Journal of Public Health and Development
Vol. 11 No. 1 January - April 2013

ORIGINAL ARTICLE

Risk factors for underweight children aged 6-24 months in Quang Ngai province, Vietnam

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Received: 28 July 2011 *Revised:* 24 January 2013 *Accepted:* 31 January 2013
Online available: April 2013

Abstract

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J Pub. Health Dev. 2013; 11(1): 3-18.

A cross-sectional study was conducted to examine significant risk factors associated with underweight status among children aged 6-24 months in Quang Ngai province, Vietnam. The study factors included parental socio-demographic factors, maternal knowledge, food provision practices, and maternal and child health care. Multistage stratified sampling was used to select 250 mothers who had children aged from 6 to 24 months. After the mothers consented to participate in this study, they were interviewed using a structured questionnaire. Their children were measured for weight and height. The statistics used were the Chi-square test and multiple logistic regression.

Nearly 31% of the children were underweight. The Chi-square test indicated the following factors separately significantly influenced the likelihood of children being underweight: parental education, family income, child birth weight, maternal knowledge (regarding food provision and child growth monitoring), frequency of essential food provision, orange juice provision, separation of food for children, amount of food eaten, the number of prenatal checkups, medical checkups before delivery, duration of day sleep, washing mother's hands before preparing food, drinking oral rehydration solution, and having latrines. When adjusted for iodized salts and other factors, children who were fed protein inappropriately had a 2.18 times greater risk of being underweight than those who were appropriately fed.

Appropriate feeding programs focusing on protein and iodized salt provision and raising maternal awareness of maternal and child health care should be implemented, especially for high-risk groups to reduce the prevalence of underweight children.

Keywords: nutritional status, food provision, underweight, children aged 6-24 months, Vietnam

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ปีที่ 11 ฉบับที่ 1 มกราคม-เมษายน 2556

ปัจจัยเสี่ยงของภาวะน้ำหนักต่ำกว่าเกณฑ์ในเด็กอายุ 6-24 เดือน ในจังหวัดขวังหงาย ประเทศเวียดนาม

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บทคัดย่อ

เฉียน โฮดัก จิราพร ชมพิกุล และสันทัด เสริมศรี
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ว.สาธารณสุขและการพัฒนา. 2556; 11(1): 3-18.

การศึกษาแบบตัดขวางนี้เพื่อค้นหาปัจจัยเสี่ยงต่อภาวะน้ำหนักต่ำกว่าเกณฑ์อายุของเด็กอายุ 6-24 เดือน ในจังหวัดขวังหงาย ประเทศเวียดนาม ปัจจัยที่ศึกษาประกอบด้วย ปัจจัยทางสังคมและประชากรของบิดามารดา ความรู้ของมารดา พฤติกรรมการให้อาหารบุตร การดูแลสุขภาพมารดาและเด็กโดยการสุ่มตัวอย่างแบบชั้นภูมิหลายขั้นตอนได้ตัวอย่างเป็นมารดา 250 คนที่มีบุตรอายุ 6-24 เดือน สัมภาษณ์มารดาและชั่งน้ำหนักวัดส่วนสูงของบุตรหลังจากมารดายินยอมเข้าร่วมโครงการแล้ว การวิเคราะห์ข้อมูลใช้การทดสอบไคกำลังสองและการถดถอยลอจิสติกพหุคูณ

ผลการวิจัยพบว่าร้อยละ 31 ของเด็กอายุ 6-24 เดือนมีภาวะน้ำหนักต่ำกว่าเกณฑ์อายุ การทดสอบไคกำลังสองแสดงถึงปัจจัยเสี่ยงที่มีนัยสำคัญทางสถิติได้แก่ การศึกษาของบิดามารดา รายได้ครอบครัว น้ำหนักแรกเกิดของเด็ก ความรู้ของมารดาเกี่ยวกับการให้อาหารบุตรและการติดตามตรวจสอบการเจริญเติบโตของเด็ก ความถี่ของการให้อาหารที่จำเป็น การให้น้ำส้ม การแยกอาหารสำหรับเด็ก ปริมาณอาหารที่รับประทาน จำนวนครั้งของการฝากครรภ์ การตรวจร่างกายโดยแพทย์ก่อนคลอด ระยะเวลานอนกลางวันของบุตร การล้างมือของมารดาก่อนเตรียมอาหาร การดื่มสารละลายน้ำเกลือแร่ของบุตร การมีห้องส้วม จากผลการวิเคราะห์การถดถอยลอจิสติกพหุคูณพบว่าเด็กที่ได้รับอาหารโปรตีนไม่เพียงพอมีความเสี่ยงของการมีภาวะน้ำหนักต่ำกว่าเกณฑ์อายุ 2.18 เท่าของเด็กที่ได้รับอย่างเพียงพอ เมื่อปรับอิทธิพลของเกลือไอโอดีนและปัจจัยอื่นๆ แล้ว

