Nutritional status of mothers and children in a mountainous commune in Ninh Binh province in Viet Nam

Trinh Hong Son¹, Yoshinori Sumimura²

¹) Medical Doctor. Researcher. Nutrition Information Education and Communication Center, National Institute of Nutrition
²) Associate professor, Global Collaboration Center, Osaka University

Abstract

Objectives: To assess the nutritional status of mothers and children in a mountainous commune in Viet Nam

Method: This is a cross-sectional survey conducted in 2008 in mountainous commune-Phu Loc, in Ninh Binh province in Viet Nam.

To assess the nutritional status of children and mothers, we collected the weight and height (or length, if children were under 2 year old) of all children under 5 years old, school-aged children and mother of children under 5 in the commune. Assessment and classification of nutritional status were conducted based on WHO Child Growth Standards 2006 (for child 0-5 years old), WHO Reference 2007 (for child 5-19 years old) and WHO’s standard of BMI index, applied for adult in Asia-Pacific region-2000 (for mothers of children under 5 years)

To assess the anemia rate, we used systematic random sampling method with mothers and children from 6 to 59 months of age as subjects. If the subjects were pregnant women, we selected all of them as this group is less than the sampling size. We took 20 ml of venous blood from subjects in the morning (fasting), and hemoglobin (Hb) concentration was determined by the Cyanmethemoglobin method. We used the standard WHO-2002 cut-off point for hemoglobin concentration in the blood by age, sex and physical condition to diagnose anemia.

Results: Undernutrition among children under 5 years of age was high with stunting prevalence (height for age z-score below -2SD) at 31.6% and underweight prevalence (weight for age z-score below -2SD) at 21.1%. The stunting prevalence in school-aged children (primary and secondary school) was 21.2%. The prevalence of Chronic Energy Deficiency (BMI<18.5) in mothers of child under 5 years of age was 19.5%, while the overweight prevalence (BMI ≥23) was 8.0%. The Anemia prevalence was high for all groups with rates for pregnant woman, mothers of children under 5 years and children from 6-59 months at 36.7%, 22.2%, and 32.4% respectively.

Conclusion: The nutritional status of mothers and children in the assessed mountainous commune was poor with high rates of stunting in children and high rates of anemia in all for children, pregnant women and mothers of children under 5 years of age. It is necessary to develop a comprehensive intervention program in order to improve the nutritional status of mothers and children in this commune in the coming years.

Keywords: Nutritional status. Anemia. Mother. Children. Viet Nam

Abbreviations: BMI, body mass index; CED, chronic energy deficiency; WAZ, weight for age Z-score; HAZ, height for age Z-score; WHZ, weight for height Z-score; BAZ, body mass index for age Z-score.

Contact address: Nutrition Information Education and Communication Center. National Institute of Nutrition. Viet Nam
48B-Tang Bat Ho Street.
Hanoi-Viet Nam
Tel: + 84-4-3972 0608 Fax: + 84-4-3971 7885
E-mail: niec2000@hotmail.com
(Received : 2011. 12. 28, Accepted : 2012. 11. 15)
I. Introduction

Undernutrition is still a major public health concern in developing countries. Currently in the world, more than 178 million children under 5 years old are stunted and 112 million are underweight. The majority of these children are concentrated in 36 developing countries. Every year there are 3.5 million deaths globally associated with undernutrition in mothers and children. Immediate consequences of undernutrition are increased morbidity and mortality, as well as prolonged illness and treatment time, resulting in high medical costs.

Long-term consequences of child undernutrition includes increased susceptibility to non-communicable nutrition-related chronic diseases like obesity, diabetes and metabolic disorders later in life. Undernutrition, particularly stunting can also affect physical growth, reduced work and learning capacity, hence, affects the economic development of the country.

