ORIGINAL

Nutritional status, feeding practice and incidence of infectious diseases among children aged 6 to 18 months in northern mountainous Vietnam

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Abstract : *Objective* : To assess the prevalence of undernutrition, incidence of infectious diseases and the situation of feeding practices to determine the risk factors for undernutrition among children aged 6 to 18 months in rural Vietnam. *Design* : A cross-sectional study was conducted among one hundred eighty-eight mother-child pairs in Bac Giang, Vietnam. Weight and height of the children were measured and referred to data from the WHO/CDC/NCHS. Incidence of infectious diseases was diagnosed based on the WHO Recommended Surveillance Standards. Data on socio-demographic variables and feeding practices were obtained through a structured questionnaire. *Result* : The prevalence of underweight, stunting and wasting was 19.7%, 23.4% and 5.3%, respectively. The incidence of diarrhea and acute respiratory infections (ARIs) during the last 14 days of the interview was 12.2% and 20.2%, respectively. Although 99% of the children were breastfed, the prevalence of exclusive breastfeeding in the first 4 mo was 21.3%. Non-exclusive breastfeeding in the first 4 month (OR 3.95, p=0.025) and low birth weight (OR 4.38, p=0.009) were associated with underweight in the children, while incidence of infectious disease was not (OR 1.16, p=0.734). *Conclusion* : Undernutrition is highly prevalent in the study site and non-exclusive breast feeding is one of the risk factors. J. Med. Invest. 57 : 45-53, February, 2010

Keywords **:** *undernutrition, exclusive breastfeeding, infectious disease, Vietnam, infant and child*

INTRODUCTION

Child deaths worldwide have decreased in number from 13·5 (13·4-13·6) million in 1980 to an estimated 9·7 (9·5-10·0) million in 2005 ; however, the decline is less than the target set by Millennium Development Goal 4 (MDG4) (1). Most of the child deaths were caused by preventable and treatable illness despite effective health interventions. At least half of the deaths are caused by undernutrition (2). UNICEF has developed a framework for the basic underlying causes of undernutrition and has demonstrated that a combination of insufficient nutrient intake and infection are the

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primary factors (3). When children consume insufficient nutrients, their immune systems deteriorate, resulting in greater incidence, severity and duration of disease. Disease in turn affects their nutrient intake and also interferes with nutrient absorption, further aggravating the undernutrition. As to the underlying causes of undernutrition, poverty plays a central role with environmental, economic, and sociopolitical factors.

In Vietnam, child undernutrition is one of the major national health problems. It has been reported that the nationwide prevalence of child undernutrition has been remarkably reduced during the last 2 decades : the prevalence of underweight among children aged under 5 y was 51.5% in 1985, but it was reduced to 25.2% in 2005 (4). However, the prevalence of undernutrition varied among ecological regions in Vietnam. A greater proportion of the population in mountanious and remote areas were undernourished than in urban areas. The child undernutrition problem was reported to occur from an early stage of their life in Vietnam. The prevalence of undernutrition increased remarkably during 6 to 18 mo and was sustained over the next 3 y (4). Previous studies indicated that premature complementary feeding (5, 6) and frequent infectious disease (7) were the primary causes. It has also been recognized that stunting occurred even before 6 mo of age : 6.3% of children aged under 6 mo were stunted (4). Poor health care and insufficient food intake during pregnancy were also suggested as high risk factors for childhood undernutrition.

Although approach for general deprivation and inequality would result in substantial reduction in undernutrition and should be global priority, major reduction in undernutrition can also be achieved through programmatic health and nutrition intervention (8-11). The present study was aimed at providing baseline information, including the prevalence of undernutrition, incidence of infectious disease and the situation in feeding practice among children aged 6 to 18 mo for future programs with which to combat child undernutrition in northern mountainous Vietnam.