โครงการการให้ความรู้ในเรื่องการให้อาหารเด็กอย่างเหมาะสม ควรย้ำในเรื่องการให้อาหารประเภทโปรตีนและอาหารที่มีเกลือแร่ไอโอดีน และควรส่งเสริมให้มีความตระหนักในเรื่องการดูแลสุขภาพมารดาและเด็ก โดยเฉพาะในกลุ่มที่มีความเสี่ยงสูง ทั้งนี้เพื่อลดความชุกของภาวะน้ำหนักต่ำกว่าเกณฑ์อายุของเด็ก

คำสำคัญ: ภาวะโภชนาการ พฤติกรรมการให้อาหารบุตร ภาวะน้ำหนักต่ำกว่าเกณฑ์อายุ เด็กอายุ 6-24 เดือน เวียดนาม

Introduction

A UNICEF report showed that more than one-quarter of all children under the age of five in developing countries were underweight. Poor nutrition remains a global epidemic contributing to more than half of all child deaths, about 5.6 million per year. In terms of both the percentage of children and sheer numbers, the highest burden is in Asia. In fact, 73% of the 146 million children who are underweight live in 10 countries (India, Bangladesh, Pakistan, China, Nigeria, Ethiopia, Indonesia, Democratic Republic of Congo [DRC], the Philippines, and Vietnam).[1]

The States of Asia News Network on Thursday, February 19, 2009, reported that more than 32.6% of children in Vietnam were malnourished, stunted or underweight, making the country one of the world's 20 worst performers in child nutrition.[2]

Children aged from six to 24 months have the highest prevalence of malnutrition of any age group in Vietnam. The prevalence of underweight (low weight-for-age) children nearly triples in this critical period, while the prevalence of wasting (low weight-for-height) and stunting (low height-for-age) doubles for children aged from 12 to 24 months. A 1995 study showed the prevalence of anemia among two to 24-month-old children accounted for 60% of malnourished children in Vietnam. Traditional home-prepared foods such as a porridge or gruel for children do not have enough nutrition to meet the nutritional needs of these vulnerable children.[3]

Quang Ngai province is among the provinces having the highest prevalence of malnutrition in children aged from six to 24 months. According to statistics from the Quang Ngai health service, in July, 2009, the total number of children under 24 months was 37,313, including 35,474 children who had growth charts, and 6,465 malnourished children (18%).[4]

Without nutrition, our bodies could not stay warm, build or repair tissue, or maintain a heartbeat. Eating the right foods can help children avoid certain diseases or recover faster when illness occurs. These and other important functions are fueled by chemical substances in our food called nutrients. Nutrients are classified as carbohydrates, proteins, fats, vitamins, minerals, and water. Once digested, carbohydrates, proteins, and fats provide the body with the energy it needs to maintain its many functions. Scientists measure this energy in kilocalories, the amount of energy needed to raise 1 kilogram of water 1 degree Celsius. In the discussion of nutrition, scientists use the term “calorie” instead of kilocalorie as the standard unit of measurement in nutrition. The damaging effects of malnutrition can pass from one generation to the next, and good nutrition, therefore, plays an important role in the growth and development of children. Giving a child a solid nutritional start has a lifelong impact on physical, mental and social development and well-being. Malnutrition weakens the immune system, making a child susceptible to disease, increasing the severity of illnesses, and impeding recovery. A sick child, in turn, can quickly become malnourished. Age-appropriate breastfeeding and nourishing complementary foods, along with adequate health care, can break this vicious cycle.[5]

This study focuses on the weight-for-age indicator for two reasons. Firstly, the prevalence of underweight children nearly triples in this critical period in comparison with that of wasting and stunting. Secondly, monitoring Vietnamese child nutritional status can be based on the child growth charts

distributed to all mothers, which monitor weight-for-age. This study, therefore, examined significant risk factors associated with underweight status among children aged 6-24 months in Quang Ngai province, Vietnam.