Micronutrient deficiencies are also a serious threat to the survival and health of mothers and children. Lack of vitamin A has been identified as the cause of death for approximately 600,000 children worldwide each year. The effects of iron deficiency and iodine deficiency to the cognitive development, learning ability and economic development potential in the future are enormous. Iron deficiency is a risk factor for maternal mortality, and is estimated to be responsible for 115,000 deaths per year and 0.4% of global total disability-adjusted life years (DALYs). Although Viet Nam has achieved remarkable progress in reducing undernutrition, the current prevalence and burden of malnutrition in children and mothers are still classified as a significant public health problem, especially stunting. The data from annual reports of the Nutrition Surveillance Network indicate that the percentage of undernutrition in children still remains at high levels according to the classification of the World Health Organization (WHO). In 2007, the percentage of underweight among children under 5 years old was 21.2% (based on the WHO child growth standards-2006) with an estimated 1.6 million underweight children under 5 years old. Stunting affects one third of children with a prevalence of 33.9% in Viet Nam, with emerging disparities and high levels in children from rural and mountainous areas and ethnic minority groups. In addition, micronutrients deficiencies, and iron deficiency in particular, are still widespread in Viet Nam and affects the survival and health of mothers and children. Data from a cross-sectional study in six provinces (Bac Can, Bac Ninh, Ha Noi, Hue, Dak Lak, An Giang) showed that the prevalence of anemia among women of reproductive age, pregnant women and children under 5 years old was 26.7%, 37.6% and 36.7% respectively. This study highlights that the anemia rate is highest in pregnant women in the third trimester. Another study conducted by National Institute of Nutrition shows that the rate of iron deficiency anemia in children aged 6–9 years in some northern rural communes was 23.6%

This study was conducted in February 2008 in Phu Loc, Nho Quan district, Ninh Binh province, Viet Nam. Like other provinces in the country, the national program for control of protein-energy malnutrition in children has been implemented in Ninh Binh in recent years, but the rate of underweight in children was still high (23.9% in 2007). Phu Loc is a mountainous commune, with a total population of 6,570 with 1,550 households. The majority of the population are farmers with low incomes and living in conditions facing many difficulties, and are therefore more prone to malnutrition compared to the overall situation in the province. This study was therefore commenced to assess the nutritional status of mothers and children and collect some basic information in order to propose nutrition intervention activities for this vulnerable commune in the coming years.

II. Methods

Anthropometric assessments (weight and height)

The subjects in this study were mothers with children <5 years old and children from 0 to under 192 months of age in the commune selected. For sampling, we covered all the mothers with children <5 years old, and children from 0 to under 192 months of age in the commune. In total, 251 mothers, 412 children from 0–59 months and 855 children from 60–192 months were measured to identify their weighed and height or length.

We used the TANITA electronic scales (produced in Japan), with an accuracy of 0.1 kg to measure the weight, and used UNICEF’s wooden rulers, with an accuracy of 1 mm to measure the vertical height (or length for children under 2 year old). Data was
compiled by software EPI data version 3.1 and analysis by software WHO Anthro 3.2.2 (for children under 5) and WHO Anthro Plus 1.0 (for school-aged children). We used WHO Child Growth Standards 2006 (for child 0–59 months) and the WHO Reference 2007 (for child 60–228 months) for assessment and classification of nutritional status of children. Undernutrition was defined by z-score values. Status of underweight, stunting and wasting was defined by z-score < -2SD for weight-for-age (W/A), height-for-age (H/A) and weight-for-height (W/H) respectively, according to WHO Reference. For children under 2 year old, we measured the length instead of height, and the indicator was called length-for-age and weight-for-length. For assessing the nutritional status of mothers, we used BMI and classification based on WHO’s standard applied for Asia-Pacific region (2000).

Assessment of anemia status in children and mothers

The subjects were mothers with children <5 years old, pregnant women and children 6–59 months. We used systematic random sampling method to withdraw sample from mothers and children. In total, 126 mothers, 145 children 6–59 months and 30 pregnant women were selected.

We used the Cyanmethemoglobin method to determine the concentration of hemoglobin in serum, by getting 20 ml of blood from veins of the subjects in the morning (fasting). Using the standard cut-off point by WHO-2002 the concentration of hemoglobin in serum was measured according to age, sex and physical condition to diagnose anemia.