METHODS

During May and June 2005, in the middle of the dry season, a cross-sectional survey was conducted in 4 communes in Yen The, Bac Giang, Vietnam. Bac Giang province is a rural mountainous region in Vietnam, located in the North-East region and 51 km from Hanoi. The province had a relatively high prevalence of childhood undernutrition among the 8 regions in Vietnam (4). Yen The district is one of the nine districts in the province. The district has a population of approximately 91,000 with 7,500 children under 5 y of age and 2,900 children under 2 y (Dec, 2004). There are 19 communes in the district, out of which four communes were selected. Extremely poor villages which belong to the government's "Phase One 10,000 Poorest Communities" Program and the villages that were already targeted in special intervention programs by the government were not included among the selected communes. All children aged 6 to 18 mo were recruited for the survey. A census was carried out to identify all children aged 6 to 18 mo and 191 eligible children were identified.

Anthropometric measurements comprising height and weight were performed among the children and mothers by four trained field workers using standard procedures (12). Briefly, children were weighed in light cloths on an infant scale. Recumbent length was measured to the nearest 0.1 cm with a portable infant measuring board. The anthropometric indicators for children, Z-scores of weight-for-age (WAZ), height-for-age (HAZ) and weight-for-height (WHZ), were calculated on the basis of growth references developed by the World Health Organization (WHO), the Center Disease for Control (CDC), and the National Center for Health Statistics (NCHS) (13) and were calculated also by using growth references recently developed by WHO (14). Most of the available data on the growth of children in Vietnam were calculated based on WHO/CDC/NCHS growth references at the time that the present study was conducted. Undernutrition was classified according to the cut-off indicated by WHO (15) : underweight was defined as WAZ<-2, stunting as HAZ<-2, wasting as WHZ<-2. Mothers were weighed in light clothes (to the nearest 100 g) on a scale. Height was measured to the nearest 0.1 cm. Chronic Energy Deficiency (CED) among mothers was classified as Body Mass Index (BMI) under 18.5 kg/m^2.

Morbidity data were collected from the mother's description of the infant's symptoms of diarrhea, acute respiratory infections (ARIs), measles and pertussis during the previous two weeks. The descriptions of the infectious diseases were based on the WHO recommended Surveillance Standards (16). Children who had a passage of 3 or more loose or watery stools in the past 24 hours were classified

as suffering from diarrhea. If the diarrhea lasted more than 2 weeks, these children were classified as suffering from chronic diarrhea. If the stool contained blood, these children were classified as suffering from dysentery. Children who had a cough or difficulty breathing were classified as suffering from ARIs. If the cough or difficult breathing was accompanied by frequent breathing (>50 breath/min. for age 2 mo to<1 y, >40 breath/min. for age 1 to<5 y), these children were classified as suffering from pneumonia. Measles was determined if a child had all of the following three symptoms : fever, maculopapular rash, and cough or coryza or conjunctivitis. Pertussis was determined if a child showed both of the following symptoms : cough for at least 2 wks with at least one of the following : paroxysms of coughing, inspiratory "whooping", post-tussive vomiting without other apparent cause.

In this survey, a face-to-face interview was conducted with mothers and children to collect information on socio-demographic status, feeding practices and coverage of local immunization and Vitamin A supplementation. Data collection concerning breast feeding practice was based on WHO guidelines (17) and on a previous study in Vietnam (5). The mothers were asked about their breastfeeding practices during the children's first 6 mo and also about the current breastfeeding status. The following operational definitions were used in the survey : breastfeeding referred to children who were receiving at the time of interview or had ever received breast milk. Breastfeeding status at 4 and 6 mo of age were classified as exclusive breastfeeding (only breast milk plus medical drops and syrups), almost exclusive breastfeeding (only breast milk and water plus medical drops and syrups), predominant breastfeeding (water, herbal teas or fruit juice in addition to breast milk), partial breastfeeding (breast milk plus other types of milk or foods) and weaned (no longer breastfed). All the questions were pre-tested at a study site and revised before initiating the survey. The interviewers, physicians from the NIN and local community health centers, were trained in standardized questionnaire administration and anthropometric measurements through lectures and practice in the field. Four investigation teams were established for the four communities, each one including at least eight members and a supervisor. During the survey, a check system was applied including checking in the field by interviewers, interviewer's checking each other, and checking by supervisors. Personnel in the local community centers and collaborators assisted in the organization of data collection and in the explanation of procedures to the study participants. The study participants were re-interviewed whenever transcription or logical questions arose or missing values were found. The apparatus and method for measurement were checked and/or adjusted for accuracy by the supervisors before each day's work. The precise age of each child was obtained from the Permanent Residence Registration where birth data are recorded.

