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NUTRITIONAL STATUS IN CHILDREN UNDER 18 MONTHS AND ASSOCIATIONS WITH COMMUNITY'S CHARACTERISTICS IN 5 PROVINCES IN VIETNAM

Mr. Thach Duc Tran

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science Program in Health Development
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Thesis Title	NUTRITIONAL STATUS IN CHILDREN UNDER 18 MONTHS AND ASSOCIATIONS WITH COMMUNITY'S CHARACTERISTICS IN 5 PROVINCES IN VIETNAM.
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Field of Study	Health Development
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ทรัช ดัค ทราน: ความสัมพันธ์ของภาวะโภชนาการในเด็กวัยน้อยกว่า 18 เดือนกับลักษณะชุมชนใน 5 จังหวัด ประเทศเวียดนาม (NUTRITIONAL STATUS IN CHILDREN UNDER 18 MONTHS AND ASSOCIATIONS WITH COMMUNITY'S CHARACTERISTICS IN 5 PROVINCES IN VIETNAM) อ.ที่ปรึกษา: รศ.นพ.สังคม จงพิพัฒน์วณิชย์, อ.ที่ปรึกษาร่วม: รศ.นพ.เกรียงศักดิ์ ประสพสันติ, 72 หน้า

การวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาความชุกของภาวะทุโภชนาการและความสัมพันธ์ระหว่างลักษณะของชุมชนกับภาวะโภชนาการในเด็กอายุ 6 ถึง 17 เดือน ในจังหวัด Lao Cai, Hung Yen, Phu Yen, Ben Tre และ Da Nang ประเทศเวียดนาม โดยทำการวิจัยแบบ Cross-sectional study ในเด็กจำนวน 2,000 คนและผู้ดูแลเด็ก ผู้ดูแลเด็กจะได้รับการสำรวจโดยใช้แบบสอบถาม เด็กจะได้รับการชั่งน้ำหนัก วัดส่วนสูงและประเมินภาวะโภชนาการโดย height for age, weight for age และ weight for height และวิเคราะห์ความสัมพันธ์ระหว่างปัจจัยที่มีโอกาสเป็นไปได้สูงกับภาวะโภชนาการในเด็กโดยวิธี multilevel regression modeling ผลการศึกษาพบว่าความชุกของเด็กเตี้ยใน Da Nang, Ben Tre, Hung Yen, Phu Yen, และ Lao Cai เท่ากับร้อยละ 9.1 (95% CI [8.3 – 9.9]) , 10.9 (95% CI [10.4 – 11.3]), 14.3 (95% CI [13.9 – 14.8]), 18.7 (95% CI [17.6 – 19.8]) และ 32.2 (95% CI [31.2 – 33.1]) ตามลำดับ ความชุกของเด็กน้ำหนักตัวน้อยใน Da Nang, Ben Tre, Hung Yen, Phu Yen และ Ben Tre เท่ากับร้อยละ 15.4 (95% CI [14.7 – 16.1]), 24.8 (95% CI [24.1 – 25.5]), 20.6 (95% CI [19.9 – 21.4]), 31.7 (95% CI [30.5 – 33.0]) และ 30.6 (95% CI [30.0 – 31]) ตามลำดับ ความชุกของเด็กผอมใน Da Nang, Ben Tre, Hung Yen, Phu Yen และ Ben Tre เท่ากับร้อยละ 4.6 (95% CI [4.4 – 4.8]), 13.7 (95% CI [13.0 – 14.3]), 3.3 (95% CI [3.3 – 3.6]), 9.4 (95% CI [8.6 – 10.2]) และ 2.2 (95% CI [2.1 – 2.3]) ตามลำดับ ปัจจัยของการให้บริการพื้นฐานในชุมชนมีความสัมพันธ์เชิงบวกกับภาวะโภชนาการในเด็ก ปัจจัยการให้บริการด้านสุขภาพในชุมชนก็มีความสัมพันธ์เชิงบวกกับ Height for age เช่นเดียวกัน เด็กที่อาศัยอยู่ในชุมชนซึ่งสามารถเข้าถึงการให้บริการด้านสุขภาพได้ง่ายจะมี HAZ สูงกว่า จากการศึกษานี้สามารถสรุปได้ว่าภาวะทุโภชนาการในเด็กในจังหวัดที่ทำการศึกษายังคงเป็นปัญหาสาธารณสุขโดยเฉพาะในพื้นที่บริเวณภูเขา(Phu Yen และLao Cai) ลักษณะของชุมชนมีความสัมพันธ์กับภาวะโภชนาการในเด็กในจังหวัดอย่างมีนัยสำคัญ

สาขาวิชาการพัฒนาสุขภาพ
ปีการศึกษา 2549

ลายมือชื่อนิสิต.....
ลายมือชื่ออาจารย์ที่ปรึกษา.....
ลายมือชื่ออาจารย์ที่ปรึกษาร่วม.....

##487 50025 30: MAJOR HEALTH DEVELOPMENT
KEY WORD: CHILD, MALNUTRITION, COMMUNITY FACTORS, VIETNAM.

THACH DUC TRAN: NUTRITIONAL STATUS IN CHILDREN UNDER 18 MONTHS AND ASSOCIATIONS WITH COMMUNITY'S CHARACTERISTICS IN 5 PROVINCES IN VIETNAM. THESIS ADVISOR: ASSOC. PROF. SUNGKOM JONGPIPUTVANICH, THESIS CO-ADVISOR: ASSOC. PROF. KRIANGSAK PRASOPSANTI, 72 PAGES

This research was to identify the prevalence of malnourished children and the association between community's characteristics and children's nutritional status among the children aged 6 to 17 months in Lao Cai, Hung Yen, Phu Yen, Ben Tre and DaNang provinces in Vietnam. This was a cross-sectional study of 2000 children and their caregivers; a caregiver questionnaire survey was performed along with child anthropometric measurements. Child nutritional status was assessed by 3 indices: height-for-age, weight-for-age, and weight-for-height. To control the problem of hierarchical data, the multilevel regression modeling for child nutritional status was performed to clarify the association with its potential factors. The results show that the prevalence of stunting of children aged 6 to 17 months in DaNang, BenTre, HungYen, PhuYen and LaoCai was 9.1 per cent (95%CI[8.3-9.9]), 10.9 per cent (95%CI[10.4-11.3]), 14.3 per cent (95%CI[13.9-14.8]), 18.7 per cent (95%CI[17.6-19.8]) and 32.2 per cent (95%CI[31.2-33.1]) respectively. The prevalence of underweight in DaNang, BenTre, HungYen, PhuYen and LaoCai was 15.4 per cent (95%CI[14.7-16.1]), 24.8 per cent (95%CI[24.1-25.5]), 20.6 per cent (95%CI[19.9-21.4]), 31.7 per cent (95%CI[30.5-33.0]) and 30.6 per cent (95%CI[30.0-31]) respectively. The prevalence of wasting in DaNang, BenTre, HungYen, PhuYen and LaoCai was 4.6 per cent (95%CI[4.4-4.8]), 13.7 per cent (95%CI[13.0-14.3]), 3.3 per cent (95%CI[3.3-3.6]), 9.4 per cent (95%CI[8.6-10.2]) and 2.2 per cent (95%CI[2.1-2.3]) respectively. The analysis of association reveals the b*asic services available in commune* had a positive association with child nutritional status. Similar associations were 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. Based on the findings, this research concluded that child malnutrition in the provinces still was public health problem especially in mountainous areas (PhuYen and LaoCai). Community characteristics were significantly associated with child nutritional status in the provinces.

Field of study Health Development
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Student's signature.....
Advisor's signature.....
Co-advisor's signature.....

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ABBREVIATIONS

ARI	Acute Respiratory Infection
CDC	Centers for Disease Control and Prevention
CHC	Commune health centre
CI	Confidence interval
HAZ	Height for age Z-score
NGO	Non-government organisation
SD	Standard deviation
UNICEF	The United Nations Children's Fund
WHO	World Health Organisation
WAZ	Weight for age Z-score
WHZ	Weight for height Z-score
WI	Wealth index

CHAPTER I
INTRODUCTION

1.1 Rationale and Background

Malnutrition causes numerous short-term and long-term consequences for children - both physical and mental. It is implicated in more than half of all child deaths worldwide, a proportion unmatched by any infectious disease since the Black Death [1]. Yet it is not an infectious disease.

Children who suffer from growth retardation tend to have increased numbers of severe diarrhoeal episodes and a heightened susceptibility to certain infectious diseases, e.g. malaria, meningitis and pneumonia [2,3]. Evidence has shown that there is an association between increasing severity of anthropometric deficits and mortality, and a substantial contribution is made by all degrees of malnutrition to child mortality [4-7]. Strong evidence exists that poor growth is associated with delayed mental development; and that there is a relationship between impaired growth status and both poor school performance and reduced intellectual achievement [8]. Growth retardation in early childhood is also associated with significant functional impairment in adult life and reduced work capacity [1], thus affecting economic productivity.

Although child malnutrition declined globally during the last two decades, with the prevalence of stunted children in developing countries falling from 48% in 1980 to 26% in 2005 [9], national levels of malnutrition still vary considerably (0% in Australia; 49% in Afghanistan) [10]. The largest decline in the level of child malnutrition was in south-eastern Asia where stunting levels decreased by one half between 1980 and 2005. Stunting rates also declined in Latin America and the Caribbean where the rate of stunted children decreased by one third (from 18% to 11%) over the last 15 years. In contrast, south-central Asia still has high levels of child malnutrition, even though the rate of stunted children declined from 51% to 40% during the 1990s. In Africa, the number of stunted children actually increased between 1990 and 2005 (from 40 million to 49 million), and it is estimated 35% of all children under five years old are stunted, which signals that little changed from a decade earlier [9].

In Vietnam, similar to the rapid improvement of the economy, nutritional status of children has improved considerably over the last 20 years. In 1985, the rate of stunting in children under 5 years of age was 60% [11], that declined by around a half by 2005 [12]. In spite of the reduction, Vietnam still is one of the countries with the highest child malnutrition rates in the region (the rate of stunting in children under 5 years of age in Malaysia was 15% in 1999 [10], and that in Thailand was 8% in 2003 [10]). Otherwise, the reduction rates vary across regions of Vietnam [13], differ among economic classes, ethnic groups and between urban and rural areas [14, 15] .

Although, there are many efforts from both non-government organizations and government to change the situation over the past two decades, child malnutrition still is a public health problem in Vietnam. Thus, to develop cost-effectiveness intervention on child nutritional status, there is an urgent need to have clear understandings about child nutritional status, which children are more likely to face malnutrition, and the role of community characteristics in child nutritional status in the Vietnamese context.

1.2 Literature review

Overview of factors of child nutritional status

Almost all research on factors affecting child nutrition status have recently been conducted based on the United Nations Children's Fund's framework for the Causes of Child malnutrition [1] and the subsequent Extended Model of Care by Engle et al [16]. The framework is comprehensive, incorporating both biological and socioeconomic causes, and encompasses causes at both micro and macro levels. It recognizes three levels of causality corresponding to immediate, underlying, and basic determinants of child nutritional status.

The **immediate determinants** of child nutritional status manifest themselves at the level of the individual human being. They are dietary intake (energy, protein, fat, and micronutrients) and health status. The immediate determinants of child nutritional status are, in turn, influenced by three **underlying determinants** manifesting themselves at the household level. These are food security, adequate care for mothers and children, and a proper health environment, including access to health services. Associated with each is a set of resources necessary for their achievement. *Food security* is achieved when a person has access to enough food for an active and healthy life. The resources necessary for gaining access to food are food production,

income for food purchases, or in-kind transfers of food (whether from other private citizens, national or foreign governments, or international institutions). We know that no child grows without nurturing from other human beings. This aspect of child nutrition is captured in the concept of care for the children and their mothers, the latter who give birth to children and who are commonly their main caretakers after they are born. *Care*, the second underlying determinant, is the provision in households and communities of "time, attention, and support to meet the physical, mental, and social needs of the growing child and other household members". Examples of caring practices are child feeding, health seeking behaviors, support and cognitive stimulation for children, and care and support for mothers during pregnancy and lactation. The adequacy of such care is determined by the caregiver's control of economic resources, autonomy in decision making, and physical and mental status. All of these resources for care are influenced by the caretaker's status relative to other household members. A final resource for care is the caretaker's knowledge and beliefs. The third underlying determinant of child nutritional status, *health environment and services*, rests on the availability of safe water, sanitation, health care and environmental safety, including shelter.

A key factor affecting all underlying determinants is poverty. A person is considered to be in (absolute) poverty when the person is unable to satisfy his or her basic needs—for example, food, health, water, shelter, primary education, and community participation—adequately. The effects of poverty on child malnutrition are pervasive. Poor households and individuals are unable to achieve food security, have inadequate resources for care, and are not able to utilize (or contribute to the creation of) resources for health on a sustainable basis.

Finally, the underlying determinants of child nutrition (and poverty) are, in turn, influenced by **basic determinants**. The basic determinants include the potential resources available to a country or community, which are limited by the natural environment, access to technology, and the quality of human resources. Political, economic, cultural, and social factors affect the utilization of these potential resources and how they are translated into resources for food security, care and health environments and services.

Research on the association between child health and nutritional status

Diarrhoea and other infectious diseases manifested in the form of fever affect both dietary intake and utilization, which may have a negative effect on improved child nutritional status. A comparative study on children's nutritional status [17] indicated that stunting was highest among children with recent diarrhoea.

In a prospective study of morbidity pattern and nutritional status of a group of healthy newborns during their first year of life in a rural area near Alexandria [18], Ahmed and colleagues showed evidence of the significant effect of morbidity risk exposure on the nutritional status at the end of the first year.

Research on the association between dietary intake and nutritional status

There is a lot research showing the effects of dietary intake on nutritional status. Golder et al. in a study of dietary intake and nutritional status of pre-school children in the Republic of the Maldives concluded that marginal nutritional status and marginal malnutrition are due to low fat intake and selected micronutrient deficiency [19]. A prospective study of Vietnamese children documents that early introduction of solid foods (< 3 months of age), or failure to exclusively breastfeed at that age, is associated with poor growth up to 48 months of age [20].

Research on the association between care practices, care resources and nutritional status

Care practices were mentioned as important factors of child nutritional status in a lot of research. Research in the Philippines [21], Uganda [22], and Vietnam [20] children shows the association between the positive behavior of breastfeeding and positive nutritional status of children. Time spent in child care is also an important care aspect. However, summaries of studies related to this issue do not lend strong support to the hypothesis that a quantitative measure of mother's time spent on child care has a significant association with child nutritional status. Blau et al. after controlling for fixed effects showed that the only remaining associations with child weight were time spent by a non-female relative, and for child height, time spent by the mother [23]. Conversely, many studies found no association between child care time and nutritional status [24, 25].