Adult women were diagnosed with anemia when the serum concentrations of hemoglobin was <120 g/l. Children under 5 years old and pregnant women were diagnosed with anemia when the serum concentrations of hemoglobin was <110 g/l.

III. Ethical approval

This study has been approved by National Institutes of Nutrition’s Ethics Committee on 17th January 2008 (Ref No. 47/VDD-QLKH).

The caretakers of all subject children signed on a written informed consent form prior to the assessment after they were explained that they have a right to decline from participation at any time.

IV. Results

Anthropometric assessments (weight and height)

Nutritional status of children under five

We weighed and measured height and length of 412 children under 5 years old, 204 girls and 208 boys respectively (Table 1). The prevalence of underweight (WAZ< -2SD), stunting (HAZ< -2SD) and wasting (WHZ< -2SD) were 21.1%, 31.6% and 3.6% respectively for boys and girls combined (Table 2). The distribution curve of the population surveyed (for both Weight for age Z-score and Height for age Z-score) are diverted to the left compared with the standard distribution curve of WHO reference population (Figure 1).

There was no statistically significant difference in the rate of undernutrition between boys and girls, however, there were statistically significant differences in the rates of underweight and stunting among age groups (Table 2) and after one year of age, the rates of underweight and stunting increased rapidly.

Nutritional status of school-aged children

We weighed and measured height of 855 school-aged children, 452 girls and 403 boys respectively (Table 1). Indicators such as Weight for age Z-score (WAZ); Height for age Z-score (HAZ); BMI for age Z-

<table>
<thead>
<tr>
<th>Age group of children (Months)</th>
<th>N</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0-11)</td>
<td>49</td>
<td>32</td>
</tr>
<tr>
<td>(12-23)</td>
<td>49</td>
<td>44</td>
</tr>
<tr>
<td>(24-35)</td>
<td>34</td>
<td>39</td>
</tr>
<tr>
<td>(36-47)</td>
<td>31</td>
<td>29</td>
</tr>
<tr>
<td>(48-59)</td>
<td>45</td>
<td>60</td>
</tr>
<tr>
<td><strong>Sub-total (0-59)</strong></td>
<td>208</td>
<td>204</td>
</tr>
<tr>
<td>(60-119)</td>
<td>148</td>
<td>178</td>
</tr>
<tr>
<td>(120-191)</td>
<td>255</td>
<td>274</td>
</tr>
<tr>
<td><strong>Sub-total (60-191)</strong></td>
<td>403</td>
<td>452</td>
</tr>
<tr>
<td><strong>Total (0-191)</strong></td>
<td>611</td>
<td>656</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age group of mothers (Years)</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-25</td>
<td>87</td>
<td>34.7</td>
</tr>
<tr>
<td>26-30</td>
<td>70</td>
<td>27.9</td>
</tr>
<tr>
<td>31-35</td>
<td>53</td>
<td>21.1</td>
</tr>
<tr>
<td>36-49</td>
<td>41</td>
<td>16.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>251</td>
<td>100.0</td>
</tr>
</tbody>
</table>
score (BAZ) were used for assessment and classification of nutritional status of school-aged children. The WAZ indicator only applies to groups of children under 10 years of age (<120 months old). Low BMI-for-age (BAZ<-2SD) was therefore used to assess nutritional status for children <120 months; the HAZ was used for both age groups.

For boys and girls combined, the prevalence of stunting was 21.2%. In children <120 months old (N = 326 for boys and girls combined), the prevalence of underweight (WAZ<-2SD) was 15.3% and stunting (HAZ <-2SD) was 15.0%. In children ≥120 months old, stunting was quite high at 25.0% (N = 529 in combined sexes) (Table 3).

When comparing the two age groups of children, we found that there was no statistically significant difference in prevalence of underweight (WAZ<-2SD), but statistically significant difference in the prevalence of stunting and wasting (p<0.05). There was no statistically significant difference of undernutrition rate between boys and girls for school-aged children at all indexes.

