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Nutritional Status and Determinants of Malnutrition in Children under Three Years of Age in Nghean, Vietnam

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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 in Nghean, Vietnam. The study carried out in November 2007, a total of 383 child/mother pairs were selected 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 into 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 in Nghean, Vietnam. Socio-economic, environmental factors and feeding practices are significant risk factors for malnutrition among under-three.

Key words: Child, nutrition, malnutrition, Nghean

INTRODUCTION

Child malnutrition is one of the serious health issues in Vietnam. 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). Thirty-four percent of the population were malnourished children under 5 years old, 44% of whom were in the mountainous areas, 37% in the rural areas and 27% in the cities and towns. Nghe An is one of poorest provinces in Vietnam. Nghean is located on the Central North Coastal zone of Vietnam, where there are many difficulties on economy and numerous natural calamities, drought and flood have happened annually. According to the annual data of national surveillance system-NIN in 2000, the prevalence of underweight and stunting in Nghe An is of very high level (41.1 and 47.2%, respectively) (Gibson, 1990; Ministry of Health, 2003), the one of provinces having the highest malnutrition rate in nationwide.

We known 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). However, to our knowledge until now no study of nutritional status of children under-three in Nghean 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 in Nghean, Vietnam.

MATERIALS AND METHODS

Research design: This study was a cross-sectional descriptive survey using a structured questionnaire 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. It was carried out in Nghean province, Vietnam.

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. At the 2nd stage, a total of 10-15 children were systematically

sampled from each village selected at the first stage. Finally, a total of 383 children under 3 years of age were recruited to the study.

Materials and data collection: Data were gathered by a combination of a structured questionnaire and the collection of anthropometric data through measurements of length/height and weight was employed.

Anthropometric measurements: The field workers were also trained to record the anthropometric measurements. The children were measured with light-weight clothing. Standardized 25 kg Seca scales measuring to the nearest 0.1 kg were used to measure weight. Measurement of recumbent length (height with child over 2 years) were taken to the nearest of 0.1 cm, using the adjustable child height measuring board.

National Center for Health Statistics (NCHS) and WHO standards (World Health Organization, 1995) were used for determination of the nutritional status of children. Standard deviation of scores (z-scores) for weight for age (WAZ), height for age (HAZ) and weight for height (WHZ) were calculated. The Z-score (SD score) is calculated as follows: Z-score = (individual value-median value of reference population)/SD value of reference population. For each of the anthropometric indicators of malnutrition a cut-off point of -2 Standard

Deviations (-2SD) below the median of that of the NCHS/WHO reference population was used. Underweight, stunting and wasting were defined as WAZ<- 2, HAZ<- 2 and WHZ<- 2, respectively.

Using the WHO guidelines, we considered mothers with a body mass index (BMI, kg/m^2) of <18.5 kg/m^2 as underweight (WHO, 1995).

Sociodemographic and child development variables: 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). Base on previous research about the causes of malnutrition, we constructed a conceptual framework. In this model (Fig. 1) we were 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,
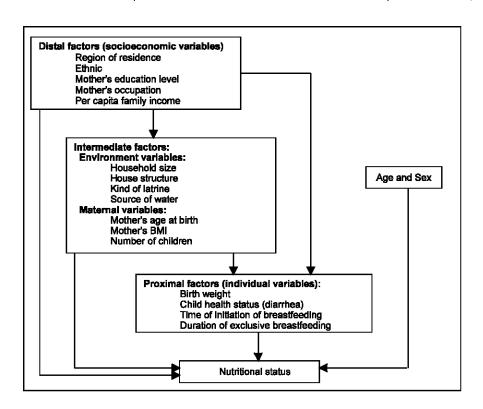

Fig. 1: Conceptual hierarchical framework of the determinants of nutritional status

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.

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, height-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).

The SPSS version 13.0 program was used to descriptive statistics, statistical significance was set at p<0.05. 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

Socio-demographic characteristics of the study population: From 383 children under three years participated in the study, eleven of children were excluded because of incomplete of 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

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	-1.23	-0.82
	(-0.90, -0.29)	(-1.63, -0.82)	(-1.07, -0.57)
13-24	-1.48	-1.99	-1.73
	(-1.77, -1.19)	(-2.28, -1.69)	(-1.94, -1.52)
25-36	-1.57	-1.93	-1.77
	(-1.87, -1.28)	(-2.20, -1.69)	(-1.97, -1.56)
All	-1.23	-1.82	-1.51
	(-1.41, -1.05)	(-2.00, -1.63)	(-1.64, -1.38)

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

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

(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 VND 500.000 (31U$) per month.. 72% children's mothers in the study were farmer, 11.6% of them were housewives and 16.4% were personals.

Nutritional status: 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 (p<0.001) and weight-for-height (p<0.001). The lowest mean Z-score of weight-for-age was -1.77 in the age

Table 2: Socioeconomic 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)[†]
Ethnic group			
Kinh groups	1.00	1.00	1.00
Minority ethnic groups	1.74 (0.92, 3.29)	0.93 (0.51, 1.68)	4.60 (1.84, 11.49)
Region of residence			
Urban area	1.00	1.00	1.00
Rural area	20.22 (3.78, 108.11)	2.04 (0.89, 4.66)	10.79 (1.07, 108.36)
Mother's education level			
Primary school or lower	0.69 (0.30, 1.61)	0.99 (0.48, 2.05)	0.53 (0.16, 1.77)
High school or higher	1.00	1.00	1.00
Mother's occupation			
Personnel	1.00	1.00	1.00
Farmer	4.83 (1.52, 15.32)	2.40 (1.05, 5.49)	2.30 (0.47, 11.17)
Housewife	7.91 (1.86, 33.59)	2.24 (0.86, 5.80)	5.51 (0.79, 38.11)
Per capita family income			
> 500.000 VND	1.00	1.00	1.00
≤500.000 VND	0.56 (0.26, 1.21)	0.91 (0.48, 1.74)	0.87 (0.24, 3.19)

†: Odds ratio adjusted for all the other variables in the table

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

group 25-36 months. The lowest mean Z-score of height-for-age was -1.72 in the age group 13-24 months. The lowest mean Z-score of weight-for-height was -1.03 in the age group 25-36 months.

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. There were significant difference (p<0.05) between the proportion of 3 types of malnutrition (underweight, stunting, wasting) for all the age groups.

Determinants of child malnutrition: 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

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			
$\geq$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			
$\geq$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

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. 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.

DISCUSSION

In the current study, the prevalence of malnutrition of children under-three in Nghean 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 of studies in Vietnam 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). Therefore, despite the steady economic development in Vietnam since 1990s, 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). 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).

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 Vietnam 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) recommended that infants should be exclusively breast-fed 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 breast-feed exclusively for at least the first 6 months of the child's life (World Health Organization, 2001). Birth weight <2500 g was the most consistent risk factor for malnutrition. This is consistent with findings from other studies that showed links between birth weight and growth in infancy and afterwards (Nojomi *et al.*, 2004; Ricci and Becker, 1996). 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, since almost all children in Vietnam are breast-fed and most continue to breast-feed during their first year of life. In addition, consistent with other studies (Wamani *et al.*, 2007), 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 (Wells, 2000).

Conclusion: The findings of this study indicates that malnutrition is still an important problem among children under three years of age in Nghean, Vietnam. 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 importance, suggesting the need for improving knowledge of mothers on child feeding practice.

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