Education is one of the most important resources that enable women to provide appropriate care for their children, which is an important determinant of children's growth and development [16]. Studies in the Philippines [26], Libya [27], and India [28] show a decreased incidence of malnutrition among young children with an increase in the level of mothers' education. Yet, some studies in Vietnam [13, 29] and Kenya [30] did not find the association between mother's education and child nutritional status.

Birth weight, child growth, and adolescent growth determine nutritional status before and during pregnancy (maternal nutrition). Maternal nutrition also influences fetal growth and birth weight [31]. The presence of an intergenerational link between maternal and child nutrition means a small mother will have small babies who in turn grow to become small mothers. Some findings on the relationship between maternal and child nutrition [32, 33] showed that a high proportion of low-birth-weight and stunted children were observed among malnourished mothers.

Beside maternal physical health, there are evidences of the relationship between maternal mental health and child malnutrition. Harpham et al. showed this relationship in the study at Vietnam and India [34]. However, the findings from Peru and Ethiopia in the same study did not provide clear evidence for a similar association.

Although women's employment enhances the household's accessibility to income, it may also have negative effects on the nutritional status of children, as it reduces a mother's time for childcare. Some studies have revealed that mothers of the most malnourished children work outside their home [35, 36]. Another study argued that there is no association between maternal employment and children's nutritional status [37].

Research on the association between domestic economics and nutritional status

The economic status of a household is also one of the most important determinants of child nutritional status [38]. Comparative studies on child nutrition for more than 15 countries [17] and some local studies in Vietnam [13, 29, 39] showed that the higher the level of economic status of the household, the lower the level of child stunting.

Research on the association between environmental, heath care behaviours and nutritional status

Unfavourable health environment caused by inadequate water and sanitation can increase the probability of infectious diseases and indirectly cause certain types of malnutrition [38]. A comparative study in some developing countries [17] showed that unprotected water source and non-availability of latrine were associated with low child stature.

Research on the association between child's own characteristics and nutritional status

Child's own characteristics are also mentioned in many studies. Schroeder showed that a cumulative indicator of growth retardation (height-for-age) in children is positively associated with age in a study in Vietnam [40]. One study showed that stunting is rare in birth 5 order 2-3 [17], and higher birth order (5+) is positively associated with child malnutrition [28]. Higher birth spacing is also likely to improve child nutrition, since the mother gets enough time for proper childcare and feeding. Studies in developing countries showed that children born after a short birth interval (less than 24 months) have higher levels of stunting in most countries where Demographic and Health surveys have been conducted [17, 41].

Research on the association between community characteristics and child nutritional status

There have been a number of attempts to examine the associations between community characteristics and child nutritional status. However few characteristics have been worked with, a few strong results have emerged. The sample sizes were usually small, and from a relatively small area without a lot of variation in important variables. Some research based on data of National Health Surveys, National Living Standard Surveys, Multipurpose Surveys like the research in north-east India [42] that had sufficient sample sizes mentioned only the region variable, not specific community characteristics. In Vietnam, there was only the research of Glewwe P. et al.[43] based on Vietnam Living Standard Survey data with sufficient sample size, however, that only considered community healthcare services.

In summary, factors affecting child malnutrition are very complicated. The immediate and underlying factors are well documented in the world as well as in Vietnam. However, the basic factors like community characteristics are not clarified. This study aims to provide evidence about those in the Vietnamese context.

CHAPTER II

RESEARCH OBJECTIVES AND CONCEPTUAL FRAMEWORK

2.1 Research questions and research objectives

- Research questions:
  - What is the prevalence of malnutrition among children aged 6 to 17 months in provinces: Lao Cai, Hung Yen, Phu Yen, Ben Tre, and DaNang?
  - What are the associations of community's characteristics and nutritional status in children aged 6 to 17 months in provinces: Lao Cai, Hung Yen, Phu Yen, Ben Tre, and DaNang?

- Research objectives:

1. To estimate the prevalence of malnutrition among children aged 6 to 17 months in provinces: Lao Cai, Hung Yen, Phu Yen, Ben Tre, and DaNang,
2. To describe the child's, the family's and the caregiver's characteristics for children from 6 to 17 months in 5 provinces: Lao Cai, Hung Yen, Phu Yen, Ben Tre, and DaNang,
3. To describe community's characteristics in 5 provinces: Lao Cai, Hung Yen, Phu Yen, Ben Tre, and DaNang,
4. To determine the associations of community's characteristics and nutritional status in children from 6 to 17 months when controlling for the effects of child's own, family's, caregiver's characteristics in 5 provinces: Lao Cai, Hung Yen, Phu Yen, Ben Tre, and DaNang.

2.2 Conceptual framework

The conceptual framework underlying this study (Figure 1) is adapted from the United Nations Children's Fund's framework for the Causes of Child Malnutrition[1] and the subsequent Extended Model of Care by Engle, et al.[16].

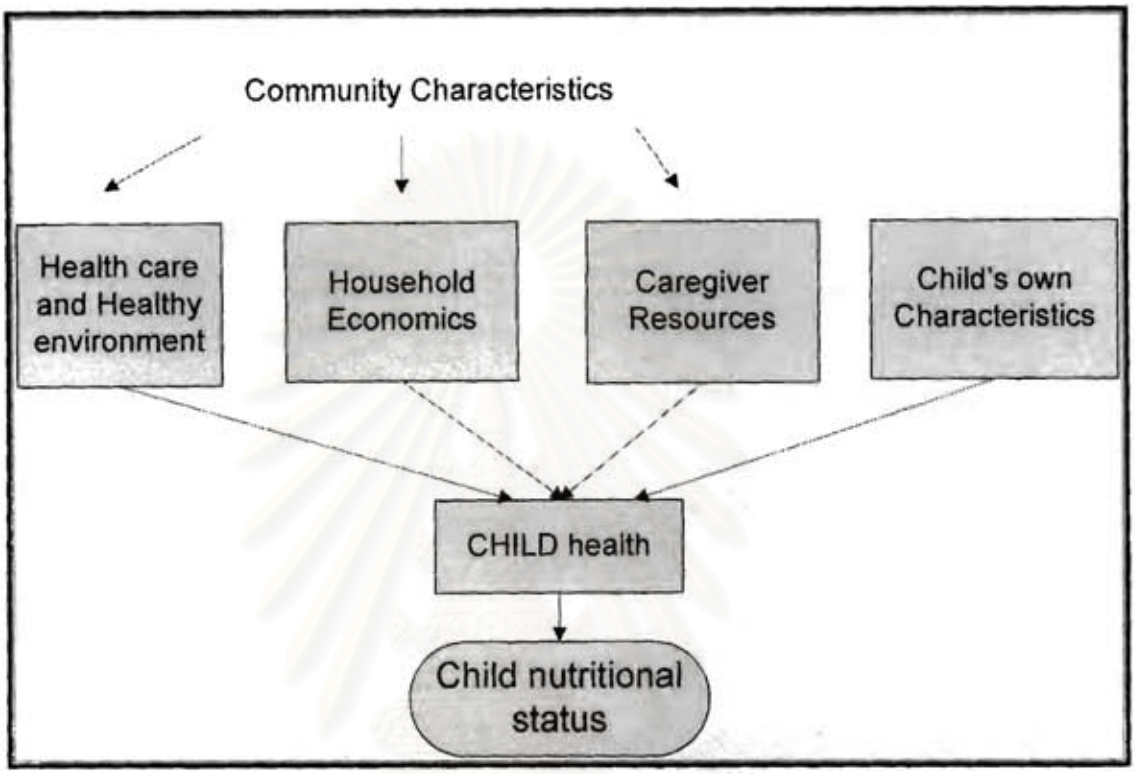


Figure 1. Conceptual framework on factors of child nutritional status

2.3 Keywords

Child, malnutrition, community factors, and Vietnam.

2.4 Research hypothesis

- The prevalence of malnutrition in children 6 to 17 months of age is different in 5 provinces: Lao Cai, Hung Yen, Phu Yen, Ben Tre, and DaNang.
- Besides child's, family's, caregiver's characteristics, the community's characteristics also have strong associations with nutritional status in children aged 6 to 17 months in provinces: Lao Cai, Hung Yen, Phu Yen, Ben Tre, and DaNang

2.5 Operational definitions

Malnutrition

Malnutrition is associated with both under-nutrition and over-nutrition. This research uses this term to refer to cases of under-nutrition. In children, malnutrition is synonymous with growth failure – malnourished children are shorter and lighter than they should be for their age [1].

There are three anthropometric indices weight-for-age (WA), height-for-age (HA) and weight-for-height (WH). The anthropometric indices are low if less than -2 SD of the reference population (National Center for Health Statistics) [44].

Low WH is considered an indicator of wasting (i.e., "thinness"). Low HA is considered an indicator of stunting (i.e., "shortness"). The third index, WA, is primarily a composite of WH and HA, and fails to distinguish tall, thin children from short, well-proportioned children.

Caregiver

Throughout this study, the term "caregiver" is used to refer to the primary caregiver. It is usually the mother of the child. In Vietnamese culture, mothers are the primary providers of food, as well as the primary caregivers for children. It is usually mothers who shop, prepare, and distribute the food for family meals, and mothers who provide the basic nurturing and care activities for children, such as feeding, cleaning, dressing, attending to illnesses, and keeping a watchful eye on the children's activities. However, if the child has separated from the mother for 1 year or the mother is not the biological mother, the main caregiver has been defined as the person who lives in the household and spends the most time for taking care of the child

Community

In this research, a community is a commune. A commune, in Vietnam, has a local government, commune health centre, primary school, post office and a market.

CHAPTER III
METHODS AND PROCEDURES

3.1 Research design

This research is based on part of the data from Young Lives study which is conducted from the year 2001 to 2015 on child well-being in Ethiopia, India, Peru and Vietnam (www.younglives.org.uk). The Young Lives study is a panel study that follows 2,000 children in each country from age 1 year until they are 15 years old. The caregiver and, when the child is old enough, both the caregiver and the child is interviewed every three to four years with a quantitative survey. The height and weight of each child is measured and community level questionnaires completed for each sentinel site at every data collection round.

Figure 2: Young Lives study

This research uses only the ***data of Vietnamese children in the fist round survey*** conducted in the year 2002 when the children were 6-17 months. Thus, this research is similar to a cross-sectional study.

3.2 Target population

The target population of this research is all children 6 – 17 months of age in 5 provinces: Lao Cai, Hung Yen, Phu Yen, Ben Tre, and DaNang.

3.3 Research Settings

Five provinces in this research, Lao Cai, Hung Yen, Phu Yen, Ben Tre, and DaNang, show some interesting characteristics:

LaoCai: typical province for the North-East and North-West, high percentage of minority ethnic groups, mountainous, underdeveloped infrastructure.

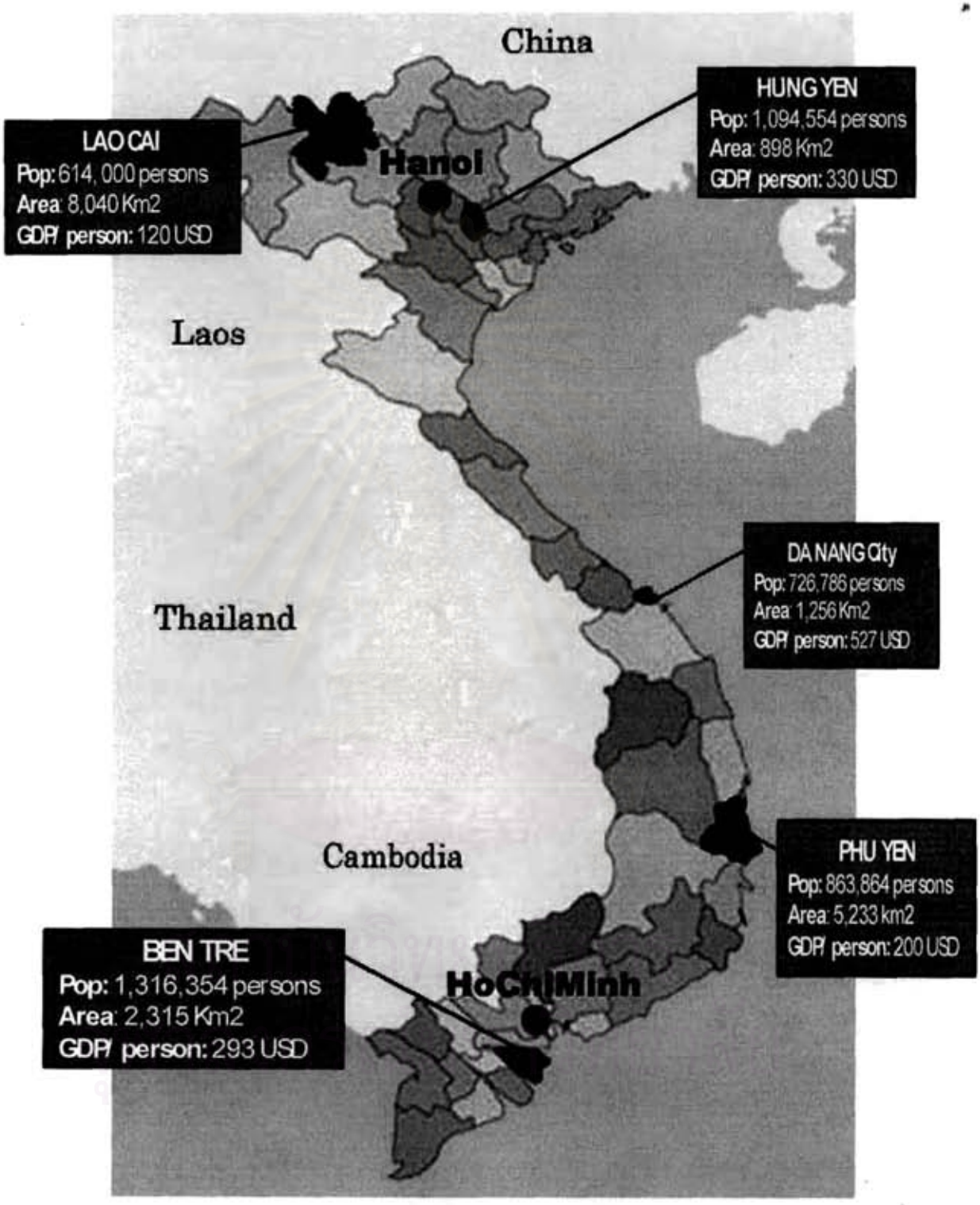
HungYen: typical rural representative of the Red River Delta region, populous; high population density, main source of income: rice farming, good infrastructure, near big cities (between Hanoi and Hai Phong), being influenced by urbanization.