Methods

A cross-sectional study was carried out to determine the relationship between nutritional status (weight-for-age status) and food provided to children aged from six to 24 months. The study population consisted of the mothers who had children aged from six to 24 months residing in Quang Ngai province, Vietnam. Data collection was conducted in January, 2010.

The sample size was calculated based upon the prevalence of underweight children (18%)[4] in Quang Ngai as reported by the provincial health center in 2008. The sample size required was at least 226 mothers to obtain sufficient accuracy. An additional 10% was added to the sample size. Thus, 250 mothers who had children aged from six to 24 months were interviewed.

Sampling techniques

A multi-stage stratified random sampling technique was used to select 250 respondents from 14 districts (consisting of 180 communities) of Quang Ngai province. There were four steps in this technique. The first step was to divide the 14 districts of Quang Ngai province into two regions: seven districts in the delta region, including a city (a total of 114 communities), and seven districts in the mountainous-island region (a total of 66 communities). The second step was to randomly select one district from each region. Son Tinh district was randomly selected from the delta region and Son Ha was randomly selected from the mountainous-island region. The ratio between the 21 communities of Son Tinh and the 14 communities of Son Ha is 3:2. Therefore, in the third step, three communities were randomly selected from Son Tinh district and two communities were randomly selected from Son Ha district. The final step was to randomly select 50 mothers of children aged six to 24 months from each of the five communities selected. Thus, 250 mothers participated in the study.

Research instruments

The research instruments were a structured questionnaire translated into Vietnamese, standard weighting machines and height measurements. Children were measured for weight and height during the interview. The questionnaire consisted of four parts. There were nine questions about socio-economic demographic factors: mother's age, marital status, education and occupation of mothers and fathers, children's age in months, gender, and weight at birth.

The maternal knowledge part regarding food provision and child growth monitoring included 16 questions. A correct answer was given a score of "1" and an incorrect answer was given a score of "0". The level of knowledge was classified into low (less than 60% of the total score), moderate (60% to 80%), and high (more than 80%).

The food provision part consisted of 17 questions about food provided for the children: meals, time, supplementary food, frequency of essential food provision, amount of food intake, and feeding practices. A response that the first time for feeding supplementary food to children was at six months of

age was given a score of "1"; responses indicating that supplementary food was provided before or after six months were given a score of "0".

There were eight questions concerning frequency of essential food provision, namely carbohydrates, protein, milk, vegetables, fruit, fat, salt, and low-nutrition foods. Questions were posed for each of the food groups. Each question had the following possible answers: a score of 4 for "usually eat the food" (≥ 5 days per week), a score of 3 for "sometimes" (3-4 days per week), a score of 2 for "rarely" (1-2 days per week), and a score of 1 for "never" eating that food type. The provision of carbohydrates, protein, milk, vegetables, and the fat or oil groups to children was appropriate when the child was usually fed these foods and inappropriate when the child was fed these foods sometimes, rarely, or never. The provision of fruit and iodized salt was appropriate when the child was usually or sometimes fed with these foods and inappropriate when the child received these foods rarely or never. The provision of low-nutrition foods, however, was appropriate when the child was never or rarely fed with this food and inappropriate when the child sometimes or often received these foods.

According to WHO guidelines about complementary food for children aged from six to 24 months, children should eat all kinds of food every day, except for low nutritional food, which should only be eaten one or two days per week. Therefore, any kind of food eaten appropriately by the children was given a score of two points and any kind of food eaten inappropriately was given a score of one point.[6] Total possible scores ranged from eight to 16; responses were divided into two categories based on the median score. Therefore, overall provision of the eight essential foods was appropriate when the total score was equal to or above the median (median=14) and inappropriate when the total score was less than the median.