Before the survey, all eligible mothers in the communities were informed of the procedures and purpose of the study, then informed consent was obtained. The protocol of this study was approved by the Scientific Board of the National Institute of Nutrition of Vietnam and the Ethical Committee of Tokushima University.

A database was established using Epi info version 6 (CDC, Atlanta, GA, USA). All data were checked for missing data and outliers, and cleaned before data analysis. Statistical analysis was performed using SPSS version 11.5J (Statistical Package for Social Science, Inc.). A one-sample Kolmogorov-Smirnov test was used to assess whether the data were normally distributed. Results were presented as mean and standard deviation (SD) or as median and 25^{th}, 75^{th} percentile. Z-scores between children aged 6 to 11.9 mo and those aged 12 to 17.9 mo were compared by unpaired *t*-test. Z-scores calculated by WHO/CDC/NCHS and WHO growth reference were compared by paired *t*-test. The proportion of children classified as underweight, stunted and wasted were compared by chi-square test. Logistic regression analysis was used to analyze the effects of infectious disease and exclusive breastfeeding status, as well as those of socioeconomic and demographic factors, on the nutritional status of children. We selected children's underweight for the analysis since acute malnutrition among children is a key indicator routinely used for describing the presence and magnitude of humanitarian emergencies (18).

RESULTS

Socio-demographic characteristics and coverage of some of local health services

A pair of twins and a child whose mother was suffering from tuberculosis were excluded and the data of 188 children were used for the analysis in the present study. Socio-demographic characteristics of the children are shown in Table 1. Ninety one percent

Table 1 Socio-demographic characteristics

Variable	All (n=188)
Gender	
Boys	111 (53.7%)[1]
Girls	87 (46.3%)
Age	
6-8.9 mo	64 (34.0%)
9-11.9 mo	34 (18.1%)
12-14.9 mo	30 (16.0%)
15-18.9 mo	60 (31.9%)
Birth weight, g	3000 (2700, 3375)[2]
Low Birth Weight	20 (10.6%)
Number of children aged under 5 y	
1 child	149 (79.3%)
≧2 children	39 (20.7%)
Family income, 1000VND/capita/d[3]	11.1 (6, 22.2)
Mother's age, y	25.0 (22, 28)
Mother's education level	
Primary school (1-5 y)	26 (13.8%)
Secondary school (6-9 y)	130 (69.1%)
More (>10 y)	32 (17.0%)
Mother's BMI[4]	
6-11.9 mo postpartum, kg/m^2	19.7 (18.4, 20.8)
12-18.9 mo postpartum, kg/m^2	19.0 (17.8, 20.1)

Abbreviation : BMI, Body Mass Index
[1] Number, % in parentheses (all such values).
[2] Median, 25th and 75th percentile in parentheses (all such values).
[3] Exchange rate as of May-June 2007 : US1$=VND17,803.
[4] n=98 for 6-11.9 mo postpartum and n=90 for 12-18.9 mo postpartum

of children belonged to the "Kinh" ethnic group. As to the main family occupation, 55.3% were farmers or agricultural workers. Water from wells was used by 98.4% of the participant households and 99% of mothers answered that they boiled the water for drinking. The latrine types were mainly traditional pit latrine (76.1%) and ventilated improved pit latrine (13.3%). The family income per capita was <17,800 VND, 17,800-35,600 VND and >35,600 VND for 67.0%, 20.7% and 12.2% of the study participants, respectively. Coverage of immunization in the study site was 99.5% for BCG, 97.4% for DPT 3rd, 97.9% for OPV 3rd, 97.3% for Measles and 63.7% for Hepatitis B 3rd. The coverage of Vitamin A distribution among the children aged 6 to 36 mo was 96.7%.