**Nutritional status of mothers**

We weighed and measured the height of 251 mothers with 157 mothers in the age group of 19-30 years old.

---

(a) WAZ: Weight for Age Z-score;  
(b) HAZ (or LAZ): Height (or Leng) for Age Z-score;  
(c) WHZ (or WLZ): Weight for Height (or Leng) Z-score  
Values are based on WHO reference 2006 (for children from 0-60 months of age). For each indicator all children with a plausible z-score are included in the evaluation (as defined under survey options). Percentages below median based on WAZ; HAZ; WHZ dependent indicators are defined as < -2 SD compare to WHO reference 2006.

### Table 2 Nutritional status of children under 5, by age group at Phu Loc commune, Ninh Binh province, Viet Nam (2008)

<table>
<thead>
<tr>
<th>Age groups</th>
<th>N</th>
<th>% &lt; -2SD</th>
<th>Mean</th>
<th>SD</th>
<th>% &lt; -2SD</th>
<th>Mean</th>
<th>SD</th>
<th>% &lt; -2SD</th>
<th>% &gt; -2SD</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total (0-59)</td>
<td>412</td>
<td>21.1</td>
<td>-0.96</td>
<td>1.22</td>
<td>31.6</td>
<td>-1.35</td>
<td>1.46</td>
<td>3.6</td>
<td>2.9</td>
<td>-0.28</td>
<td>1.08</td>
</tr>
<tr>
<td>(0-11)</td>
<td>81</td>
<td>9.9</td>
<td>-0.23</td>
<td>1.35</td>
<td>11.1</td>
<td>-0.25</td>
<td>1.73</td>
<td>7.4</td>
<td>4.9</td>
<td>-0.04</td>
<td>1.34</td>
</tr>
<tr>
<td>(12-23)</td>
<td>93</td>
<td>18.3</td>
<td>-0.76</td>
<td>1.37</td>
<td>33.3</td>
<td>-1.3</td>
<td>1.55</td>
<td>2.2</td>
<td>6.5</td>
<td>-0.18</td>
<td>1.18</td>
</tr>
<tr>
<td>(24-35)</td>
<td>73</td>
<td>19.2</td>
<td>-1.11</td>
<td>0.99</td>
<td>34.2</td>
<td>-1.63</td>
<td>1.04</td>
<td>8.2</td>
<td>0.0</td>
<td>-0.33</td>
<td>1.07</td>
</tr>
<tr>
<td>(36-47)</td>
<td>60</td>
<td>26.7</td>
<td>-1.35</td>
<td>1.03</td>
<td>40.0</td>
<td>-1.9</td>
<td>1.26</td>
<td>0.0</td>
<td>0.0</td>
<td>-0.35</td>
<td>0.81</td>
</tr>
<tr>
<td>(48-59)</td>
<td>105</td>
<td>30.5</td>
<td>-1.36</td>
<td>0.9</td>
<td>39.0</td>
<td>-1.72</td>
<td>1.02</td>
<td>1.0</td>
<td>1.9</td>
<td>-0.47</td>
<td>0.88</td>
</tr>
</tbody>
</table>

P-value: Sig. (p<0.01)  
Sig. (p<0.001)

---

Figure 1 Distribution curve of population surveyed at Phu Loc commune, Ninh Binh province, Viet Nam were diverted to the left compared with the standard distribution curve of WHO reference population.
Table 3 Nutrition status of school age children at primary and secondary school, at Phu Loc commune, Ninh Binh province, Viet Nam (2008)

<table>
<thead>
<tr>
<th>Age group (months)**</th>
<th>N</th>
<th>(a) WAZ &lt; -2SD n (%)</th>
<th>(b) HAZ &lt; -2SD n (%)</th>
<th>(c) BAZ &lt; -2SD n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-119 months</td>
<td>326</td>
<td>50 (15.3)</td>
<td>49 (15.0)**</td>
<td>21 (6.4)**</td>
</tr>
<tr>
<td>≥ 120 months</td>
<td>529</td>
<td>N/A*</td>
<td>132 (25.0)**</td>
<td>71 (13.4)**</td>
</tr>
<tr>
<td>Combine all age group</td>
<td>855</td>
<td>N/A*</td>
<td>181 (21.2)</td>
<td>92 (10.8)</td>
</tr>
</tbody>
</table>