In addition to feeding the children with breast milk, feeding with supplementary milk was considered appropriate and feeding without supplementary milk inappropriate. A daily meal fortified with oil was appropriate and meals without oil inappropriate. Orange juice fed to children was appropriate; not providing orange juice was inappropriate. At least three main meals and one sub-meal per day given to children was appropriate. Less than three main meals or no sub-meal per day given to children was inappropriate. Food for children prepared separately from family food was appropriate and vice versa. Children who finished all their food or nearly all their food was appropriate while finishing less than half of the amount of food was inappropriate. Drinking water was appropriate when it was boiled or mineral water; other water was inappropriate.

There were 13 questions about maternal and child health care: antenatal care, sleeping time, and care for diarrhea in children. Antenatal care was divided into two categories. WHO recommends that antenatal care should consist of at least four visits to a doctor, nurse, or midwife during pregnancy.[6] Therefore, at least four such medical visits was appropriate; fewer visits was inappropriate. Sleep at night for six-to-24-month-old children of about 11 hours was appropriate; other amounts of sleep were inappropriate. However, appropriate daytime sleep for the children 6-24-months is about 120-195 minutes: other amounts of sleep were inappropriate.[7] Always washings hands with soap was appropriate; other

cases were inappropriate. For the question about using/drinking oral rehydration solutions (ORS), "yes" was recorded as appropriate. A response of "yes" to the question about having a latrine was recorded as appropriate and a "no" response was inappropriate.

The Mahidol University Ethics Committee provided ethical clearance to proceed with the study (MU-IRB 2009/320.1512), while the provincial health office of Quang Ngai province issued permission to conduct the study. The questionnaire was initially pre-tested with 30 mothers randomly selected from the Nghia Dien community, a rural community in the province, in December, 2009. The Kruder-Richardson method (KR20) was used to analyze the reliability of the results. The results show that KR20 was equal to 0.728.

Descriptive statistics were used to describe the study variables. Chi-square tests and multiple logistic regression were used to determine the association between nutritional status and independent variables. The WHO-Anthro 2009 software was used to analyze the children's nutritional status.

Results

Based on the WHO thresholds for the child growth standards regarding weight-for-age8, nearly 31% of children were underweight or light and the remaining 69% were normal or overweight. These results, obtained from 250 children, are shown in Table 1.

Table 1 Percentage distribution for nutritional status of children in Quang Ngai province

Nutritional status (Weight-for-age index)	Z scores of weight-for-age	Frequency	Percent
Overweight	+2SD – <+3SD	2	0.8
Average weight	-2SD – <+2SD	171	68.4
Underweight	-3SD – <-2SD	56	22.4
Light	< -3SD	21	8.4

These categories were then divided into two groups: normal nutritional status (average or overweight) and underweight (underweight or light) for further analysis.

Table 2 shows that parental educational level, family income, child's birth weight, and maternal knowledge were significantly associated with nutritional status. The children of the mothers with low knowledge regarding food provision had a 2.28 times greater risk of being underweight than did the children of the mothers with fair to good knowledge.

Table 2 The association between the nutritional status of children with socio-demographics factors and maternal knowledge on food provision

	Nutritional status (weight-for-age index)		Crude OR	95% CI	Chi-square p-value
	Underweight (%)	Normal (%)			
Mothers' educational level					
≥ Secondary	79.3	20.7	1		
Primary education	43.7	56.3	4.95	2.74-8.95	<0.001***
Fathers' educational level					
≥ Secondary	78.7	21.3	1		
Primary education	43.3	56.7	4.84	2.66-8.81	<0.001***
Family income					
Sufficient or better	81.7	18.3	1		
Low	58.5	41.5	3.17	1.77-5.69	<0.001***
Child's birth weight					
≥2500 grams	70.8	29.2	1		
<2500 grams	30.0	70.0	5.67	1.42-2.54	0.009**
Knowledge levels					
Fair to good	24.5	75.5	1		
Low	42.5	57.5	2.28	1.31-3.96	0.004**

*** p-value < 0.01, *** p-value < 0.001*

Using the Chi-square test (Table 3), the frequency of essential food provision, supplementary milk provision, orange juice provision, separation of food, and amount of food eaten were found to be significant factors related to child nutritional status. The children fed essential food inappropriately had a 4.05 times greater risk of being underweight than those fed food appropriately.