Z-scores and the prevalence of undernutrition calculated by WHO/CDC/NCHS reference (13) among the children are shown in Table 2. The prevalence of underweight, stunting and wasting

Table 2 Z-scores and prevalence of undernutrition

	All	6-11.9 mo	12-18.9 mo
n	188	98	90
WAZ	-1.21±1.01[1]	-0.89±1.01	-1.57±0.90 **
HAZ	-1.20±1.06	-0.94±1.04	-1.50±1.01 **
WHZ	-0.52±0.88	-0.21±0.86	-0.99±0.77 **
Underweight	37 (19.7%)[2]	14 (14.3%)	23 (25.6%) *
Stunting	44 (23.4%)	18 (18.4%)	26 (28.9%)
Wasting	10 (5.3%)	3 (3.1%)	7 (7.8%)

Abbreviation : WAZ, Weight-for-Age ; HAZ, Height-for-Age ; WHZ, Weight-for-Height
[1] Mean±SD (all such values).
[2] Number, % in parentheses (all such values).
*$P<0.05$; ** $P<0.01$. vs. children aged 6-11.9 month (unpaired *t*-test)

was 19.7%, 23.4% and 5.3%, respectively. The WAZ, HAZ and WHZ among the children aged 12 to 18.9 mo were significantly lower than those among the children aged 6 to 11.9 mo ($P<0.05$). When the Z-score was calculated by the recent WHO growth reference (14) for all the children (n=188), the mean WAZ, HAZ and WHZ were -0.91±1.08, -1.21±1.19 and -0.37±1.09, respectively ; and the prevalence of underweight, stunting and wasting was 25.5% (n=48), 14.9% (n=28), 6.9% (n=13), respectively. Comparing these scores with the NCHS growth reference, the mean WAZ and WAZ were significantly lower ($P<0.001$), the mean HAZ was similar ($P=0.772$), and a higher proportion of children was classified as stunted ($P<0.001$) and fewer children were classified as underweight ($P<0.001$).

Table 3 shows the incidence of diarrhea and ARIs

Table 3 Incidence of infectious disease during the last 14 days of the survey

	Total	age group	
		6-11.9 mo	12-18.9 mo
n	188	98	90
Diarrhea			
acute diarrhea	23 (12.2%)[1]	10 (10.2%)	13 (14.4%)
dysentery	5 (2.7%)	2 (2.0%)	3 (3.3%)
chronic diarrhea	1 (0.5%)	1 (1.0%)	0 (0.0%)
Acute Respiratory Infectious disease			
cough and difficult breathing	38 (20.2%)	21 (21.4%)	17 (18.9%)
bronchial infection	5 (2.7%)	2 (2.0%)	3 (3.3%)
pneumonia	11 (5.9%)	8 (8.2%)	3 (3.3%)
throat infection	15 (8.0%)	8 (8.2%)	7 (7.8%)
nose infection	3 (1.6%)	4 (2.0%)	2 (1.1%)

[1] Number, % in parentheses (all such values).

during the last 14 days of the interview. The incidence of diarrhea and ARI was 12.2% and 20.2%, respectively. The incidence of diarrhea and ARIs did not differ for older children and younger children. There was no child with measles or pertussis during the time of the survey.

Ninety nine percent of the children had been breastfed or were being breastfed at the time of interview. The percentage of currently breastfed children was 99.0% among those aged 6 to 11.9 mo, while that was 73.3% among those aged 12 to 18.9 mo. Breastfeeding status in the first 4 and 6 mo is shown in Table 4. In the first 4 mo, 21.3% of the children were exclusively breastfed and 18.6% were almost exclusively breastfed. The prevalence of exclusively and almost exclusively breastfed children declined rapidly as at 6 mo, there was no child who had been exclusively breastfed and only 3.2% who were almost exclusively breastfed, while the percentage of partially breastfed children increased to 95.2%.

A logistic regression model was used to identify the risk factors related to a child's underweight (Table 5). As independent variables, incidence of infectious disease, exclusive breastfeeding in the first 4 mo, gender, age of children, low birth weight, number of children age under 5 y, family income, mother's age and mother's education level were applied. For the analysis, incidence of infectious disease was defined if the child had diarrhea or ARIs. Exclusive breastfeeding was defined if the child had exclusive breastfeeding or almost exclusive breastfeeding in the first 4 mo. Non-exclusive breastfeeding in the first 4 mo (OR 3.95, p=0.025) and low birth weight (OR 4.38, p=0.009) were associated with underweight in the children, while incidence of infectious disease was not (OR 1.16, p=0.734).