(d) Weight for age Z-score; (b) Height for age Z-score; (c) BMI for age Z-score
Values are based on WHO reference 2007 (61 months to 19 years). For each indicator all children with a plausible z-score are included in the evaluation (as defined under survey options). Percentages below median based on WAZ; HAZ; BAZ dependent indicators are defined as < -2 SD compared to WHO reference 2007.
*) N/A: Non-applicable, because WAZ indicator only applied for child < 120 months of age (WHO’s standard reference 2007)
** There was statistically significant difference between two age group in prevalence of stunting (height-for-age; p < 0.001) and Low BMI-for-age (BAZ < -2SD; p < 0.005)

Table 4 Prevalence of CED (BMI < 18.5) and Mean of BMI in mothers with children under five at Phu Loc commune, Ninh Binh province, Viet Nam (2008)

<table>
<thead>
<tr>
<th>BMI of mothers</th>
<th>Mean of Mother’s BMI (by age group)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age group</td>
<td>N</td>
</tr>
<tr>
<td>19-30</td>
<td>157</td>
</tr>
<tr>
<td>31-49</td>
<td>94</td>
</tr>
<tr>
<td>Total</td>
<td>251</td>
</tr>
</tbody>
</table>

Sig. (p<0.005) Sig. (p<0.005) Sig. (p<0.005)

Anemia
The results showed that anemia was highest in pregnant women, followed by children < 5 years and mothers with children under 5 years of age respectively (Figure 2). The prevalence of anemia in pregnant women was 36.7% and 32.4% in children 6–59 months (Table 5). There was statistically significant difference in the rate of anemia in children 6–23 months compared with children 24–59 months (p < 0.05).

The prevalence of anemia among mothers was 22.2% (Table 6) and there was no statistically significant difference in the rate of anemia among young mothers 19–30 years old and mothers 31–45 years old (p > 0.05).

V. Discussion
Nutritional status of children
The prevalence of underweight, stunting and

(62.5%) (Table 1). Body Mass Index (BMI) was used as the indicator for assessment and classification of nutritional status of mothers. According to WHO’s classification for Asian populations, the prevalence of chronic energy deficiency (CED) in mothers was 19.5% (BMI < 18.5), and overweight was 8% (BMI ≥ 23) (Table 4). There were statistically significant difference in CED prevalence (p < 0.005) and overweight prevalence (p < 0.005) between the two age groups of mothers (19–30 years old vs. 31–49 years old).

We compared the mean values of BMI between the two age groups of mothers (19–30 year old group vs. 31–49 year old group) and found that the mean of BMI in the 31–49 year old group is higher than mean of BMI in the 19–30 year old group. This difference is statistically significant (ANOVA testing, p < 0.001).
wasting can be categorized into low to very high prevalences and can be the basis for choosing the right interventions. According to epidemiological criteria for assessing severity of undernutrition in the population of under-five children\(^{11}\), the prevalence of underweight between 20 to 29.9% or the prevalence of stunting between 30 to 39.9% falls into the classification of high rate of undernutrition.

Through the survey on nutritional status of children under 5 years old in this mountainous commune, the results showed that the rate of child undernutrition was high, particularly stunting (31.6% for both boys and girls), and tended to increase with age. After one year of age, the rate of underweight and stunting increased rapidly (Table 2).

