CHAPTER VI
POTENTIAL CONTRIBUTING FACTORS TO HEIGHT-FOR-AGE

6.1 Variables included in modeling analysis

6.1.1 Outcome variable

Height-for-age was selected as the outcome variable because of reflecting long-term nutritional status of children. The distribution of height for age Z-score of the sampled children was appropriately normal (as examined in part 4.1).

6.1.2 Independent variables

The variables selected for inclusion in the model were grouped in four categories: child variables, caregiver variables, household variables and commune variables. All of these variables were described in chapter 3.

Child variables include the *age group*, *sex* and *birth weight* of the child, *occurrence of life threatening illness,* and *number of antenatal care visits*. Child age was categorized into four groups (6-8 months, 9-11 months, 12-14 months, and 15-17 months). *Birth weight* of child and anthropometric indices association has been proven by many previous studies. As in other developing countries, collecting birth weight in Vietnam is very difficult. Among 1994 surveyed children, 12 per cent reported that parents did not know or could not remember their birth weights. As the use of this variable for the model analysis is essential, I transferred the variable into three groups (birth weight less than 2.5 kilograms, 2.5 kilograms or more, and not known/not remembered).I have also constructed an *Antenatal care variable* with 2 groups (less than 3 times, 3 times and more).

Caregiver variables involved in the model are *age group*, *education* and *ethnicity* of caregiver. *Age of caregiver* was classified as less than 20 years old and 20 years old and more. .The *Education* variable consists of completing secondary school and less group and higher educated group. *Ethnicity of caregiver* was divided into 2 groups (Kinh and non-kinh).

Many household variables (household durable assets, housing characteristics, using services, household human resource) were combined in a proxy variable called wealth index (see part 3.8.2). The wealth index, the *household economic status variable,* classified households into 3 groups: poorest (bottom 1 third), middle (next 1 third) and richest (the top 1 third)).

Community variables considered include 2 groups, health care related variables and available basic service variables. Health care related variables consist of *distance to the nearest public hospital, commune health centre provided fee reduction services for children, the commune health centre provided fee reduction services for the poor, having any on-going child health programme (*not including Expanded Programme on Immunization programme), *number of private clinics inside the commune, number of pharmaceutical stores inside the commune.* Available basic service variables included *commune had any shop selling basic provisions, public telephone system, piped water system, daily market inside commune.* In each of the group, the variables were combined into a composite variable measuring the general characteristic by Principle Components Analysis method. The two proxy variables generated, health care index and basic service index, were transferred into three-category variables (in which all communes were divided into 3 groups equally: the lowest (bottom 1 third), middle (next 1 third) and the highest (the top 1 third)). The location of the commune variable also was involved in the analysis. This variable consists of two categories (mountainous areas and plain areas).

6.2 Multilevel analysis results

The height-for-age Z-score was subjected to multilevel analysis for determining the associations of explanatory variables and child nutritional status of children aged 6 to 17 months. The multilevel modeling of height-for-age was performed in 4 steps in order to examine the changing nature of the explanatory potential of background characteristics. These four steps were designated as Model 1 – the intercept-only model, Model 2 – based on child characteristics, Model 3 – which incorporated child, caregiver and household background, Model 4 (full model) which also took into consideration the commune characteristics. All of the models consist of fixed and random parameters. The fixed effects of the models refer to the explanatory terms (gender, age etc.) in the regression equation, whilst the random part refers to the variances of the child and commune level error terms. In additional, *rho* was

calculated for every model (*rho* is 'intra-level-2-unit correlation'; in this case the intra-commune correlation). *Rho* measures the proportion of the total variance which is between-communes, given the covariates.

Table 23 shows the parameter estimates for the four multilevel models of height-for-age Z-scores for the children aged 6 to 17 months. The first model, Model 1, is the simplest variance component model. This model tells us that the commune level variation (approximately 16 per cent of the total variation (*rho*=0.16)) is not small when compared to the child level variation. In model 2, 3 and 4, step by step more variables were added into the analysis. *Rho* decreases sharply from 0.16 to 0.02 (means 2 per cent) in Model 4. This proves that the covariates (independent variables) in Model 4 almost explained all of the variation which is between-commune.

Returning the estimated regression coefficients of child characteristics, the coefficient for the first variable, *sex of child*, was statistical significant ($p<0.01$). The results in Table 23 shows that HAZ of girls was higher than that of boys about 0.14 holding all other explanatory variables constant. Model 2 to 4 also provide information on the relationship between child age and the outcome variable. Compared with the reference group (6-8 months of age), the regression coefficients of the 9-11 months group, 12-14 months group, 15-17 months group were -0.19, -0.33, and -0.64 in model 4 respectively. The results show that the older group was, the lower HAZ was. The coefficients for the variables *sex* and *age of child* were quite stable among the models shows that the association of *sex, age* and the outcome variable were not affected by other variables.

