0.63)
13-24	-0.76 (-1.09, -0.43)	-1.05 (-1.38, -0.73)	-0.91 (-1.14, -0.68)
25-36	-0.73 (-1.06, -0.41)	-1.27 (-1.57, -0.97)	-1.03 (-1.25, -0.81)
All	-0.35 (-0.55, -0.14)	-0.93 (-1.14, -0.72)	-0.63 (-0.78, -0.48)

Table 3: Environment and maternal variables and their odds ratios (95% confidence interval) for malnutrition of children under three years of age by logistic regression analysis

Categorical variables	Malnutrition		
	Underweight (Adjusted odds ratio) [†]	Stunted (Adjusted odds ratio) [†]	Wasted (Adjusted odds ratio) [†]
Household size (people)			
≤4	3.07 (1.48, 6.33)	1.49 (0.86, 2.60)	1.84 (0.59, 5.74)
>4	1.00	1.00	1.00
Type of house			
Permanent	1.00	1.00	1.00
Semi-permanent	1.27 (0.64, 2.53)	1.19 (0.62, 2.29)	2.28 (0.87, 5.94)
Kind of latrine			
Septic tank, pour flush latrine	1.00	1.00	1.00
Other	0.77 (0.38, 1.54)	1.33 (0.78, 2.27)	3.50 (0.81, 14.97)
Source of water			
Protected	1.00	1.00	1.00
Unprotected	1.20 (0.63, 2.28)	0.71 (0.39, 1.29)	0.38 (0.13, 1.12)
Mother's age at birth (years)			
>24	1.00	1.00	1.00
≤24	1.12 (0.64, 1.98)	0.82 (0.51, 1.33)	2.16 (0.88, 5.29)
Mother's BMI			
Non underweight (BMI ≥ 18.5)	1.00	1.00	1.00
Underweight (BMI < 18.5)	1.95 (1.15, 3.33)	1.39 (0.87, 2.23)	1.89 (0.86, 4.11)
No of children			
1-2	1.00	1.00	1.00
>3	3.35 (1.41, 7.90)	2.47 (1.20, 5.10)	5.46 (1.53, 19.45)

†: Odds ratio adjusted for all the other variables in the table and the socioeconomic variables that were significant in the first step and child's age and sex

The results also indicated that the risk factors also found to be significantly related to wasting were region of residence and ethnic group. Mother's education level and per capita family income were not significantly related to underweight, stunting and wasting in the model 1.

In the second step of logistic regression, the results (Table 3) showed that number of children in family = 3 was the most important risk factor for underweight, stunting and wasting. In addition, household size and mother's BMI were significantly related to underweight in the model 2.

The findings showed that type of house, kind of latrine, source of water and mother's age at birth were not significantly related

to underweight, stunting and wasting in this model. In the final step of logistic regression (Table 4), the analysis identified low birth weight was the most important risk factor for underweight, stunting and wasting. And duration of exclusive BF < 6 months was risk factor for underweight and stunting. In the model, time of initiation of BF was significantly related only to underweight. While, diarrhoea in last 2 weeks was not significantly related to underweight, stunting and wasting. With regard to age groups and sex, this model also indicated that the risk of malnutrition increases with age and a higher prevalence of malnutrition was observed in boys than girls.

Table 4: Individual variables and their odds ratios (95% confidence interval) for malnutrition of children under three years of age by logistic regression analysis

Categorical variables	Malnutrition		
	Underweight (Adjusted odds ratio) [†]	Stunted (Adjusted odds ratio) [†]	Wasted (Adjusted odds ratio) [†]
Gender			
Boy	1.00	1.00	1.00
Girl	0.50 (0.28, 0.87)	0.90 (0.57, 1.43)	0.34 (0.14, 0.82)
Age (months)			
6-12	1.00	1.00	1.00
13-24	2.43 (1.10, 5.36)	1.93 (1.07, 3.46)	3.12 (0.73, 13.28)
25-36	4.28 (1.93, 9.46)	0.92 (0.50, 1.68)	16.02 (3.67, 69.79)
Birth weight			
≥2500 g	1.00	1.00	1.00
<2500 g	7.99 (3.29, 19.42)	4.35 (2.08, 9.10)	8.62 (3.12, 23.77)
Initiation of BF			
Within 1 h	1.00	1.00	1.00
After 1 h	2.54 (1.15, 5.60)	1.02 (0.54, 1.92)	1.66 (0.55, 4.99)
Duration of exclusive BF			
≥6 months	1.00	1.00	1.00
< 6 months	4.41 (1.36, 14.23)	3.58 (1.55, 8.27)	6.92 (0.81, 58.68)
Diarrhoea in last 2 week			
Yes	1.96 (0.83, 4.62)	1.16 (0.54, 2.49)	2.43 (0.79, 7.45)
No	1.00	1.00	1.00