PhuYen: typical province for central coast of Vietnam, suffering severe natural disasters, severely damaged by wars, mix of coastal, midland and highland, poor infrastructure, main sources of income from agriculture and seafood.

BenTre: typical province for Mekong River Delta, severely damaged by flooding, high percentage of landless families in rural area, low educational level.

DaNang: ranking in the middle of the five biggest cities in Vietnam, rapid urbanization, high level of education, receiving big investment from international sources and government, poverty rate is low.

Figure 3 – Study areas: LaoCai, HungYen, DaNang, PhuYen and BenTre



3.4 Sampling and sample size

Sampling process of Vietnam Young Lives study:

The sampling of Young Lives study is *sentinel site sampling with semi-purposive of sites* [45]. A sentinel site is defined as a commune. The sampling steps were: (1) In each of five provinces, ranking all communes in the province by poverty level: poor, average, better off and rich; (2) selecting 2 communes in the poor group, 1 in average, and 1 in the better off and rich which were most representative for each group providing four sentinel sites in each province; (3) screening and listing eligible children; (4) selecting a sample of 100 children in each sentinel site using simple random sampling [39].

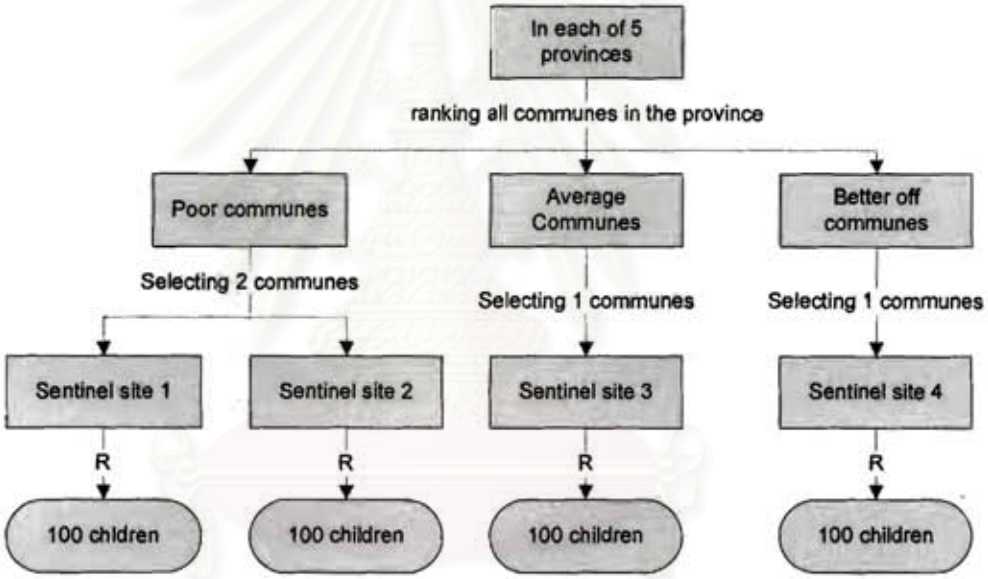


Figure 4 : Sampling process of Young Lives study

Sample size:

The sample size of Young Lives study is ***2000 children (400 children per province)***.

Inclusion and exclusion criteria

For this research, all of the children of Young Lives study will be involved. However, there were 6 children excluded from all analyses because data collectors could not measure their anthropometrics. For the analyses of prevalence of child malnutrition, there are no exclusion criteria. At first, in the thesis proposal, I planned

to exclude all children who have genetic, congenital, or chronic diseases related to short stature when analyzing association between child nutritional status and other variables. Nevertheless, when examining the database I found that the information on the diseases of surveyed children was not reliable. The data collection method for the Young Lives study was to interview caregivers using a structured questionnaire. The interviewers were not doctors. There was only one question which collected information on diseases. Therefore, the information gathered was not reliable enough to diagnose diseases for any children. In the end, I decided to not exclude any of the children from the analysis.

3.5 Research Variables

Independent variables:

- **Child:** sex, age, birth order, birth interval, chronic and acute diseases
- **Caregiver:**
  - + Primary information: age, ethnic, occupation
  - + Education: years of education
  - + Mental health: depression (Self-reporting questionnaire 20 items (SRQ20) recommended by WHO, validated in Vietnam)
  - + Social support: Active member of community groups, Receiving any spiritual/physical support
- **Child care:**
  - + Frequency meet the child of the biological mother and father
  - + Sending child to childcare facility since born or not
  - + Duration of breast-feeding:
- **Household level:**
  - + Wealth index: built around the five elements of household capital (natural, physical, human, financial, social)
  - + Number of economic shocks
  - + Source of drinking water, toilet facility
  - + Highest education in the household: years of education

- Community level:

Physical and social environment:

+ Urban/rural

+ Distance to the regional/district capital

+ Total land area, population

+ Activities used land most

+ Ecological classification for commune

+ Natural disasters occurred in the last 4 years

+ Largest ethnic groups in the commune

+ Major religious groups in the commune

Infrastructure and access:

+ Services available in commune: public telephone, piped water, electricity power.

+ Market available in the commune

+ Loudspeaker system available at hamlet level

+ Type of toilet used commonly in commune

+ Main source of drinking water

+ How rubbish is treated

+ Distance from the commune center to the nearest road accessible by car

+ Health and development programmemes in the commune

The economy:

+ 3 main economic activities undertaken by members of commune

+ Average income per capital/month in the commune

+ The main sources from which people in commune borrow money

Health care:

+ Distance to the nearest public hospital

+ Health programmes are being carried out by the commune health station

+ Number of traditional, western medicine clinics, and medicine shops in the commune

Outcome variables:

In this research, anthropometric methods were used to assess the nutrition status of children. Height and weight measurements of the children, taking age and sex into consideration, are converted into Z-scores based on the National Center for Health Statistics (NCHS) reference population to build three anthropometric indices,

height-for-age z-score (HAZ), weight-for-age z-score (WAZ), and weight-for-height z-score (WHZ) [46]. The Z-score cutoff point recommended by WHO to classify low anthropometric levels is 2 SD units below the reference median for each of the three indices [47].

3.6 Research instruments

In the Young Lives study, as the children were less than 24 months of age at the time of the survey, *recumbent length* was measured using a standard technique [48] to the nearest 1 mm with a portable wooden measuring board (ShorrBoard, Shorr Productions, USA) with moveable head-panel. *Body weight* of lightly clad children was measured using standard techniques [48] on a Seca UNICEF solar powered electronic scale and read to the nearest 0.1 kg. If the child was unable to stand on the scale, both the mother and child were weighed together, and the weight of the mother subtracted from the combined weight by a computer function in the electronic scales.

Other variables for the children, caregivers, and households were collected by household questionnaires (Annex 1). Besides that, a community questionnaire was designed for collecting information at community level (Annex 2). Those questionnaires were designed by an academic consortium involving the University of Reading, the London School of Hygiene and Tropical Medicine, London's South Bank University, the University of Sussex, and the South African Medical Research Council, and Vietnamese Principle Investigator. The questionnaires were also commented on by the Vietnamese Policy Advisory Committee and Technical Advisory Committee members. The questionnaires were also pre-tested and adapted for the local culture.

3.7 Data collection

A training course was undertaken for both anthropometrics measurers and interviewers. Training of anthropometric measurement techniques for the measurers was carried out by an expert from the National Institute of Nutrition. Anthropometry standardization exercises were conducted twice during the training of the anthropometry survey team. These measurements were recorded in a spreadsheet and a simple method was used to assess the precision and accuracy of the trainees' measurements in comparison to the measurements recorded by the supervisor. The standardization exercises are used to identify trainees who needed more training and

those anthropometric techniques that needed improvement. Questionnaire interviewers, who were staff from the General Statistics Office, went through a ten-day training course including two-day testing in fieldwork. They also had to pass an end of -course test.

In the first round survey, data was collected by 4 anthropometrics surveyors and 20 interviewers divided into 2 teams. The fieldwork was conducted from July to November 2002 under two levels of supervision and quality control. At the first level, there was a team leader and a supervisor of the data collection team who were responsible for administration and technical supervision. At the second level, quality control staff checked all completed questionnaires again before packing and sending to the central office. The first round data collection was done in a three-month period.

The respondents for the household questionnaire were the head of household and the primary caregiver. For the community questionnaire, the information was gathered by interviewing the leader of the commune or people responsible for the issue as well as from secondary data.

3.8 Data management and Analysis

Data entry and data cleaning was carried out by the Information Technology Unit of Research and Training Centre for Community Development. This process was done in Microsoft Access software with 10% double data entry.

3.8.1 Analysis strategy

The data analyses were performed in STATA version 9.0 in 3 stages below:

Stage 1 – Descriptive analysis

At the first stage, the distributions of HAZ, WAZ, and WHZ were described by descriptive statistics and graphic methods by provinces. All other variables were also be described the distributions in this step.

Stage 2 – Estimation of the prevalence of malnutrition

At the second stage, the estimated prevalence of stunted, underweight, and wasted children were calculated for each province. Since this research is designed as a complex survey (multistage sampling design), *Svy commands* in STATA [49] were applied to do these analyses that give estimates adjusted for sampling design. Options were used in *Svy commands* include *psu, strata, pweight, fpc.*

Stage 3 – Association analysis

In the analysis of association, only HAZ were involved to reflect the child nutritional status. The reason is that this research focuses on the community determinants of child nutritional status. These determinants influence child nutritional status in long-term. Height-for-age indicates the long-term nutritional status of the child. Therefore, HAZ is the most suitable.

To determine the association of potential factors and child nutritional status in this research, the *multilevel regression analysis* was applied. This is a quite complicated and newly developed technique. The rationale and basic principles are explained below.

The data structure in this research is hierarchical in which children are nested within their communes. It is also called multilevel data with level 1 is child and level 2 is commune. In such multilevel research, variables can be defined at any level of the hierarchy. Variables are measured at their natural level; for example, at commune level, I measured population, land area, and at the child level I measured sex, age. In traditional methods, it is usual to move variables by aggregation or disaggregation to one single level of interest, followed by ordinary statistical tests of association or ordinary multiple regression. Aggregation means that the variables at a lower level are moved to a higher level, for instance by computing commune mean child HAZ. Disaggregation means moving variables to a lower level, for instance by assigning to all children a variable that reflects the population of the commune they belong to.

Analyzing variables from different levels at one single common level creates two different sets of problems [50]. One of them is statistical. If data are aggregated, the result is that different data values from many subunits are combined into fewer values for fewer higher level units. Information is lost, and the statistical analysis loses power. On the other hand, if data are disaggregated, the result is that a few data values from a small number of super-units are "blown up" into values for a much larger number of subunits. Ordinary statistical tests treat all these disaggregated data values as independent information from this much larger sample. The proper sample size for these variables is of course the number of higher level units. Using the higher number of disaggregated cases for the sample size leads to significance tests that reject the null-hypothesis far more often than the nominal alpha level suggests. The other set of problems encountered is conceptual. If the analyst is not very careful in

the interpretation of the results, s/he may analyse data at one level, and draw conclusions at another level.

The most practical way to look at multilevel data is to investigate cross level hypotheses, or multilevel problems. Multilevel models are designed to solve this kind of problems in which all variables from different levels are analyzed simultaneously using a statistical model that includes the various dependencies. There are many multilevel models and the *multilevel regression models* are essentially a multilevel version of the familiar multiple regression model. The full *multilevel regression model* assumes that there is a hierarchical data set, with one single dependent variable that is measured at the lowest level and explanatory variables at all existing levels. This technique, *two-level regression model*, is the most suitable for the research question and data structure of this research.

The principle of constructing the *two-level regression model* is that conceptually the model can be viewed as a hierarchical system of regression equations. We can set up a separate regression equation in each separate commune to predict the dependent variable Y by the explanatory variable X as follows:

$$Y_{ij} = \beta_{0j} + \beta_{1j} X_{ij} + e_{ij} \qquad (1)$$

In this regression equation β_{0j} is the usual intercept, β_{1j} is the usual regression coefficient, and e_{ij} is the usual residual error term. The subscript j is for the communes and the subscript *i* is for children. The difference with the usual regression model is that we assume that each commune is characterized by a different intercept coefficient β_{0j} and also a different slope coefficient β_{1j}. In other words: the intercept and slope coefficients are assumed to vary across the communes.

Across all communes, the regression coefficients have a distribution with some mean and variance. The next step in the hierarchical regression model is to predict the variation of the regression coefficients by introducing explanatory variables at the commune level, as follows:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} Z_j + u_{0j} \qquad (2)$$

and

$$\beta_{1j} = \gamma_{10} + \gamma_{11} Z_j + u_{1j} \qquad (3)$$

Equation (2) states that the intercept β_{0j} can be predicted by variable Z of commune level. The equation (3) states that the relationship between outcome variable Y and the variable X depends upon the variable Z. The u-terms u_{0j} and u_{1j} in equation (2) and (3) are residual error terms at commune level, and to be independent from the residual errors e_{ij} at child level.

The model with one child level and one commune level explanatory variable can be written as one single complex regression equation by substituting equations (2) and (3) into equation (1):

$$Y_{ij} = \gamma_{00} + \gamma_{10} X_{ij} + \gamma_{01} Z_j + \gamma_{11} Z_j X_{ij} + u_{1j} X_{ij} + u_{0j} + e_{ij} \qquad (4)$$

In general, there are more than one explanatory variable at every level. Assume that we have P explanatory variables X at the child level, indicated by the subscript p (p=1..P). Likewise, we have Q explanatory variables Z at the commune level, indicated by the subscript q (q=1..Q). Then, equation (4) becomes the more general equation:

$$Y_{ij} = \gamma_{00} + \gamma_{10} X_{pij} + \gamma_{0q} Z_{qj} + \gamma_{pq} Z_{qj} X_{pij} + u_{pj} X_{pij} + u_{0j} + e_{ij} \qquad (5)$$

The ordinary single level regression model would estimate only the intercept and (P+Q) regression slopes. Conversely, even with a modest number of explanatory variables at both levels, equation (5) implies a very complicated model (P regression slopes for the level 1, Q regression slopes for level 2, and PxQ regression slopes for cross level interactions). Usually, we do not want to estimate the complete model, because this is likely to get us into computational problems, and also because it is very difficult to interpret such a complex model.