Regarding the other child variables, *birth weight*, *life threatening illness, antenatal care,* the coefficients changed very much from model 2 to model 3 (when adding the caregiver and household variables). It means that these variables were affected by the caregiver and household characteristics. In details, as expected low birth weight children had lower HAZ than the normal birth weight children did (highly significant at $p<0.01$ in all of the models). Antenatal care also had strong association with current HAZ of the child. Children whose mothers got three or more antenatal care had 0.15 HAZ higher than the others ($p<0.01$).

There were three caregiver background variables included in the models (*age, education, and ethnicity)*. Table 23 reveals that child whose caregiver was less than 20 years of age had lower HAZ than the others ($p<0.1$). The education of the caregiver also had a strong association with HAZ of the child. Caregivers with lower education had children with lower HAZ. Among the three caregiver variables, the *ethnicity variable* had strongest association with HAZ. Model 4 shows that children of Kinh caregivers had 0.3 Z-score higher than the children of non-Kinh caregivers in terms of height-for-age ($p<0.01$). The slightly changing of coefficients for *age* and *education of caregiver variables* when adding in the commune variables shows that the associations between the variables and child nutritional status were not affected by the commune characteristics. However, the coefficient for *ethnicity of caregiver variable* decreased remarkably when adding the commune variables.

Table 23 also shows the apparent association between household economic status and child nutritional status. Poor children tended to have poor nutritional status and it is highly significant. The coefficients did not change much from Model 3 to Model 4.

Model 4 (full model) incorporated all child level variables and commune level variables. Table 23 reveals that child nutritional status strongly associated with all of the three commune variables. Children who lived in plain areas Z-score was 0.24 higher than children who lived in mountainous area in terms of height-for-age ($p=0.01$). *Basic services available in commune* had positive association with child nutritional status. Children who lived in commune with more basic services tended to have higher HAZ. A similar association was also reported between *commune health care index variable* and height-for-age of the children. Children living in communes easily accessing health care services had higher HAZ.

Table 23 Multilevel regression models of height-for-age Z-scores for children aged 6 to 17 months

	Model 1		Model 2		Model 3		Model 4	
	Coef.	p-value	Coef.	p-value	Coef.	p-value	Coef.	p-value
Fixed part								
Intercept	-1.08	0.00	-1.28	0.00	-1.54	0.00	-1.84	0.00
Sex *(1: Girl; 0: Boy)*			0.15	0.00	0.14	0.00	0.14	0.00
Child age group								
6-8 months (ref.)			0.00		0.00		0.00	
9-11 months			-0.18	0.00	-0.18	0.00	-0.19	0.00
12-14 months			-0.31	0.00	-0.33	0.00	-0.33	0.00
15-17 months			-0.63	0.00	-0.64	0.00	-0.64	0.00
Birth weight								
Normal (ref.)			0.00		0.00		0.00	
Low birth weight (<2.5kg)			-0.53	0.00	-0.47	0.00	-0.47	0.00
Not known/not remembered			-0.33	0.00	-0.15	0.05	-0.11	0.14
Life threatening illness *(1:No, 0: yes)*			0.13	0.03	0.08	0.16	0.09	0.14
Antenatal care *(1: 3 times+, 0: less than 3)*			0.22	0.00	0.16	0.00	0.15	0.00
Age of caregiver *(1: Less than 20 years old; 0: 20+)*					-0.13	0.05	-0.11	0.09
Education of caregiver *(1:Secondary and less; 0: above)*					-0.17	0.01	-0.17	0.01
Ethnicity of caregiver *(1: Kinh; 0: Non-kinh)*					0.47	0.00	0.30	0.00
Household economics								
1/3 poorest (ref.)					0.00		0.00	
1/3 average					0.19	0.00	0.20	0.00
1/3 richest					0.25	0.00	0.27	0.00
Location of the commune *(1: plain; 0: mountainous)*							0.24	0.01
Commune basic service index								
1/3 lowest (ref.)							0.00	
1/3 average							0.22	0.01
1/3 highest							0.21	0.01
Commune health care index								
1/3 lowest (ref.)							0.00	
1/3 average							0.12	0.21
1/3 highest							0.21	0.02
Random part								
Variance of level 2 – commune	0.402		0.312		0.213		0.117	
Variance of level 1 – individual	0.937		0.887		0.876		0.874	
Rho	**0.16**		**0.11**		**0.06**		**0.02**	

(ref.): reference category (coef.): regression coefficient