Table 4 Breastfeeding status (Total n=188)

	Breastfeeding at age 4 mo	Breastfeeding at age 6 mo
Exclusive	40 (21.3%)[1]	0 (0%)
Almost exclusive	35 (18.6%)	6 (3.2%)
Predominant	4 (2.1%)	2 (1.1%)
Partial	108 (57.4%)	179 (95.2%)
Artificial	1 (0.5%)	1 (0.5%)

[1] Number, % in parentheses (all such values).

Table 5 Odds ratio of the risk factors for underweight (Total n=188)

	Underweight		
	Odd Ratio	95% CI	*P*-value
Morbidity[1]			
No	1.00		
Yes	1.16	0.48, 2.81	0.734
Exclusive breast feeding at age 4 mo			
Yes	1.00		
No	3.95	1.19, 13.16	0.025
Gender			
Boys	1.00		
Girls	0.66	0.79, 3.96	0.329
Age			
6 to 11.9 mo	1.00		
12 to 18.9 mo	2.11	0.94, 4.75	0.072
Low Birth Weight			
Normal	1.00		
Birth weight< 2500 g	4.38	1.45, 13.24	0.009
Number of children aged under 5 y			
1 child	1.00		
2 children	2.27	0.82, 6.26	0.113
Family income			
more than 11,100 VND/capita/d	1.00		
under 11,100 VND/capita/d	0.86	0.37, 2.02	0.734
Mother's age at birth			
less than 25 y	1.00		
over 25 y	1.37	0.60, 3.14	0.451
Mother's education level			
Up to primary school	1.00		
More	0.69	0.19, 2.48	0.568

[1] Morbidity was defined as "Yes" if the child had the incidence of diarrhea or ARI during the last 14 days of the survey.

DISCUSSION

To our knowledge, this is the first study to assess the nutritional status, feeding practice and incidence of infectious diseases simultaneously in order to determine the risk of undernutrition among children aged 6 to 18 mo in northern mountainous Vietnam. In mountainous areas, the prevalence of undernutrition among children is remarkably higher compared to other regions (19). Growth faltering in Vietnam occurs early in their life and the prevalence of undernutrition accumulates with age; it starts from 3 to 4 mo of age and increases quickly from 6 to 12 mo of age, then obtains the highest level at age 24 mo (20); therefore, early prevention and control of undernutrition are expected. The present study indicated that high prevalence of undernutrition in terms of underweight, stunting and wasting among children aged 6 to 18 mo in northern mountainous Vietnam. Non-exclusive breastfeeding status in the first 4 mo and low birth weight were predictors for the child undernutrition, while incidence of infectious disease was not.

The prevalence of underweight and stunting in the study site were relatively lower compared to those nationwide as well as a previous report in Bac Giang province on children under 5 y (4). This was due to the fact that the prevalence of malnutrition was relatively higher among children older than 12 mo compared to younger children, which is consistent with a previous report of Vietnam (21), and that our study participants were relatively younger than those in the previous reports. Another report on Vietnamese children of the same age in a mountainous region demonstrated a similar prevalence of undernutrition (22). Additionally, using the recent WHO growth reference resulted both in a difference in mean Z scores for WAZ and WHZ and in changes in the prevalence of stunting and underweight. The differences in results between the WHO/CDC/NCHS growth reference and the recent WHO growth reference were similar to those in a previous report in Vietnam (23).