Fortunately, computer programmes like HLM, VARCL, GLLAMM, and MLn allow us to specify which regression coefficients are assumed to vary and which not, and to include only a few selected cross level interactions. So that, generally we limit ourselves to parameters that have proven their worth in previous research, or are interesting in view of our theoretical problems. However, there still are so many variables in my research, so that I will use an exploratory procedure to select a model.

Analysis strategies of building multilevel regression model

This analysis was performed in STATA version 9 (using *xtmixed* command). The exploratory procedure was used to select a best model. The procedure is to start with

the simplest possible model, the intercept-only model, and to include the various types of parameters step by step. At each step, we inspect the results to see which parameters are significant, and how much residual error is left at the two distinct levels.

In detail, there are 4 models were built. In the first model, the *intercept-only model*, I analyzed a model with no explanatory variables. The second model was built with only child variables. The caregiver and household variables were added in the third model. In last, the model consisted of all significant variables in previous models and community variables. In each model, only variables having significant association with the outcome variable were kept in the model and moved to the upper model. In this analysis, significant level of p-values is less than 0.1.

3.8.2 Indices calculation

Nutritional indices: Anthropometric indices were computed using the EpiNut module of Epi Info 2002. This module uses the CDC 2000 reference and calculates Height-for-Age Z-Score, Weight-for-Age Z-Score, and Weight-for-Height Z-Score from child's height, weight, age and sex.

Wealth index: this is a composite variable that measures the poverty level of a household. The variable was constructed by Principle Components Analysis from information on household ownership of durable goods, housing characteristics, basic services, and human resource. There are some other approaches, "direct" measures, such as income, expenditure or consumption. Those are both expensive and difficult to collect, therefore, this study does not apply those approaches.

The Household Wealth Index was constructed using three steps. In the first step, 14 variables were chosen to represent household durable assets (four variables), housing characteristics (four variables), services (three variables), human resource (two variables), and poverty classification by community leaders (Table 1). In the second step, using principal component analysis, the asset index, A_i, for individual household i was defined as

$$A_i = \sum_k \left[f_k \frac{(a_{ik} - \bar{a}_k)}{s_k} \right],$$

where a_{ik} is the value of asset k for household i, $\bar{a}_k$ is the sample mean, and s_k is the sample standard deviation. The household score index, A_i, is the sum of scores of the included variables weighted by the elements of the first eigenvector.

In the third step, households were classified into living standards quintiles. Quintiles grouped by cut-off points of 20%, 40%, 60%, and 80% of the household wealth index score distribution were used stratified by provinces. In some instances, three groups: poorest (bottom 1 third), middle (next 1 third) and the rich (the top 1 third) or two groups: the poor (bottom 40%) and the non-poor /better off (upper 60%) were used.

Table 1 Household asset items used in constructing household wealth index using principal component analysis

Household asset item	Variable description
Household durable assets:	
Motorbikes	0 = No; 1 = Yes
Television set	0 = No; 1 = Yes
Telephone	0 = No; 1 = Yes
Refrigerator	0 = No; 1 = Yes
Housing characteristics	
Number of rooms per person considering household equivalence scale	room/person
House wall material	1 = Brick/concrete; 0=other
House roof material	1=concrete/tiles/slates; 0=other
House floor material	1=Cement/tile/laminated;0=Other
Services	
Main source of drinking water	1= running or bored well,0 = other
Kind of toilet facility	Water flushed latrine/semi-sealed latrine= Yes, 0 = other
Type of fuel for cooking	1=Gas/electricity; 0=other

Household human resource	
Highest educated	1=not yet going to school, 2=primary; 3=secondary; 4=high school; 5=above
Human resource = members (*able-bodied, aged 18-<60 years old, * 1.5 if completed primary, * 2 if completed secondary education, * 2.5 if completed higher education*)/household size	ratio
Household wealth status classified by commune leaders using the government's income per capita criteria	1 = Poor; 0= average or better.

3.9 Ethical considerations:

In each phase of the Young Lives study – including the selection of sentinel sites and eligible children, and conducting interviews – written consent forms for all aspects of the research were sent to participants and local government at different levels (i.e. provincial, district, and communal). Besides getting research ethics approval from London South Bank University UK, London School of Hygiene and Tropical Medicine UK, and Reading University UK, in Vietnam ethical approval for the Young Lives project was granted by VUSTA [39].

For this research, the proposal got the approval of Research Ethics Committee of Chulalongkorn University.

3.10 Identification of limitations

The Young Lives study is a well-designed study with high quality data. At the moment only the first round data is available. Therefore, my research, based on the data of Young Lives study, can only assess the associations between some variables and child nutritional status.

3.11 Generalising from the findings

The findings of this research are based on data from 5 provinces. They should not be generalised for all Vietnamese children. The results can only be generalised for children from 6 – 17 months in Lao Cai, Hung Yen, Phu Yen, Ben Tre and DaNang.

CHAPTER IV
STUDY POPULATION CHARACTERISTICS

Among 2000 sampled children in the Young Lives study, there were 6 children not measured for height and weight. Thus, all of my analyses were based on the data obtained from 1994 children who have complete collected data.

4.1 Characteristics of surveyed children

Table 2 provides information on the general characteristics of the survey sample in total and by province. Overall, the proportion of children aged 6-8 months (the youngest group) and the proportion of children aged 15-17 months (the oldest) were 20 per cent and 22.1 per cent of the survey sample, less than those in the other age groups (28.7 per cent of children aged 9-11 months and 29.2 per cent of children aged 12-14 months). Almost of all surveyed samples of the five provinces shared the same characteristics of child age. Only in PhuYen the percentage of children in the 15-17 months age group (30.6 per cent) was higher than the other groups (proportions of children aged 6-8 months, 9-11 months and 12-14months were 12.5 per cent, 29.6 per cent, and 27.3 per cent respectively).

Beside age, gender of a child is very important when assessing child nutrition in population. Among the surveyed sample, the proportion of male was slightly higher then that of female (51.5 per cent compared with 48.5 per cent), yet in BenTre the proportion of male was less than that of female. The sex-distribution of the survey sample reflects that of the population, according to Vietnam Population Census Survey 1999,

In the survey sample, 56.8 per cent of the children in LaoCai and 13.3 per cent of the children in PhuYen were non-kinh group (ethnic minority). In Vietnam, there are 54 ethnic groups. However, the Kinh make up 87 per cent of the total population. The minority ethnic groups tend to live in mountainous, under-developed areas.

Table 2 also presents information on child' siblings, ethnicity and living with parents. Overall, nearly half of the children had no siblings at that point of time. In PhuYen and LaoCai, the percentages of children having 2 or more siblings were much higher than that in the others (27 per cent and 25.6 per cent compared with 7.8 per cent 12 per cent and 15.8 per cent). The reason is that PhuYen and LaoCai have high proportions of ethnic minority households who usually have many children. The

proportion of children living with both mother and father was 95.7 per cent of the survey sample. The proportions in HungYen and DaNang were slightly lower than that in the others because people in those provinces usually work and live far from their houses.

Characteristics of pregnancy and delivery with the children are shown in Table 3. Weight of birth is the most important index of child nutritional status when delivered. Overall, 8.6 per cent of the children were reported as having a less than 2.5 kilograms weight at birth (low birth weight). The figure was an under-estimate of low birth weight proportion as for 12.1 per cent of the children birth weight was not known or not remembered. However, the proportion of low birth weight children in the survey sample is accurate compared with the UNICEF/WHO estimates of the incidence of low birth weight in 2000 [51]. Regarding antenatal care, nearly 1 in every 5 mothers of the children received no antenatal care during the pregnancy period. The proportions in PhuYen (25 per cent) and LaoCai (41 per cent) were much higher than that in the others (10 per cent in BenTre, 9 percent in HungYen and 6 per cent in DaNang). Overall, half of the children were delivered at hospitals, 1 in every 5 children were delivered at home. The proportions of children delivered at home were very high in LaoCai (55.5 per cent) and PhuYen (29.1 per cent). The figures from Table 2 show that pregnancy and delivery care in PhuYen and LaoCai was not as good as that in the others.

Breastfeeding is the most important nutrition source for children during the first year of life. Among the surveyed children, almost of them were breastfeed (98.1 per cent – Table 4). 96.7 per cent of children were breastfeed at least 6 months. With respect to vaccination status of the children, 79 per cent of children were reported receiving as BCG vaccination, 9.9 per cent did not receive it and 10.5 per cent their parents did not remember or did not know. For measles vaccination, the figures were 80.3 per cent, 11.1 per cent and 8.7 per cent respectively. Overall, the coverage percentages of the vaccinations in the survey sample are less than that shown in Vietnam National Demographic and Health Survey 2002 (the coverage of BCG vaccination among children in Vietnam in 2002 was 93 per cent and that of measles vaccination was 83 per cent [52]. The number of children reported not receiving BCG vaccinations in PhuYen (12 per cent), LaoCai (14 per cent) and HungYen (18 per cent) were higher than that in the others (4.3 per cent in BenTre and 1.8 per cent in DaNang).

Table 5 shows physical health of children. Overall, 5.6 per cent of surveyed children reported diarrhoea and 3.7 per cent reported a high fever with cough lasting at least 24 hours. 4.3 per cent of children were perceived as having long-term health problems. 13 per cent of children were reported to have a life threatening illness or injury. The proportions of children illness are not much different across provinces except diarrhoea and life threatening illnesses/injuries.

Table 2 General characteristics of studied children by province

Characteristics	PhuYen	BenTre	LaoCai	HungYen	DaNang	Total
	n %	n %	n %	n %	n %	n %
Total	**399**	**399**	**398**	**399**	**399**	**1994**
	100	**100**	**100**	**100**	**100**	**100**
Age groups (months)						
6 - < 9	50	91	90	90	77	398
	12.5	22.8	22.6	22.6	19.3	20.0
9 - < 12	118	107	115	129	104	573
	29.6	26.8	28.9	32.3	26.1	28.7
12 - < 15	109	125	132	90	126	582
	27.3	31.3	33.2	22.6	31.6	29.2
15 - < 18	122	76	61	90	92	441
	30.6	19.1	15.3	22.6	23.1	22.1
Sex						
Male	206	197	206	215	203	1027
	51.6	49.4	51.8	53.9	50.9	51.5
Female	193	202	192	184	196	967
	48.4	50.6	48.2	46.1	49.1	48.5
Number of siblings						
No	155	211	176	189	175	906
	38.9	52.9	44.2	47.4	43.9	45.4
1	135	157	120	162	161	735
	33.8	39.4	30.2	40.6	40.4	36.9
2 and more	109	31	102	48	63	353
	27.2	7.8	25.6	12.0	15.8	17.7
Ethnicity						
Kinh	346	399	172	399	397	1713
	86.7	100	43.2	100	99.5	85.9
Others	53	0	226	0	2	281
	13.3	0	56.8	0	0.5	14.1

Living with parents						
With mother and father	388 97.2	385 96.5	384 96.5	374 93.7	377 94.5	1908 95.7
With either mother or father	11 2.8	14 3.5	13 3.3	20 5.0	20 5.0	78 3.9
With neither mother nor father	0 0	0 0	1 0.3	5 1.3	2 0.5	8 0.4

Table 3 Characteristics of pregnancy and delivery with the children by province

Characteristics	**PhuYen**	**BenTre**	**LaoCai**	**HungYen**	**DaNang**	**Total**
	n **%**	**n** **%**	**n** **%**	**n** **%**	**n** **%**	**n** **%**
Total	**399** **100**	**399** **100**	**398** **100**	**399** **100**	**399** **100**	**1994** **100**
Weight of birth(kg)						
2.5 and more	291 72.9	372 93.2	204 51.3	344 86.2	371 93.0	1582 79.3
Less than 2.5	48 12.0	26 6.5	25 6.3	47 11.8	25 6.3	171 8.6
Not known, not remembered	60 15.0	1 0.3	169 42.5	8 2.0	3 0.8	241 12.1
Antenatal visits						
No	99 24.9	39 9.9	162 40.7	35 8.8	23 5.8	358 18.0
1-2 times	160 40.3	132 33.3	148 37.2	125 31.3	78 19.6	643 32.3
3 times and more	138 34.8	225 56.8	88 22.1	239 59.9	298 74.7	988 49.7
Place of delivery						
Hospital	190 47.6	200 50.1	94 23.6	219 54.9	293 73.4	996 50.0
Commune health centre	77 19.3	147 36.8	81 20.4	162 40.6	96 24.1	563 28.2
Home	116 29.1	16 4.0	221 55.5	17 4.3	6 1.5	376 18.9
Other	16 4.0	36 9.0	2 0.5	1 0.3	4 1.0	59 3.0

Table 4 Characteristics of child care among the children by province

Characteristics	PhuYen	BenTre	LaoCai	HungYen	DaNang	Total
	n %	n %	n %	n %	n %	n %
Total	**399** **100**	**399** **100**	**398** **100**	**399** **100**	**399** **100**	**1994** **100**
Duration of breastfeeding						
No	**2** **0.5**	**3** **0.8**	**6** **1.5**	**15** **3.8**	**12** **3.0**	**38** **1.9**
Less than 6 months	**0** **0**	**6** **1.5**	**1** **0.3**	**1** **0.3**	**20** **5.0**	**28** **1.4**
6 months and more	**397** **99.5**	**390** **97.7**	**391** **98.2**	**383** **96.0**	**367** **92.0**	**1928** **96.7**
Total	**399** **100**	**399** **100**	**398** **100**	**399** **100**	**399** **100**	**1994** **100**
BCG vaccination						
Yes	303 75.9	351 88.0	283 71.1	278 69.7	373 93.5	1588 79.6
No	**48** **12.0**	**17** **4.3**	**55** **13.8**	**70** **17.5**	**7** **1.8**	**197** **9.9**
Not know	48 12.0	31 7.8	60 15.1	51 12.8	19 4.8	209 10.5
Total	**399** **100**	**399** **100**	**398** **100**	**399** **100**	**399** **100**	**1994** **100**
Measles vaccination (for children > 12 months						
Yes	152 65.8	170 84.6	143 74.1	157 87.2	199 91.3	821 80.3
No	**51** **22.1**	**13** **6.5**	**22** **11.4**	**16** **8.9**	**11** **5.1**	**113** **11.1**
Not know	28 12.1	18 9.0	28 14.5	7 3.9	8 3.7	89 8.7
Total	**231** **100**	**201** **100**	**193** **100**	**180** **100**	**218** **100**	**1023** **100**

Table 5 Physical health of the children by province

Health problems	PhuYen	BenTre	LaoCai	HungYen	DaNang	Total
	n %	n %	n %	n %	n %	n %
Total	**399** **100**	**399** **100**	**398** **100**	**399** **100**	**399** **100**	**1994** **100**
Last 24 hours						
3 or more loose or watery stools	34 8.5	14 3.5	17 4.3	32 8.0	15 3.8	112 5.6
High fever and cough	16 4.0	8 2.0	22 5.5	13 3.3	15 3.8	74 3.7
Perceive of long term health problem	13 3.3	18 4.5	12 3.0	18 4.5	24 6.0	85 4.3
Occurrence of life threatening illnesses or injuries	74 18.6	46 11.5	68 17.1	40 10.0	33 8.3	261 13.1

4.2 Characteristics of the primary caregivers

Table 6 shows information about the primary caregivers of the surveyed children (hereafter called "the caregivers"). It can be seen that almost all caregivers were biological mothers (98.7 per cent). The majority of the caregivers were in the 20 to 29 years age group. Thus, 1 in every 10 caregivers was less than 20 years of age, the proportion was double in LaoCai. Only 2.9 per cent of the caregivers were older than 40 years.