Another research conducted by Nguyen Anh Vu in Hung Yen provinces had the same finding\(^ {12} \) where undernutrition rates seemed to increase with the age of children, especially after 12 months of age. This may indicate that inappropriate complementary feeding practices can significantly affect the nutritional status of children (WHO defined for appropriate complementary feeding practices as: timely, adequate and appropriate). For children under 6 months, breastmilk plays an important role in providing nutrition and protection from diseases, and after 6 months, complementary foods should also be introduced to children. Yet, if the

---

Table 5  Prevalence of anemia in children aged 6-59 months in Phu Loc commune, Ninh Binh Province, Viet Nam by age group and sex (2008)

<table>
<thead>
<tr>
<th>Age group in months</th>
<th>Total</th>
<th>Girl</th>
<th>Boy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>% Anemia (Hb&lt;110g/l) n (%)</td>
<td>N</td>
</tr>
<tr>
<td>(6-23)</td>
<td>52</td>
<td>25 (48.1)</td>
<td>28</td>
</tr>
<tr>
<td>(24-59)</td>
<td>93</td>
<td>22 (23.7)</td>
<td>50</td>
</tr>
<tr>
<td>Total</td>
<td>145</td>
<td>47 (32.4)</td>
<td>78</td>
</tr>
</tbody>
</table>

Table 6  Prevalence of anemia in mothers with children under 5, in Phu Loc commune, Ninh Binh Province, Viet Nam by age group

<table>
<thead>
<tr>
<th>Age group* (Years)</th>
<th>N</th>
<th>Anemia (Hb&lt;120g/l) n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-30</td>
<td>74</td>
<td>17 (23.0)</td>
</tr>
<tr>
<td>31-45</td>
<td>52</td>
<td>11 (21.2)</td>
</tr>
<tr>
<td>Total</td>
<td>126</td>
<td>28 (22.2)</td>
</tr>
</tbody>
</table>

*  There was no statistically significant difference between two age groups
complementary feeding practice is inappropriate, there will be negative impact on their nutritional status, which explains why undernutrition rates tend to increase with age. In addition, other factors also affect this group of older children, such as restricted time for childcare by mothers due to short maternity leave period.

In Viet Nam, there were clear differences in the decrease of undernutrition prevalence among urban, rural and mountains areas; the reduction being highest in the urban regions and lowest in the mountains areas\(^5\). Drivers for disparities related to undernutrition in children under 24 months of age may be living locations, ethnicity, and access to social and health services, including iron supplementation for mothers during pregnancy and information on recommended breastfeeding and complementary feeding practices. Other factors, such as child diarrhea, household food insecurity, limited knowledge about maternal nutrition, no deworming for the child in the last 6 months, etc might also play important roles\(^13\). Some recent researches on factors that cause undernutrition, which were conducted in some mountain areas and rural areas of Viet Nam, have shown that the nutrition status of the children is positively related to better household living condition and educational level of the parents. Stunting is for instance higher in children whose parents are farmers and higher in households with more children. Stunting prevalence is also lower in households with safe water access and hygienic latrines\(^7,13\).

The prevalence of stunting in school-aged children was high, especially in children from 120–190 months of age (25.0%), and stunting seemed more serious in the older age group. The survey data on the nutritional status of school-aged children in 1985, 1995, 2000 and 2005 showed that, mean of height and weight at school-aged children is always lower than the Reference Population, the older the more obvious differences\(^14,15\). In Viet Nam, school age children account for about 1/3 of the population. Children at school age (6–17 years old) will undergo two important milestones in the process of growth and physical development, which are pre-puberty and adolescence. In pre-puberty (6–9 years old), the body needs more nutrients to reserve as a preparation stage to accelerate development through adolescence\(^14\). Thus, the intervention program in pre-pubescent stage plays an important role to reduce malnutrition among school age in Viet Nam, as well as to contribute to improve nutritional status at later life stage (adolescence).