Table 3 The association between the nutritional status of children and provision of different food types

Food provision	Nutritional status (weight-for-age index)		Crude OR	95% CI	Chi-square p-value
	Underweight (%)	Normal (%)			
Time for supplementary food					
Appropriate	23.7	76.3	1		
Inappropriate	33.0	67.0	1.58	0.81-3.10	0.171
Frequency of essential food provision					
Appropriate	17.1	82.9	1		
Inappropriate	45.5	54.5	4.05	2.27-7.25	<0.001***
Supplementary milk					
Yes	14.6	85.4	1		
No	34.0	66.0	3.00	1.21-7.47	0.009**
Oil added in daily meals					
Appropriate	30.4	69.6	1		
Inappropriate	33.3	66.7	1.14	0.51-2.57	0.750
Orange juice					
Appropriate	22.3	77.7	1		
Inappropriate	41.4	58.6	2.47	1.42-4.27	0.001**
Number of main meals per day					
Appropriate	31.2	68.8	1		
Inappropriate	28.9	71.1	0.90	0.44-1.82	0.758
Separation of food for children					
Separated	23.4	76.6	1		
Not separated	51.5	48.5	3.48	1.93-6.29	<0.001***
Amount of food eaten					
Appropriate	25.4	74.6	1		
Inappropriate	37.1	62.9	1.73	1.01-2.98	0.046*
Drinking water					
Appropriate	31.1	68.9	1		
Inappropriate	28.6	71.4	0.89	0.37-2.11	0.785

** p-value< 0.05, ** p-value< 0.01, *** p-value < 0.001*

In respect to maternal and child health care, Table 4 shows that prenatal checkups, medical checkups before delivery, duration of daytime sleep, the washing of the mother's hands before preparing food, drinking ORS and having a latrine related significantly to child nutritional status. Other factors were not found to be significantly related to the nutritional status of children. The children of the mothers not medically checked had a 7.5 times greater risk of being underweight than did the children of the mothers who had been checked.

Table 4 The association between the nutritional status of children and health care

Health care	Nutritional status (weight-for-age index)		Crude OR	95% CI	Chi-square p-value
	Underweight (%)	Normal (%)			
Medical checkup before delivery					
Appropriate (yes)	28.6	71.4	1		
Inappropriate (no)	75.0	25.0	7.50	1.97-28.55	0.001**
Number of medical checkups					
Appropriate (≥ 4 times)	15.2	84.8	1		
Inappropriate (< 4 times)	38.0	62.0	3.44	1.80-6.55	<0.001***
Daytime sleep habit					
Appropriate (yes)	29.7	70.3	1		
Inappropriate (no)	50.0	50.0	2.37	0.80-7.01	0.123
Duration of daytime sleep					
Appropriate	13.2	86.8	1		
Inappropriate	32.8	67.2	3.23	1.20-8.65	0.010*
Duration of night sleep					
Appropriate (10-12 hrs)	27.5	72.5	1		
Inappropriate (< 10, > 12 hrs)	33.8	16.2	1.35	0.79-2.32	0.277
Washing mother's hands after taking care of a child after defecation					
Appropriate	25.6	74.4	1		
Inappropriate	31.8	68.2	1.35	0.62-2.93	0.449
Washing mother's hands before preparing food					
Appropriate	16.2	83.8	1		
Inappropriate	33.3	66.7	2.58	1.03-6.48	0.029*

Table 4 The association between the nutritional status of children and health care (Cont.)

Health care	Nutritional status (weight-for-age index)		Crude OR	95% CI	Chi-Square p-value
	Underweight (%)	Normal (%)			
Having diarrhea					
No	28.8	71.2	1		
Yes	40.0	60.0	1.65	0.85-3.22	0.147
Using ORS					
Appropriate (yes)	27.9	72.1	1		
Inappropriate (no)	38.0	62.0	1.58	0.89-2.83	0.123
Drinking ORS					
Appropriate (yes)	25.5	74.5	1		
Inappropriate (no)	40.4	59.6	1.99	1.14-3.45	0.015*
Fever or coughs					
Appropriate (no)	29.9	70.1	1		
Inappropriate (yes)	34.9	65.1	1.25	0.63-2.51	0.528
Latrine					
Appropriate (yes)	22.3	77.7	1		
Inappropriate (no)	40.0	60.0	2.32	1.34-4.03	0.002*

** p-value< 0.05, ** p-value< 0.01, *** p-value < 0.001*

In order to determine significant predictors for child nutritional status, multiple logistic regression was used. All significant factors from the chi-square tests were included. After using multiple logistic regression, the only factor that was related to child nutritional status was frequency of essential food provision. Other factors were no longer significantly associated with child nutritional status. This, presumably, is because they are strongly correlated with essential food provision.