The education levels of the caregivers are presented in Table 6. Overall, the proportion of low educated caregivers (no schooling and not completed primary) was 27.3 per cent. The proportion was highest in LaoCai, and then is PhuYen and BenTre. Even in DaNang, a big city, 10 per cent of the surveyed caregivers were in a low education group. The percentage of caregivers completing high school and above was low (6 per cent in PhuYen, 7.6 per cent in BenTre, and 5.3 per cent in LaoCai). That figure in DaNang is much higher (20.5 per cent).

Ethnicity of the caregivers was the same as that of their children. More than half of the caregivers in LaoCai were non-kinh ethnic groups and the rate in PhuYen was 13.3 per cent.

Table 6 Characteristics of the primary caregivers by province

Health problems	PhuYen	BenTre	LaoCai	HungYen	DaNang	Total
	n %	n %	n %	n %	n %	n %
Total	399 100	399 100	398 100	399 100	399 100	1994 100
Relationship to the child						
Biological mother	397 99.5	397 99.5	392 98.5	388 97.2	393 98.5	1967 98.7
Others	2 0.5	2 0.5	6 1.5	11 2.8	6 1.5	27 1.4
Age						
Less than 20	23 5.8	45 11.3	91 22.9	43 10.8	10 2.5	212 10.6
20 to less than 30	266 66.7	233 58.4	245 61.6	279 69.9	212 53.1	1235 61.9
30 to less than 40	102 25.6	114 28.6	48 12.1	65 16.3	160 40.0	489 24.5
40 and more	8 2.0	7 1.8	14 3.5	12 3.0	17 4.3	58 2.9
Education level						
No schooling/not completed primary	135 33.8	135 33.8	216 54.3	20 5.0	39 9.8	545 27.3
Primary	184 46.1	182 45.6	117 29.4	153 38.4	115 28.8	751 37.7
Secondary	56 14.0	52 13.0	44 11.1	178 44.6	123 30.8	453 22.7
High school	12 3.0	15 3.8	11 2.8	34 8.5	54 13.5	126 6.3
Higher	12 3.0	15 3.8	10 2.5	14 3.5	68 17.0	119 6.0
Ethnic						
Kinh	346 86.7	399 100	172 43.2	399 100	397 99.5	1713 85.9
Others	53 13.3	0 0	226 56.8	0 0	2 0.5	281 14.1

4.3 Characteristics of the households

Table 7 presents information on the main characteristics of the surveyed households. Each household had only one child aged 6-17 months of age involved in this study. Therefore, the total surveyed households was equal to the total of surveyed children (1994).

Majority of the households had 4-6 household members (medium size) living and eating together. 22.6 per cent of the household were of a small size (3 or fewer members) and 17 per cent a large size (7 or more members). Among the 5 provinces, households in HungYen had the smallest average household size. Table 7 also provides information about the highest education levels in the households. When compared with education levels of the caregivers (table 6), the highest education levels in the households were much better. The proportion of household where no one had completed primary school was 7.5 per cent, compared with 27.3 per cent of caregivers. Almost all low educated households were in PhuYen, BenTre and LaoCai.

Household characteristics are shown in table 7. 58.6 per cent of household had walls built of brick or concrete, 47.7 per cent had sturdy roofs and 55 per cent had floors of finished materials. The house characteristics varied province by province. Houses of the households in Ben Tre and Lao Cai had poorer quality than others. In HungYen and DaNang, the three characteristics were not consistent. The floor characteristic in HungYen was not as good as wall and roof. Conversely, the roofs in DaNang were not as good as walls and floors.

Regarding durable assets, table 7 shows information on 4 main assets in the surveyed households. More than half of the households had colour TVs, nearly half had motorbikes, and 1 in every 10 households had refrigerators and phones. The proportions changed across provinces. LaoCai had fewest households having these assets and DaNang had most households having these assets.

Like owning durable assets, using basic services also shows household economic status. Electricity is the most basic service. 15.6 per cent of the households did not use electricity (most settled in LaoCai, PhuYen and BenTre). Very few households in BenTre, LaoCai and BenTre reported using clean sources of drinking water (1.5 per cent, 2.8 per cent and 6.8 per cent respectively). .In DaNang the proportion using flush/septic tank toilets was high (84 per cent). The proportions in the other provinces were less than 10 per cent. Half of the households in DangNang used gas or electricity for cooking. The percentages in the others were very low.

Table 7 Characteristics of the studied households by province

Characteristics	PhuYen	BenTre	LaoCai	HungYen	DaNang	Total
	n %	n %	n %	n %	n %	n %
Total	**399** **100**	**399** **100**	**398** **100**	**399** **100**	**399** **100**	**1994** **100**
Household size (person)						
3 and less than	95 23.8	84 21.1	80 20.1	120 30.1	72 18.1	451 22.6
4 – 6	254 63.7	239 59.9	233 58.5	246 61.7	232 58.2	1204 60.4
7 and more	50 12.5	76 19.1	85 21.4	33 8.3	95 23.8	339 17.0
Highest education						
No schooling/not completed primary	34 8.5	38 9.5	71 17.8	3 0.8	3 0.8	146 7.5
Primary school	175 43.9	161 40.4	191 48.0	93 23.3	58 14.5	678 34.0
Secondary school	134 33.6	107 26.8	91 22.9	185 46.4	115 28.8	632 31.7
High school	32 8.0	61 15.3	23 5.8	74 18.6	96 24.1	286 14.3
Above	24 6.0	32 8.0	22 5.5	44 11.0	127 31.8	249 12.5
Housing quality						
Wall – brick or concrete	266 66.7	124 31.1	29 7.3	372 93.2	377 94.5	1168 58.6
Roof – sturdy	241 60.4	42 10.5	157 39.5	357 89.5	155 38.9	952 47.7
Floor – finished material	282 70.7	95 23.8	139 34.9	199 49.9	382 95.7	1097 55.0

Characteristics	PhuYen	BenTre	LaoCai	HungYen	DaNang	Total
	n %	n %	n %	n %	n %	n %
Durable assets						
Colour television	200 50.1	247 61.9	113 28.4	219 54.9	326 81.7	1105 55.4
Motorbike	152 38.1	189 47.4	94 23.6	115 28.8	292 73.2	842 42.2
Phone	17 4.3	52 13.0	4 1.0	16 4.0	162 40.6	251 12.6
Refrigerator	13 3.3	39 9.8	7 1.8	12 3.0	139 34.8	210 10.5
Services						
Electricity	306 76.7	308 77.2	275 69.1	399 100	398 99.8	1686 84.6
Drinking water – cleaned	27 6.8	6 1.5	11 2.8	278 69.7	338 84.7	660 33.1
Toilet facility – Flush/septic tank toilet	30 7.5	39 9.8	12 3.0	24 6.0	335 84.0	440 22.1
Cooking material – Gas/electricity	20 5.0	53 13.3	7 1.8	21 5.3	196 49.1	297 14.9

4.4 Characteristics of the communes

The 1994 surveyed children were distributed in 31 communes. The information on the 31 communes was collected by Community Questionnaire. Among the surveyed communes, there were urban and rural communes (ratio 4:27); low, medium and high population density communes (one third of the communes in each group); coastal, plain and mountainous communes (14, 8 and 9 communes respectively). 18 of the 31 surveyed communes had no ethnic minority groups. There were 4 communes (Pacheo, PhongNien, BanXeo, Tachai) in which at least half of the population was ethnic minority people (H'mong, Nung, Tay).

Table 9 presents information on infrastructure and services of the surveyed communes. Among the communes, there were 6 communes with no public telephone, only 8 communes had piped water systems, 2 communes did not have any shops selling basic provisions. Some communes had no market (3 in 31), some had weekly markets (4 in 31). Most of them had daily markets. The type of toilet used and how rubbish is treated shows the level of development and levels of public health

provision Half of the communes in which households with no toilet were common. Among the surveyed communes, only 6 of them had garbage collection system.

The main economics activities in 25 communes were agriculture for 3 it was fishing and for 3 others handicraft, trade and services (table 10). This is to be expected as 27 of the surveyed communes were in rural areas where agriculture plays a very important role in the life of people.

Table 11 shows distribution of the communes by on-going projects and programmes. At that time, 24 of the 31 communes had programmes on preventing child malnutrition. Those programmes were implemented by both government and non-government organizations. Other programmes like general health or poverty alleviation were also very popular in the surveyed communes. Other child health programmes like preventing ARI, Diarrohea (not including Expanded Programme on Immunization programme that was being run in every commune of Vietnam) were being carried out in more than half of the communes.

Tables 12, 13 and 14 provide information on the health care situation for local people. In Vietnam, commune health centres (CHCs) play a very important role in the government health care system. The CHCs provide basic health care services to people both preventing and treating, especially in rural areas. Fee reduction for the poor and children of CHCs helps reduce the burden of health care expenditure for vulnerable people. Tables 13 shows that 25 CHCs in 31 surveyed CHCs had fee reduction policy for children and 26 CHCs had that policy for the poor. Besides that, the distance from commune to public hospital is one of factors affecting the ability of health care utilization. Among 31 surveyed communes, 45 per cent were settled far from public hospitals (more than 10 kilometers). Private clinics provide more choices for people when seeking health care services. 17 communes in all the surveyed communes had no private clinic, 7 communes had 1 to 5 clinics, and the same number of communes had more than 5 clinics (Table 14). However, 24 communes had at least one medicine shop.

Table 8 Geographic and demographic characteristics of surveyed communes

Characteristics	n	%
Total	**31**	**100**
Urban/rural		
Urban	4	12.9
Rural	27	87.1
Sub-ecological zones		
Coastal area	14	45.2
Plain area	8	25.8
Mountainous area	9	29.0
Area (/km^2)		
< 10	13	41.9
10 to < 30	8	25.8
30 and more	**10**	**32.3**
Population density (person/km^2)		
< 200	10	32.3
200 to < 1000	11	35.5
1000 and more	**10**	**32.3**
Percentage of ethnic minority people		
None	18	58.1
Less than 5%	4	12.9
5% to less than 50%	5	16.1
50% and more	4	12.9

Table 9 Infrastructure and services of the surveyed communes

Characteristics	n	%
Total	**31**	**100**
Services available in commune		
Public telephone	25	80.7
Piped water	8	25.8
Shop selling basic provisions	29	93.6
Market available in commune		
No market	3	9.7
Daily market	24	77.4
Weekly market	4	12.9
Common types of toilet used		
No toilet	16	51.6
Flush/septic tank toilet	19	61.3
Other	10	32.3
How rubbish is treated		
Garbage collection	6	19.4
Burned	24	77.4
Dumped	10	100
Other	14	45.2

Table 10 Distribution of the surveyed communes by main economic activities of the inhabitants

Characteristics	n	%
Agriculture	25	80.6
Fishing	3	9.7
Handicraft, trade, services	3	9.7
Total	**31**	**100**

Table 11 On-going projects and programmes in the surveyed communes

Characteristics	n	%
Total	**31**	**100**
Preventing child malnutrition	24	77.4
General health programme	25	80.7
Poverty alleviation	26	83.9
Education programme	16	51.6
Other child health	17	54.8

Table 12 Distribution of commune health centres by fee reduction for children and the poor

Characteristics	n	%
Total	**31**	**100**
For children	25	100
For the poor	26	100

Table 13 Distribution of the communes by distance to public hospital

Characteristics	n	%
Total	**31**	**100**
Less than 2 kilometers	15	48.4
2 to less than 10 kilometers	2	6.5
10 kilometers and more	14	45.2

Table 14 Private clinics and medicine shops in the communes

Characteristics	n	%
Total	**31**	**100**
Number of private clinics		
None	17	54.8
1-5	7	22.6
6 and more	7	22.6
Number of medicine shops		
None	7	22.6
1-5	16	51.6
6 and more	8	25.8

CHAPTER V
NUTRITIONAL STATUS OF CHILDREN

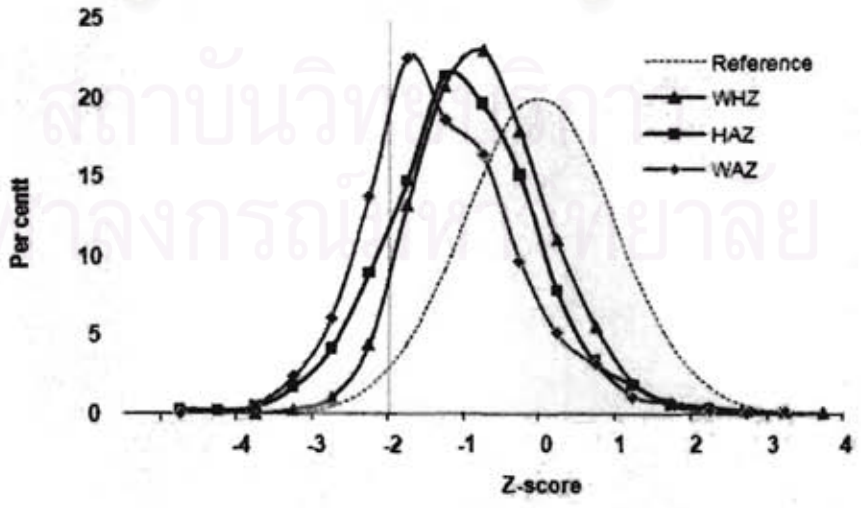
This chapter describes the nutritional status of children by province. .Differences in the nutritional status between boys and girls, among age groups, among household economic groups are also described in this chapter. Height-for-age Z-score (HAZ), weight-for-age Z-score (WAZ), weight-for-height Z-score (WHZ), stunting (HAZ <-2), underweight (WAZ<-2) and wasting (WHZ<-2) were used to reflect the status of nutrition in the whole population as well as among sub-groups.