Iron deficiency is most common in developing countries, so it is very crucial to assess iron status of a population to alleviate this public health problem\(^11\), especially in mothers and children. In our research, the prevalence of anemia among children 6–59 months of age was high, 32.4%, and the anemia appeared early in young children with high prevalence (48.1% in children 6–23 months vs. 23.7% in children 24–59 months). The research to assess iron deficiency for 1,175 children under 5 years of age in 6 provinces in Viet Nam showed the highest prevalence of anemia among children 6–12 months of age\(^6\). This may be due to iron-poor food in the diet of young child in the initiation period of complementary feeding. In infants under 4 months of age, iron is provided by the reserves in the body and from breast milk. However, after six months of age, if the diet does not meet the daily requirement for iron, the child easily suffers from anemia.

Nutritional status of mothers

Nutritional status and health of women of reproductive age, during pregnancy, or lactating mothers can affect the nutritional status and health of children significantly because they adversely affect the development of the fetus and newborn\(^1\). A cross sectional survey conducted in 450 pregnant women in 10 communes of Khoai Chau district in Hung Yen province in 2007 revealed that 22.6% of the women had CED (BMI<18.5) prior to pregnancy and CED decreased as the age increased\(^16\). In our survey at Phu Loc, Chronic Energy Deficiency (BMI <18.5) generally fall into the group of mothers in the age of 19–30 years old (24.8 %), while overweight/obesity (BMI>23.0) occur more frequently in the age of 31–49 years old (13.8%). The difference is statistically significant (p<0.005) on CED rate, as well as overweight/obesity rate between two age groups (Table 4).

Anemia is still quite common in the group of mothers with children under five years of age and pregnant women. Nutritional anemia was associated with household income: number of children; maternal knowledge on nutrition and anemia prevention; personal and environmental sanitation\(^16\). Beside that, in
mountainous areas, it is hard for the pregnant women to access to health care services adequately, hence, they do not use iron tablet properly, leading to very high rates of anemia among this group.\textsuperscript{16-19}

Strengthening of nutritional education and communication activities for mothers in order to disseminate knowledge and practical guidance on proper nutrition is a proven solution that is necessary and effective to improve nutritional status for mothers and for children.\textsuperscript{20, 21}

VI. Conclusions

Undernutrition and stunting in particular was high in this mountainous commune. The high rate of anemia was also concern. The results of this study will provide useful information for develop nutrition intervention program for this commune in the coming years. There are needed a comprehensive nutrition intervention package, with evidence based. Stunting reduction interventions targeting pregnant women, children under 2 and new mothers should be priorities. From the results of this survey, and refer to other research results on the rural and mountainous areas of Viet Nam, we propose the following solution when developing nutrition intervention program for this community: Enhance the dissemination of nutrition knowledge to mothers and child caregivers, using the nutrition education communication activities appropriate with the customs of local people; Integrate nutrition program with other programs, such as primary health care, immunization, reproductive health care, etc. Focusing on solutions to reduce stunting, such as encouraging exclusive breastfeeding for first six months, micronutrient supplementation, deworming combined with vitamin A capsules distribution; Strengthen the nutrition education for school age children, including practice guidance on personal hygiene and environmental sanitation.

There should be more research on the causal model of malnutrition as well as study on knowledge, attitudes and behavior on nutrition of target groups in order to propose more specific nutrition intervention programs for this community.

Acknowledgements

This research was supported by Ronpaku program (VAST-10934) of JSPS, the Research Project Regarding Anthropological Study on Food Security, Grant-in-Aid for Scientific Research (KAKENHI) (A) 22242029 of JSPS, and the Collaborative Research Project (2008-2009) Model construction on utilization VAC framing system for nutrition care and food security of GLOCOL, Osaka University. The authors would like to thank researchers and colleagues of the National Institute of Nutrition of Viet Nam for their participation in the research, and also thank to local authorities, families, mothers and children in the commune for their invaluable help and support in the process of the research.

References

7) Nga TT, Ninh NX, Lam NT, et al. Nutritional status, anemia and some common infectious diseases among primary school children (aged 6-9 years old) in some rural areas of northern Viet Nam. In:


Tuan NM, Lap HK. Meal seen and practiced a solution in prevention and control of malnutrition for children under 5 years old in the mountainous area. In: Journal of Food and Nutrition Sciences, Vol.6-No.3+4-October 2010.