When frequency of essential food provision was separately analyzed and was adjusted for child birth weight, the significant risk factors related to child nutritional status were protein provision (OR = 2.21) and iodized salt provision (OR = 2.24). Provision of other foods was not significantly related to child nutritional status (Table 5).

Table 5 Risk factors for underweight children aged 6-24 months

Predictors	Adjusted OR	95% CI for OR	p-value
Child birth weight			
≥ 2500 grams	1		
< 2500 grams	4.08	0.98-17.02	0.054
Protein			
Appropriate	1		
Inappropriate	2.21	1.15-4.25	0.018*
Milk			
Appropriate	1		
Inappropriate	1.04	0.50-2.16	0.924
Vegetables			
Appropriate	1		
Inappropriate	1.77	0.89-3.54	0.106
Fruit			
Appropriate	1		
Inappropriate	1.22	0.55-2.71	0.618
Fat or oil			
Appropriate	1		
Inappropriate	1.74	0.82-3.68	0.147
Iodized salt			
Appropriate	1		
Inappropriate	2.24	1.05-4.81	0.038*
Poor value food			
Appropriate	1		
Inappropriate	1.43	0.69-2.93	0.334

** p-value < 0.05*

Discussion

In this study, underweight children aged six to 24-months in Quang Ngai province were classified by weight-for-age according to WHO guidelines. The prevalence of underweight children found in this study was nearly 31%. This figure was substantially greater than 18%, the official rate reported by the provincial health center on July 15, 2009.[4] However, the provincial health center rate reported the results for children aged zero-to-24-months. This prevalence was also the same level reported for Vietnam by the American Red Cross Vietnam Education and Child, Nutrition Initiative.[4]

Regarding socio-demographic factors, this study found that maternal education related significantly to child nutritional status. This is consistent with a study reported in ADB/UNESCAP, which reported that 27% of children whose mothers had a secondary education were underweight, while 43% of those whose mothers had only a primary education were underweight.[9] Similarly, a relationship between paternal education levels and the nutritional status of children was found in this study. This is similar to a study by Rahman et al., which showed that children of fathers with higher levels of education were less likely to be underweight than those with illiterate fathers.[10] This study also generated sufficient evidence to indicate that family income related significantly to child nutritional status. This is similar to a report by the WHO meeting in December, 2001, Developing a Global Strategy for Infant and Young Child Feeding[11] and similar to a study by Adrienne, et al.[12] In addition, a relationship between child birth weight and the nutritional status of children was found. This is similar to the findings of Mason and Shrimpton that the prevalence of underweight children and low birth weight were correlated.[13]

With regard to maternal knowledge, the study generated sufficient evidence to indicate that maternal knowledge levels related significantly to child nutritional status. This is consistent with a study by Blaylock, which found significant evidence that maternal knowledge of health and nutrition influenced children's nutrient intake.[14]

Regarding salient significant factors of food provision, a relationship between the frequency of essential food provision and the nutritional status of children was found. This is consistent with the WHO guiding principles for children six-to-24-months of age regarding frequency feeding and appropriate kinds of food. There was a significant relationship between supplementary milk and the nutritional status of children. This is consistent with the WHO guiding principles for feeding children six to 24 months of age with supplementary milk every day.[15] Orange juice provision was also found to have a relationship with the nutritional status of children. According to the Linus Pauling Institute, Micronutrient Information Center, Vitamin C, ascorbic acid, is one of the most important vitamins found in citrus juices, particularly orange juice. Unlike most mammals and other animals, humans do not have the ability to make their own vitamin C. Therefore, children must obtain vitamin C through their diet. The human body requires Vitamin C for the synthesis of collagen, blood vessels, tendons, ligaments, and bones, and to strengthen the immune system to prevent diseases. It is logical that children not fed with orange juice cannot prevent disease well and are liable to fall ill. A child's being unhealthy or sick can result in its being underweight.[16] In addi-

tion, a significant relationship between separation of food and the nutritional status of children was found. This result is consistent with WHO guidelines that complementary food should be prepared appropriately (mashed, chopped, or softened) to suit the children's eating abilities.[16] One of the salient significant factors was the amount of food eaten by the children. This finding is consistent with the WHO guideline that complementary food should be increased to suit children's eating abilities as they show more interest.[15]