5.1 Distribution of height-for-age, weight-for-age and weight-for-height Z-scores

By examining the Z-score curves for weight-for-age, height-for-age and weight-for-height, the quality of anthropometric measurements in a survey can be assessed. Figure 5 illustrates that the anthropometric data of the survey was reliable (the three Z-score curves are quite smooth and the shapes are appropriately normal).

The figure 5 also reveals that all of the three Z-score curves were shifted to the left of the WHO reference curve. As we know, the farther the distribution to the reference curve, the worst the nutritional status of the children in the population is. The Z-score curve for weight-for-height was closest to the reference curve. Conversely, weight-for-age Z-score curve was farthest from the reference curve.

Figure 5. WHZ, HAZ and WAZ distributions for surveyed children



5.2 Child nutritional status by province

5.2.1 – Height-for-age Z-score by province

Figure 6 provides information on HAZ distributions for the cohort of children by province. There were some extreme values in the data in every province. The box-plots also show that all of distributions were appropriately normal. Overall, HAZ of children in DaNang and BenTre were similar and were better than that in the others. Among the provinces, HAZ of children in LaoCai was worst. Illustrated in table 15 is the prevalence of stunting (HAZ<-2) across provinces. Table 15 presents information on numbers of children stunted (n) among the surveyed children, the percentages of stunted children in surveyed sample (crude %), the estimated prevalence of stunting in the population (adjusted %) and 95% confident intervals. The prevalence of stunted children aged 6-17 months in DaNang was 9.1 per cent (95%CI [8.3-9.9]) and that in BenTre was 10.9 per cent (95%CI [10.4-11.3]). Next were HungYen and PhuYen, where the prevalence was 14.3 per cent (95%CI [13.9-14.8]) and 18.7 per cent (95%CI [17.6-19.7]) respectively. The prevalence in LaoCai was extremely high (three times higher than that in DaNang), 32.2 per cent (95%CI [31.2-33.1]). Figure 7 shows the severity levels of the stunting in each province. Stunting is classified into 2 categories: moderate stunting (HAZ: -2.99 to <-2) and severe (HAZ ≤-3). The proportions of severe stunting (HAZ<-3) was very low in DaNang and BenTre (1 per cent), higher in HungYen and PhuYen (2 per cent and 3 per cent respectively). Like the general stunting, severe stunting in LaoCai was also very high (8 per cent of the population).

Figure 6. HAZ distributions for surveyed children by province

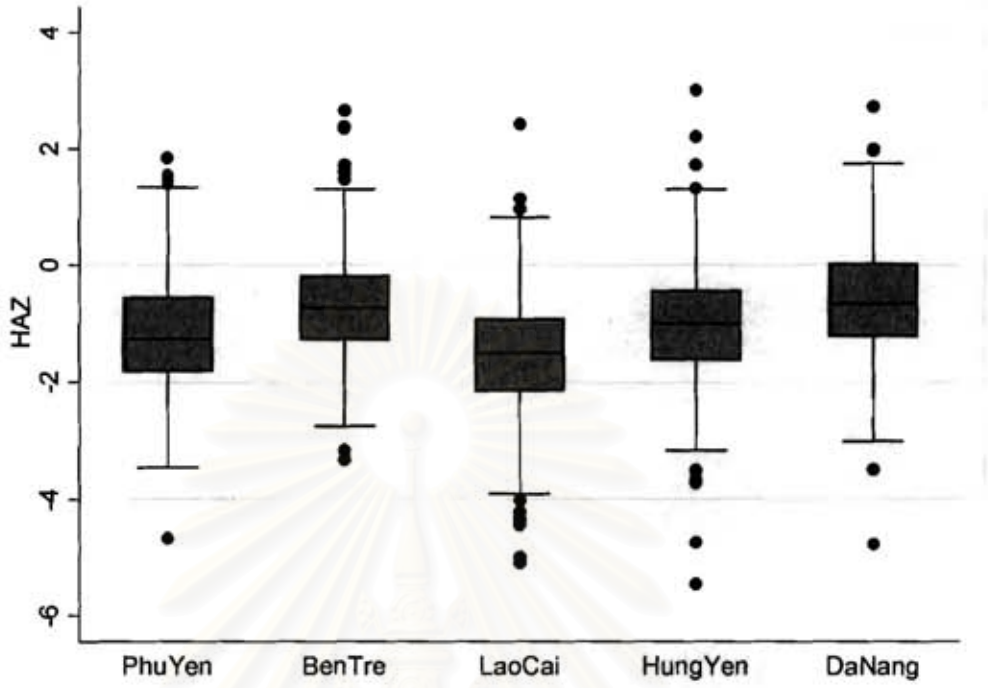
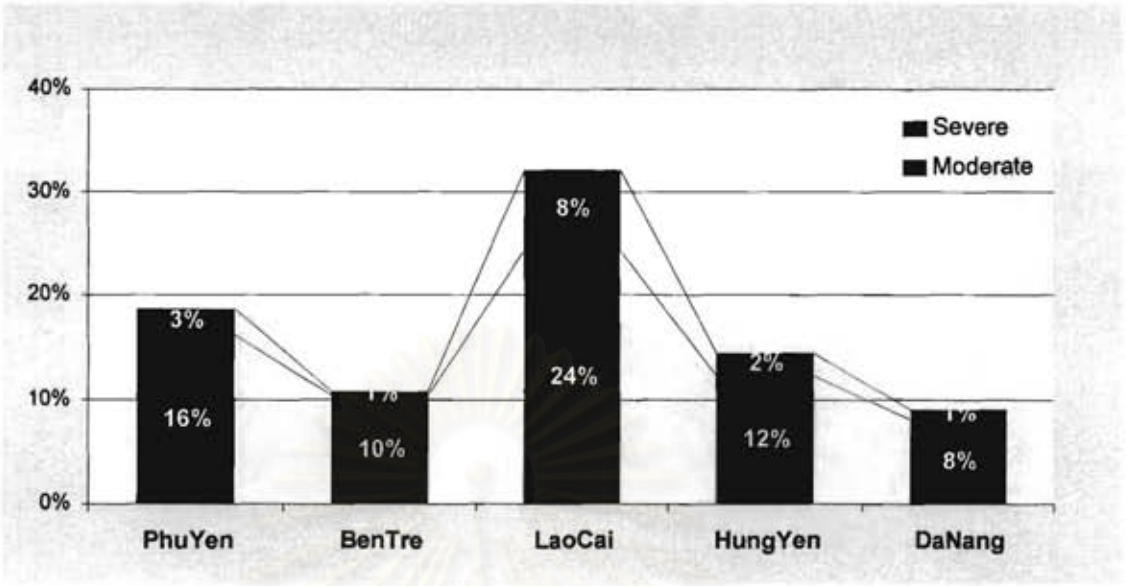


Table 15 Prevalence of stunting and 95% confidence interval by province

	PhuYen (N=339)	BenTre (N=339)	LaoCai (N=338)	HungYen (N=339)	DaNang (N=339)	Total (N=1994)
Stunting (HAZ<-2)						
n	73	37	124	58	26	318
Crude %	18.3	9.3	31.2	14.5	6.5	16.0
*Adjusted %**	18.7	10.9	32.2	14.3	9.1	17.7
95% CI	[17.6-19.8]	[10.4-11.3]	[31.2-33.1]	[13.9-14.8]	[8.3-9.9]	[17.3-18.2]

*Adjusted for sampling design by svy-command in STATA software

Figure 7. Prevalence of stunting by severity level and province



5.2.2 – Weight-for-age Z-score by province

Like HAZ distributions, WAZ distributions of the surveyed children were appropriately normal across provinces (Figure 8). Overall, weight-for-age of the children in DaNang was the best among 5 provinces. The WAZ distributions of children in PhuYen and LaoCai were more narrow and lower than that in the others.

Figure 8. WAZ distributions for surveyed children by province

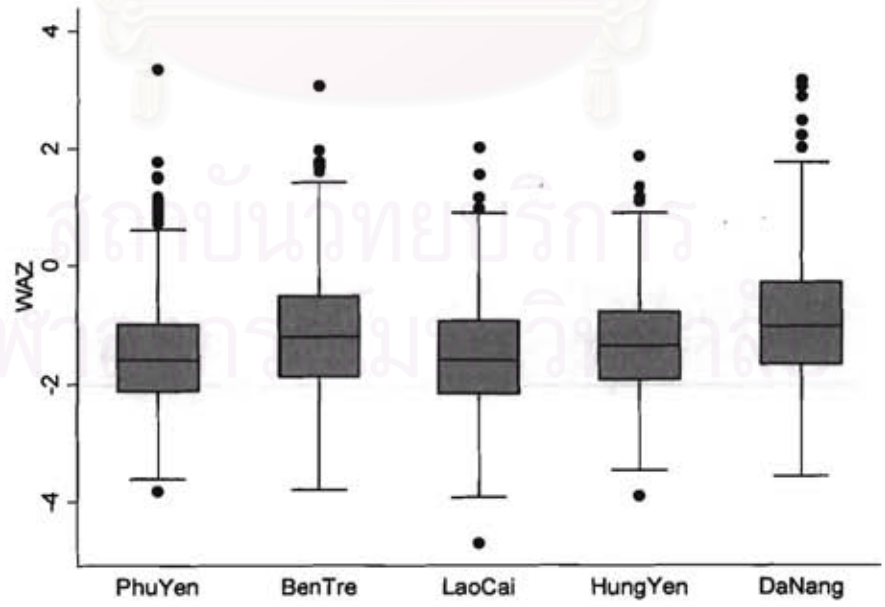
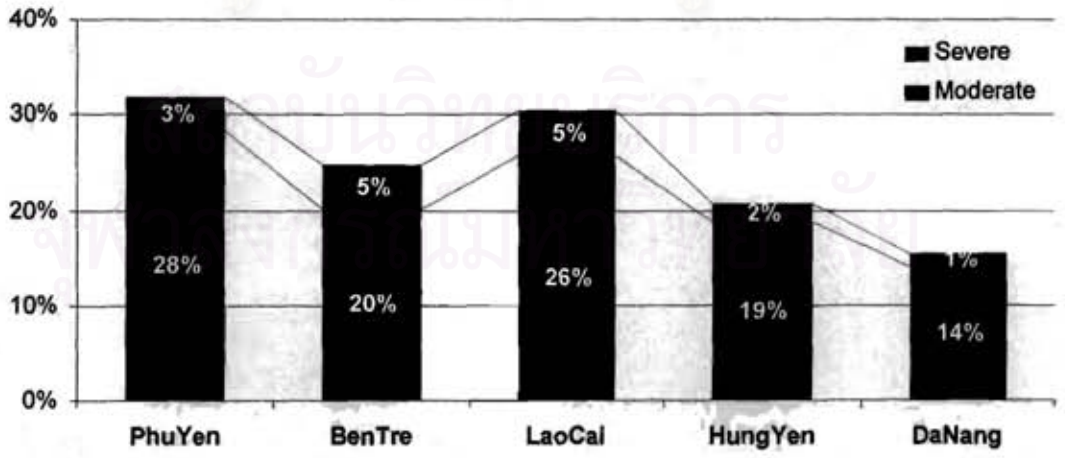


Table 16 provides information on prevalence of underweight children. It is clear that the prevalence of underweight children in DaNang was much lower than that in the other provinces (15.4 per cent, 95%CI [14.7-16.1]). The prevalence in PhuYen and LaoCai was highest, 31.7 per cent (95%CI [30.5-33.0]) and 30.6 per cent (95%CI [30.0-31.1]) respectively. The severity level of underweight children is clarified in figure 9. The proportion of the severely underweight (WAZ<-3) in LaoCai and BenTre were 5 per cent, the highest among the 5 provinces. In DangNang was only 1 per cent were underweight

Table 16 Prevalence of underweight and 95% confidence interval by province

	PhuYen (N=339)	**BenTre (N=339)**	**LaoCai (N=338)**	**HungYen (N=339)**	**DaNang (N=339)**	**Total (N=1994)**
Underweight (WAZ<-2)						
n	117	80	122	91	51	461
Crude %	29.3	20.1	30.7	22.8	12.8	23.1
Adjusted %	31.7	24.8	30.6	20.6	15.4	25.2
95% CI	[30.5-33.0]	[24.1-25.5]	[30.0-31.1]	[19.9-21.4]	[14.7-16.1]	[24.7-25.6]

Figure 9. Prevalence of underweight by severity level and province



5.2.3 – Weight-for-height Z-score by province

The last anthropometric index, weight-for-height, reflects body weight relative to height. Figure 10 shows that this index was best in LaoCai, lower was DaNang and HungYen.and BenTre. That in PhuYen was worst. Table 17 presents the prevalence of wasting (WHZ<-2) in the 5 provinces. The prevalence in LaoCai was 2.2 per cent (95%CI [2.1-2.3]). Compared with LaoCai, the prevalence in PhuYen and BenTre were four and five times higher (9.4 per cent and 13.7 per cent). The proportion of severely wasted children (WHZ<-3) was 1 per cent in PhuYen and BenTre (figure 11). LaoCai, HungYen and DaNang had almost no severely wasted children.