Since suitable and low-cost alternatives to breastfeeding are not available and non-breast milk food such as unhygienic water and low nutrient-density food has several problems in most of developing countries, WHO (24) has recommended giving only breast milk during the first 4 to 6 mo. The benefits of exclusive breastfeeding in the first 6 mo for the child's nutritional status were also reported both in industrialized countries and developing countries (25). In this study, non-exclusive breastfed children in the first 4 mo had 3.95 times higher incidence of underweight (P=0.025). The result supports the previous findings that Vietnamese children who were not exclusively breastfed or predominantly breastfed in the first 4 mo showed significantly lower anthropometric measurements at the age of 6 to 12 mo than the children who were exclusively or predominantly breastfed (5). It has been reported that an ideal method of identifying exclusive breastfeeding is a descriptive longitudinal and prospective study design with an indicator of "exclusively breastfeeding since birth" (26). In this study, we developed a standardized definition of exclusive breast feeding status following the definition that WHO has proposed (17), while we determined the status by retrospectively asking the time of introduction of non-breast milk food. Since this study has a cross-sectional design, the assessments might have retrospective bias. Although we could not draw a direct epidemiological inference for causality between exclusive breastfeeding and underweight, our findings indicate that advantages of the practice of exclusively breastfeeding would include amelioration of undernutrition among the children. Exclusive breastfeeding has been recommended through a childhood undrernutrition control program provided by the government of Vietnam since 2000 to the present and covering all communes in the country (27) ; however, the percentage of mothers giving exclusive breastfeeding in the first 4 mo is still low in Vietnam and even lower than the global rate : 51% (28). In the present study, chronic energy malnutrition among mothers was also highly prevalent and mothers complained that "the child appeared hungry just after breastfeeding" and gave this as the reason for non-exclusive breastfeeding (data not shown). Further efforts to scale-up exclusive breastfeeding, such as monitoring and evaluation with a feedback system that allow for periodic program corrections and continued innovation (29), are expected.

As to the other risk factors of underweight in this study, low birth weight was the strong predictor of underweight. This observation is consistent with the findings of other studies in Vietnam (21) and other Asian countries (30, 31). In Vietnam, thanks to the economic improvement during the last two decades, the prevalence of low birth weight has been decreasing, especially in urban areas ; however, the prevalence of low birth weight remains high in rural areas (32). It has been demonstrated that the identification

in an early stage and immediate direct intervention such as extra macro- and micro-nutrition can help infants of low birth weight catch up with their heavier contemporaries (33). It has been also shown that appropriate breastfeeding and the quality of breast milk are also important to catch up to the normal nutritional status (34).

Although a marked negative relationship between diarrhea and the physical growth of children has been demonstrated in clinical and epidemiological studies (35-38) and the relative risk of diarrhea mortality is significantly increased for malnourished children especially among children aged 6 to 11 mo (39), this relationship was not observed in the present study. Since the incidence of diarrhea has seasonal variation and the survey was conducted in May, colder and drier season with a lower incidence of diarrhea, a further prospective longitudinal survey is needed.

In addition, socioeconomic factors such as older age, male gender, higher number of children aged under 5 yrs, lower family income, young mothers' age at giving birth and mothers' poor education those observed association with childhood undernutrition in previous studies in Vietnam (19, 21) and also in other Asian countries (27, 28, 40-42) were assumed to be predictors of childhood underweight in the present study. However, we did not observe any association between these socioeconomic factors and children's underweight in the logistic regression model. For economic status, inequality of income was reported in Vietnam and it was the lowest in the northern mountainous area compared to other regions (43). The mean family income in the present study was similar to the reported income in northern mountainous areas : 10.9000 VND (40). Significant association between economic status and childhood undernutrition has been observed when across different economic areas are plotted (19) ; however, the present study was conducted in a particular rural mountainous area, and the difference of family income might be too small to show the significant association to childhood underweight. Mother's young age at birth was assumed to be a risk factor for underweight because of lack of experience in child care ; however, younger mothers in the study area usually lived with their parents and could have support from them. Therefore the mother's younger age at birth may not be a risk factor for the childhood underweight. Lower education is considered to create difficulties in accessing skills, information and health care services (44), and several previous studies have reported a relationship between the mother's education level and the childhood underweight ; however, the small sample size may limit the opportunity to observe such a statistical association in the present study.

Other factors such as vitamin A deficiency, zinc deficiency and anemia continue to be serious problem in the public health of preschool children, particularly in children aged under 2 y in mountainous areas, and contribute to underweight in this population (22, 45). A further research is needed to assess their micronutrient status and efficacy of nutritive intervention for children aged under 2 y to be considered in the health system in northern mountainous Vietnam.

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