†: Odds ratio adjusted for all the other variables in the table and variables that were significant in the first step and variables that were significant in the second step

Discussion

In the current study, the prevalence of malnutrition of children under-three was 27.7% for underweight, 36.3% for stunting, 10.2% for wasting was ranked in the "high level" world-wide by WHO categorization. Because of almost all studies in India give figures for specific indicators of malnutrition in children under 5 years of age and not for children under three years of age. For this reason, it was difficult to assess the improvement in the nutrition status of children under three years of age in the present study. The levels of underweight, stunting and wasting identified in this study were higher than as compared with other studies in developing countries (de Onis *et al.*, 2000; Mahgoub *et al.*, 2006) [4]. Therefore, despite the steady economic development in India, child nutrition status has not improved as much as might be expected.

The hierarchical logistic regression analysis identified region of residence, mother's occupation and ethnic as determinants of malnutrition in this study, living in rural areas were risk factors for malnutrition (underweight and wasting). The reason for these may be due to differences in economic levels and cultural and social security, lack of social security causes poor accessibility to education and health services.

A research made in Malaysia also reported that the prevalence of stunting was high among children in poor rural areas (Khor and Sharif, 2003) [9]. This finding also indicated that children of mothers were farmer found to be risk factor for stunting. This may be due to the high levels of poverty as well as a lack of knowledge and understanding of farmers mothers on child health care practices. This result also reported by some studies (Filiz *et al.*, 2007; Sakisaka *et al.*, 2006) [6].

Our analysis also showed that environment and maternal factors were associated with children's nutritional status;

number of children in family, household size and mother's BMI as important determinants for nutritional status. We may explain number of children in family as determinant for nutritional status by on the one hand, a mother who had many children will to devote less time to child care than mother who had two children or less.

On the other hand, a large number of children in family suggest that there is more competition for available food. One difference with other studies (Raghav and Vefna, 2005; Ramoteme *et al.*, 2005) is that in the present study we was found large household size as a protective factors against malnutrition in children. We can explain this finding by large household size is most the extended family which is the basic family unit in Indian tradition. In this family, children were well cared for. This also suggests that part of the positive effect of household size on nutritional status was mediated by the quality of family, a proxy of resources invested on quality of life.

Before, the World Health Organization (WHO, 2001) [18] recommended that infants should be exclusively breastfed for 4-6 months with the introduction of complementary foods (any fluid or food other than breast milk) thereafter. In 2001, after a systematic review and expert consultation, this advice was changed and exclusive breast-feeding is now recommended for the first 6 months of life. The present study also supports recommendation of WHO that children should breastfeed exclusively for at least the first 6 months of the child's life (World Health Organization, 2001) [18].

Finding of this study showed that the risk of malnutrition increases with age. Children in the youngest age group, 6-12 months, were at a significantly lower risk of underweight, stunting and wasting as compared with children in the older

age groups. This low risk may be due to the protective effect of breast-feeding. In addition, consistent with other studies (Wamani *et al.*, 2007) [16], the present study finding of a higher prevalence of underweight, wasting were observed in boys than girls. The cause of this discrepancy is not well established in the literature, but there is a belief that boys are more influenced by environmental stress than girls.

Conclusion

The findings of this study indicates that malnutrition is still an important problem among children under three years of age. Socioeconomic, environmental factors are significant risk factors for malnutrition among under-three. The current study also identified that a greater risk of malnutrition was associated with poor knowledge of mothers on child feeding practice. These findings are very important, suggesting the need for improving knowledge of mothers on child feeding practices.

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