Figure 10. WHZ distributions for surveyed children by province

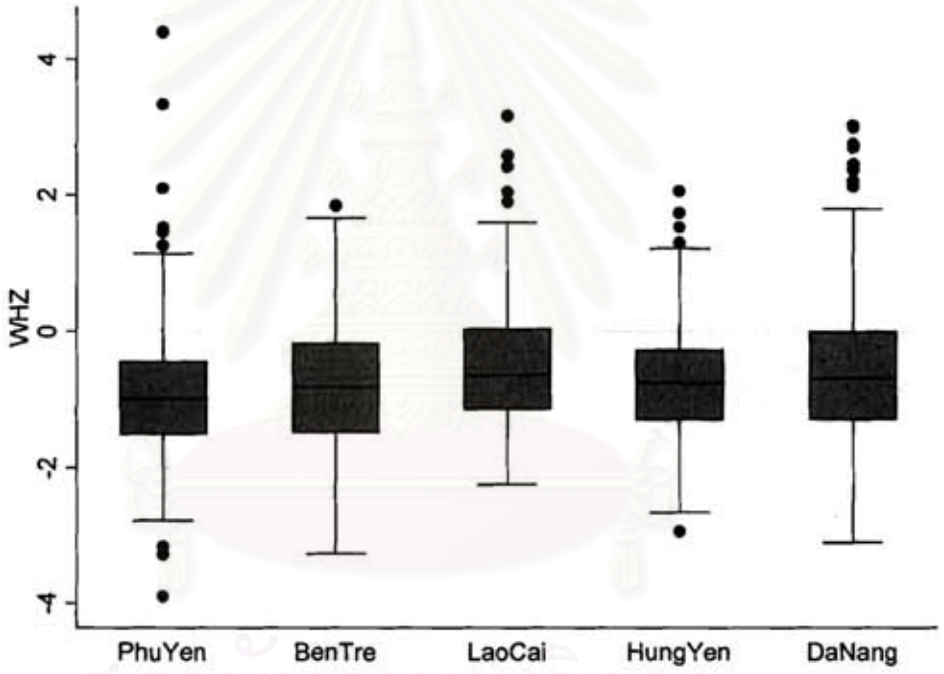
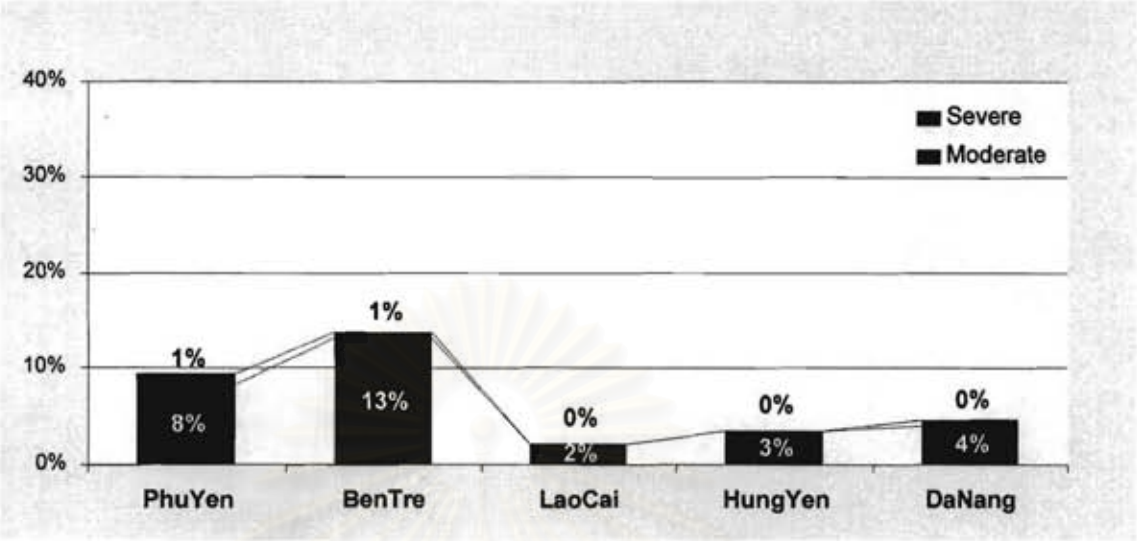


Table 17 Prevalence of wasting and 95% confidence interval by province

	PhuYen (N=339)	BenTre (N=339)	LaoCai (N=338)	HungYen (N=339)	DaNang (N=339)	Total (N=1994)
Wasting (WHZ<-2)						
N	38	34	8	17	19	116
Crude %	9.5	8.5	2.0	4.3	4.8	5.8
Adjusted %	9.4	13.7	2.2	3.4	4.6	6.7
95% CI	[8.6-10.2]	[13.0-14.3]	[2.1-2.3]	[3.3-3.6]	[4.4-4.8]	[6.3-7.1]

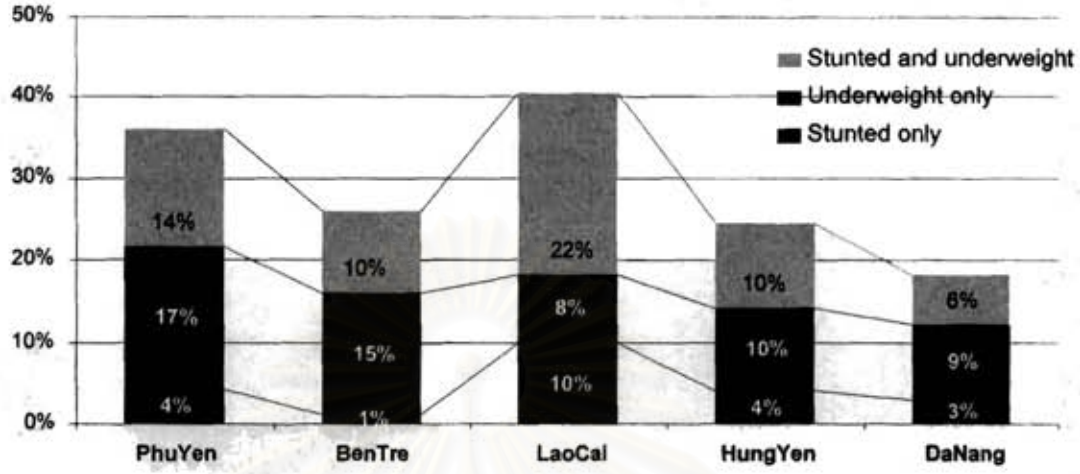
Figure 11. Prevalence of wasting by severity level and province



5.2.4 – Concurrent underweight and stunting by province

Figure 12 provides a two-way classification of underweight and stunting across provinces. The term "underweight only" refers to the child who has WAZ<-2 and HAZ≥-2. It means his/her weight is low but height is normal. The term "stunted only" refers to the child who is short (HAZ<-2) but weight is normal (WAZ≥-2). Concurrent underweight and stunting shows that the child is in serious under-nutrition situation. It means that the child is both short (HAZ<-2) and low weight (WAZ<-2). The proportion of stunted and underweight children in LaoCai was much higher than that in the others (22 per cent compared with 14 per cent in PhuYen, 10 per cent in BenTre and HungYen, and 6 per cent in DaNang).

Figure 12. Prevalence of stunting, underweight and concurrent stunting and underweight by province



5.3 Child nutritional status by child sex

Figure 13 to 15 shows the HAZ, WAZ and WHZ distributions for male and female children. All of the distributions were appropriately normal. The distribution for girls were slightly higher than that for boys, this means nutritional status of girls was better than that of boys. Table 18 presents the prevalence of stunting, underweight and wasting in boys, all of which were statistically significantly higher than that in girls. There were slightly higher proportions of girls than boys with severe stunting, severe underweight and severe wasting. However, the magnitudes of the differences (1 per cent in ever index) were not of public health importance. Figure 17 shows the prevalence of concurrent underweight and stunting. Consistent with the figures shown above, the prevalence of concurrent underweight and stunting in boys was significantly higher than that in girls (16 per cent of boys compared with 10 per cent for girls).

Figure 13. HAZ distributions for surveyed children by child sex

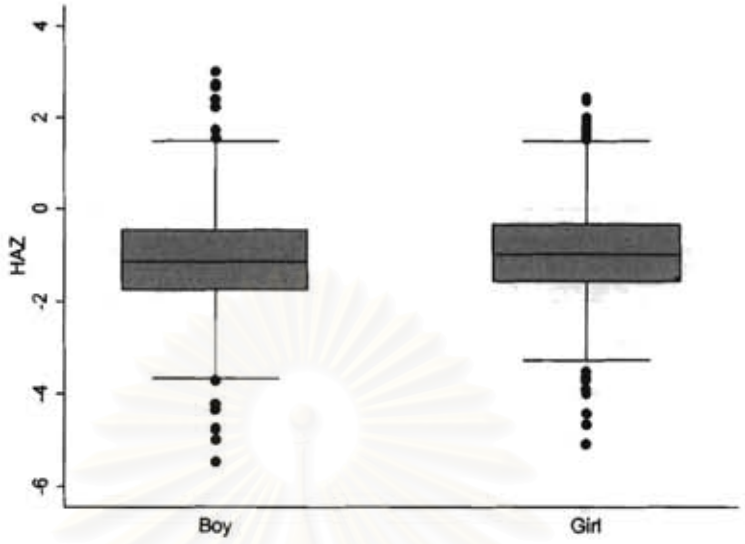


Figure 14. WAZ distributions for surveyed children by child sex

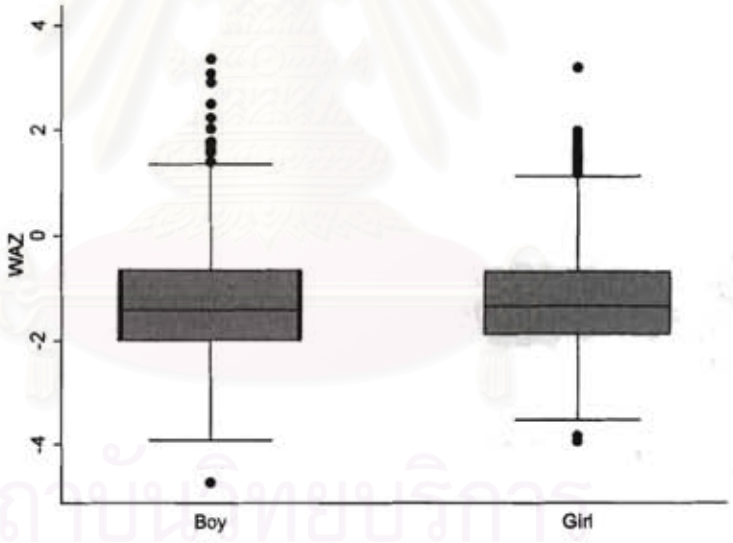


Figure 15. WHZ distributions for surveyed children by child sex

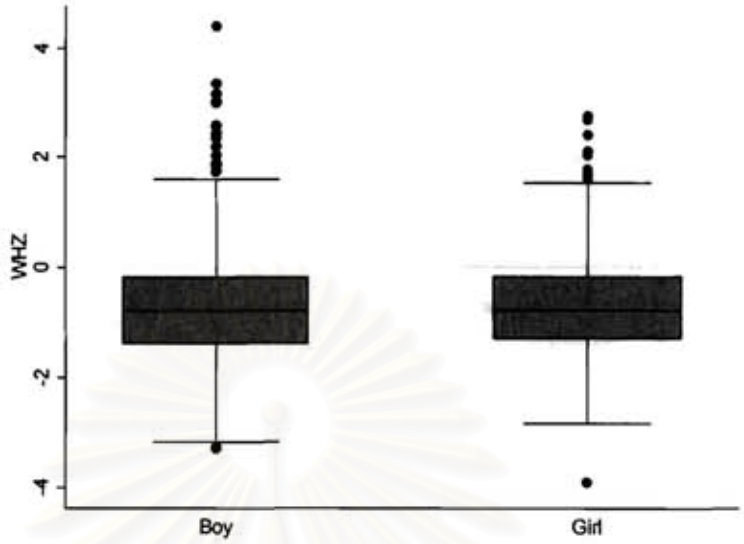


Table 18 Prevalence of wasting and 95% confidence intervals by child sex

	Male (N=1027)	Female (N=967)	Total (N=1994)
Stunting (HAZ<-2)			
n	188	130	318
Crude %	18.3	13.4	16.0
Adjusted %	20.8	14.3	17.7
95% CI	[20.2 - 21.3]	[13.9 – 14.7]	[17.3 – 18.2]
Underweight (WAZ<-2)			
n	264	197	461
Crude %	25.7	20.4	23.1
Adjusted %	27.9	22.1	25.2
95% CI	[27.4 – 28.4]	[21.6 – 22.6]	[24.7 – 25.6]
Wasting (WHZ<-2)			
n	67	49	116
Crude %	6.5	5.1	5.8
Adjusted %	7.9	5.3	6.7
95% CI	[7.3 – 8.6]	[5.1 – 5.5]	[6.3 – 7.1]

Figure 16. Prevalence of underweight, stunting and wasting by severity level and sex

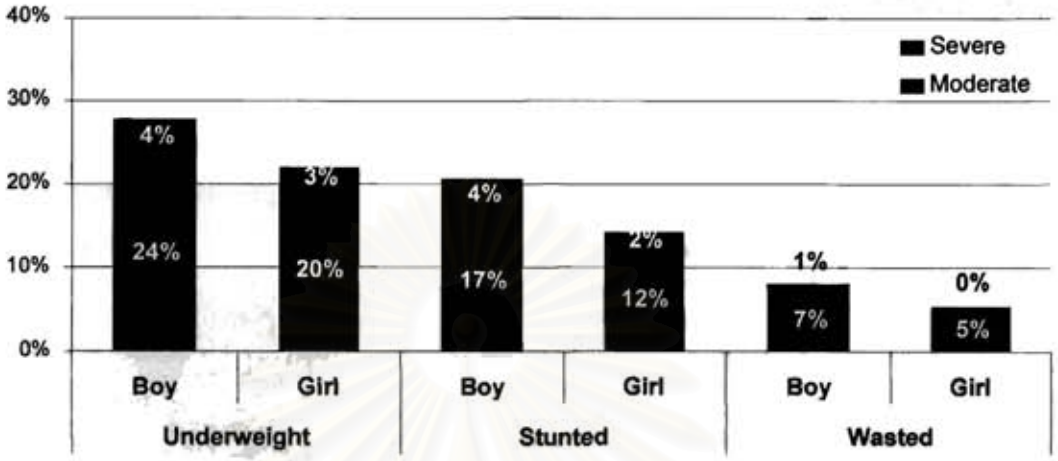
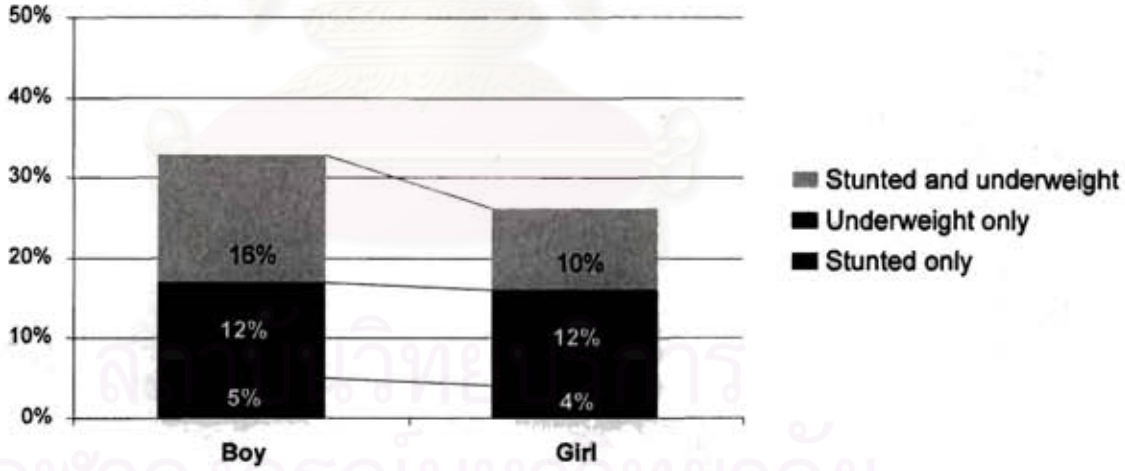