Concerning health care, this study produced sufficient evidence to indicate that prenatal checkups related significantly to child nutritional status. In this study, each of the two communities in the mountainous area with difficult terrain for travel had a health center that was far from populated areas and pregnant women not only lacked health information but also had difficulty accessing the health centers. Therefore, a minority of them did not receive prenatal checkups and often gave birth at home with midwives. As a result, their babies had a low birth weight, and the lack of prenatal care could result in children's being underweight.[17] Furthermore, this study also provided sufficient evidence to indicate that the children whose mothers had prenatal checkups fewer than four times had a 3.44 times greater risk of being underweight than those whose mothers were medically checked at least four times. This is consistent with a study by Jonsson, who found that one of determinants for an underweight child can be inadequate prenatal care.[18] An interesting factor was the duration of daytime sleep. A relationship between the duration of daytime sleep and the nutritional status of children was found. This result is consistent with a study by the Miriam Hospital, which found that child sleep changes hormones associated with hunger and appetite. Being hungrier, the child is more motivated to eat, and so eats more food.[19] A relationship between the mother's washing of her hands before preparing food and the nutritional status of children was also found. This is consistent with a report by the ADB/ UNESCAP Concluding Workshop on Enhancing Social and Gender Statistics Bangkok, 24-27 June, 2003, which reported that 28% of children whose mothers washed their hands before preparing food were underweight, but 48% of children whose mothers did not were underweight.[9] This study provided sufficient evidence to indicate that children living in houses without latrines had a 2.32 times greater risk of being underweight than did children living in houses with latrines. This is similar to a study by Gobotswang, which found that children who had no latrine had a greater risk of being underweight than did children from households with a latrine.[20]

After analyzing all significant independent variables by multiple logistic regression to determine which factors were significantly related to the nutritional status of children, when controlling for other factors, it was found that frequency of essential food provision was the only significant risk factor for child nutritional status (OR= 2.61, 95% CI = 1.24-5.52). Other factors were no longer associated with the nutritional status of children. This finding is consistent with the results of a study by Saadeh.[21]

Furthermore, eight variables for the overall frequency and kinds of food were continually developed and adjusted for the child's birth weight in the third model of the multiple logistic regression. The most significant risk factors related to children being underweight were protein provision and iodized salt

provision. Other factors were no longer associated with the nutritional status of the children. In addition, in the final model of the multiple logistic regression, the child's birth weight was also found to have a relationship with the nutritional status of children. This result is similar to the findings in a study by the Research and Special Studies Division, which showed that children who had a low birth weight were at greater risk of being underweight than were children with a normal birth weight.[22] The results are also similar to those in a study by Ogunba, which found that most children who were provided inappropriately with protein were wasted, stunted or underweight,[23] and to the results in a study by Chizuru and Nishida, which found that iodine deficiency can result in underweight, stunting, and wasting.[24]

Recommendations

In order to improve the nutritional status of children, the following public health activities are recommended. Firstly, appropriate feeding programs focusing on protein and iodized salt provision and raising maternal awareness of maternal and child health care should be implemented, especially for high-risk groups (mothers with low education and low family income, mothers of low birth-weight children, households without latrines) to reduce the prevalence of underweight children. Secondly, high risk groups of pregnant women who have symptoms of poor nutritional status and have poor weight gain (less than six kilos for six months of pregnancy) should be identified. Thirdly, behavior change interventions for pregnant woman should be implemented by health education information agencies, communicating strategies about prenatal care and nutritional food during pregnancy. Finally, direct communication (face-to-face) and indirect channels of communication (mass media) should be utilized to raise general awareness of maternal and child health care. Mothers need to be educated about such matters as breastfeeding, complementary feeding, feeding sick children, balancing and diversifying diet and food groups, preparing safe drinking water, creating a healthy home environment, and family planning.

Acknowledgements

The authors would like to express their sincere thanks to all mothers who participated in the study and to the leaders of the Quang Ngai provincial health office.

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