Figure 17. Prevalence of stunting, underweight and concurrent stunting and underweight by sex



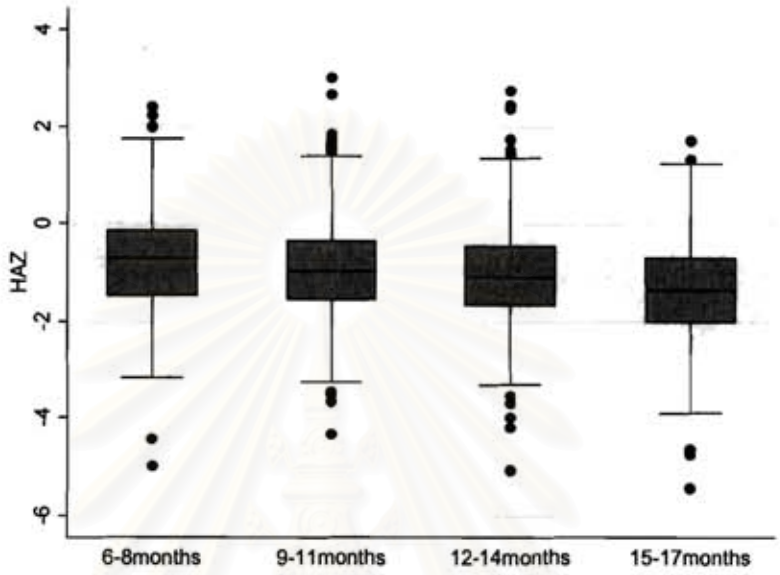
5.4 Child nutritional status by child age

5.4.1 – Height-for-age Z-score by child age

Figure 18 shows the HAZ distributions for 3-month old surveyed children. All of the distributions of this anthropometric indicator were shifted significantly below zero, the expected value of the reference distribution. The higher the ages of the

children, the farther the distribution was shifted below zero. This shows an apparent trend of decreasing HAZ by increasing age.

Figure 18. HAZ distributions for surveyed children by child age

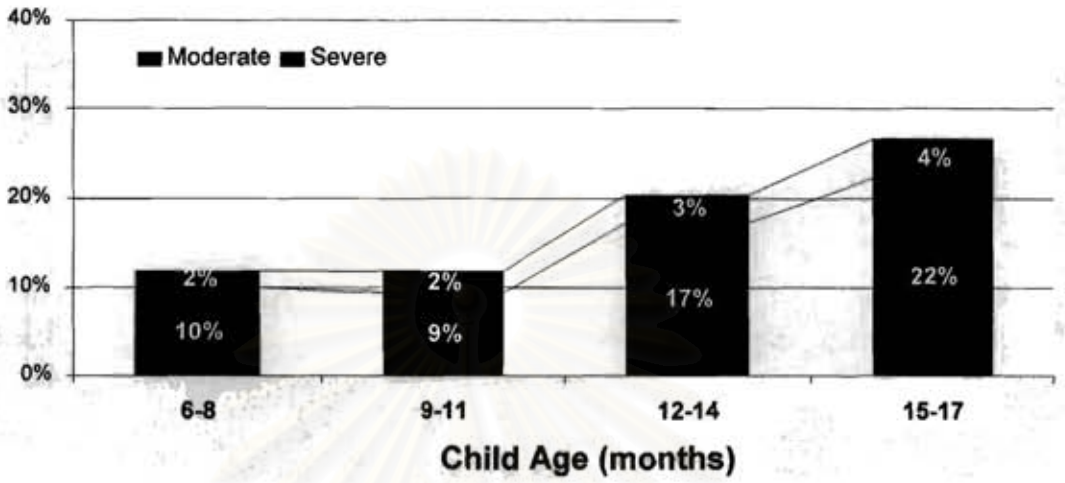


As seen in Figure 18, there was a continuing increase in the prevalence of stunting of children aged 6 to17 months. The prevalence of stunting in children aged 6 to 8 months was 12 per cent. The prevalence in children aged 15 to 17 months was about 27 per cent (two times the first group). Figure 19 shows the increasing of proportions of severe stunting by age (2 per cent in the first age group to 4 per cent in the last age group).

Table 19 Prevalence of stunting and 95% confidence intervals by child age group

	Age of child (months)				Total (N=1994)
	6-<9 (N=398)	9-<12 (N=573)	12-<15 (N=582)	15-<18 (N=441)	
Stunting (HAZ<-2)					
n	36	67	103	112	318
Crude %	9.1	11.7	17.7	25.4	16.0
Adjusted %	11.8	11.9	20.4	26.7	17.7
95% CI	[11.2 – 12.4]	[11.4- 12.3]	[19.8- 21.0]	[25.9- 27.5]	[17.3- 18.2]

Figure 19. Prevalence of stunting by severity level and child age



5.4.2 – Weight-for-age Z-score by child age

Like height-for-age, weight-for-age was worsened as the age of the surveyed child increased (Figure 20). However, the changes were much sharper than the changes in HAZ. Table 20 shows the prevalence of underweight by age. Again, there was a marked increasing in the prevalence from children aged 6-8 months to 15-18 months (9 per cent to 38 per cent). The proportion of the severely underweight also increased from children aged 6-8 months to 15-18 months (1 per cent to 5 per cent)

Figure 20. WAZ distributions for surveyed children by child age

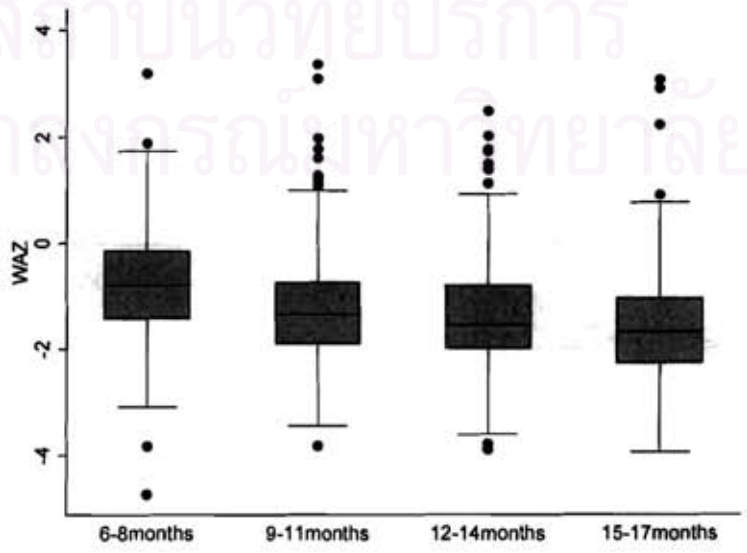
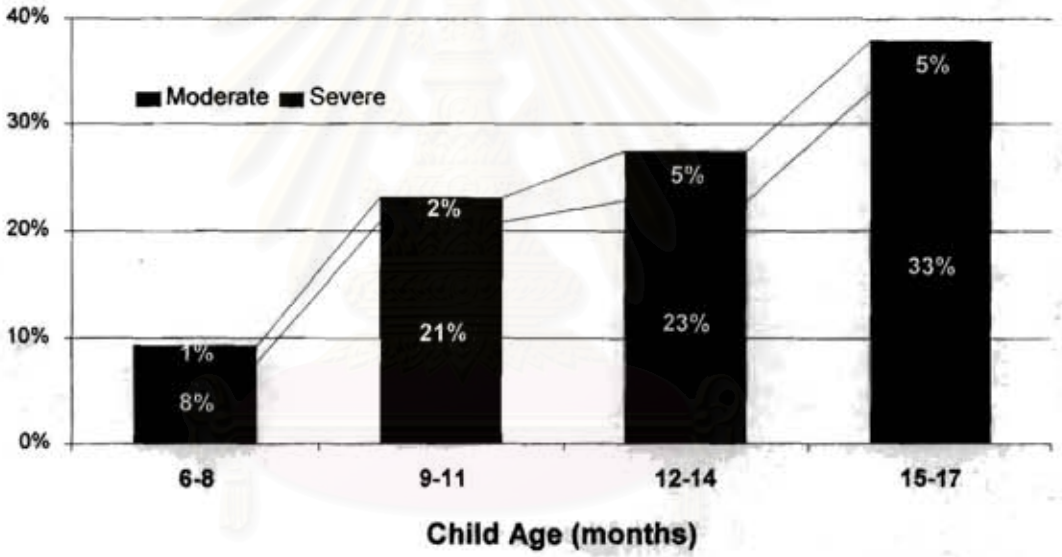


Table 20 Prevalence of underweight and 95% confidence intervals by child age group

	Age of child (months)				Total (N=1994)
	6-<9 (N=398)	9-<12 (N=573)	12-<15 (N=582)	15-<18 (N=441)	
Underweight (WAZ<-2)					
N	31	124	148	158	461
Crude %	7.8	21.6	25.4	35.8	23.1
Adjusted %	9.2	23.1	27.5	37.9	25.2
95% CI	[8.7-9.7]	[22.7-23.6]	[26.8-28.1]	[37.3-38.4]	[24.7-25.6]

Figure 21. Prevalence of underweight by severity level and child age



5.4.3 – Weight-for-height Z-score by child age

Similar to the previous anthropometric indices, weight-for-height of the children decreased when age increased. Figure 22 shows that the distribution of children aged 6-8 months was appropriate reference distribution. However, the distribution of the older children moved well below zero. Table 21 provides information on the prevalence of wasting (WHZ<-2). The prevalence of wasting in children aged 6-8 months was 1 per cent. That prevalence was much higher in children aged 15-17 months (12.8 per cent).

Figure 22. WHZ distributions for surveyed children by child age

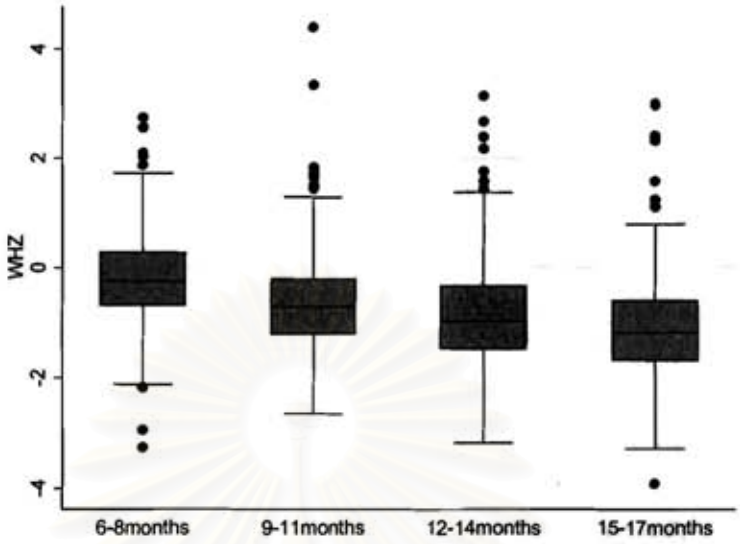


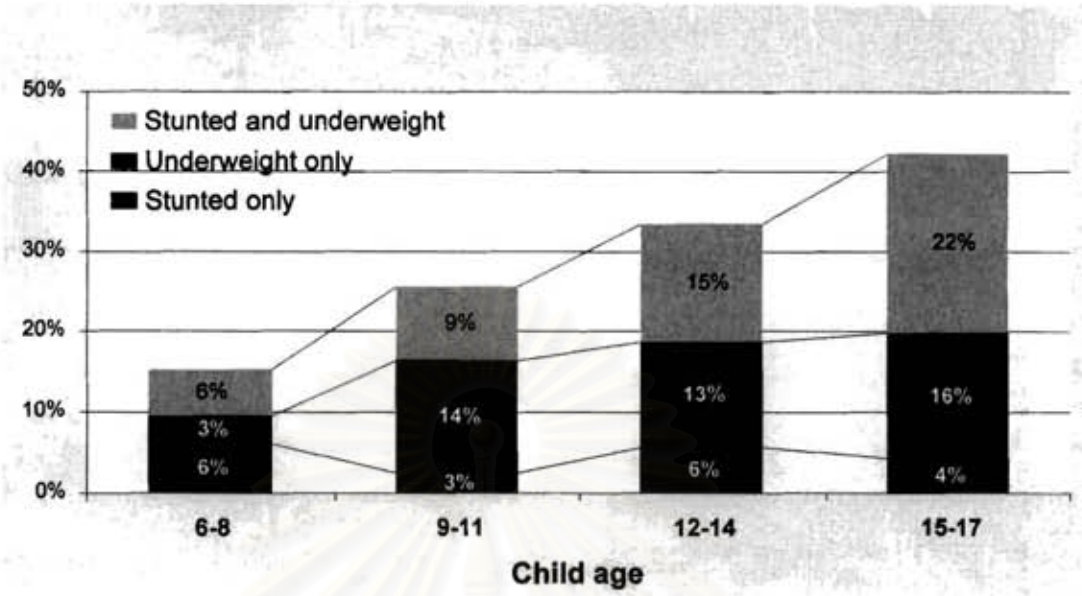
Table 21 Prevalence of wasting and 95% confidence intervals by child age group

	Age of child (months)				Total (N=1994)
	6-<9 (N=398)	9-<12 (N=573)	12-<15 (N=582)	15-<18 (N=441)	
Wasting (WHZ<-2)					
n	6	18	43	49	116
Crude %	1.5	3.1	7.4	11.1	5.8
Adjusted %	0.9	4.3	8.1	12.8	6.7
95% CI	[0.8-1.0]	[3.7-4.9]	[7.5-8.6]	[12.3-13.3]	[6.3-7.1]

5.4.4 – Concurrent underweight and stunting by child age

As illustrated in Figure 23, there was a continuing increase in the prevalence of concurrent of stunting and underweight from children aged 6-8 months to 15-17 months (from 6 per cent to 22 per cent). A difference to note is the change of prevalence of underweight only in children aged 6-8 months (3 per cent) to that in children aged 9-11 months (14 per cent).

Figure23. Prevalence of stunting, underweight and concurrent stunting and underweight by child age



5.5 Child nutritional status by household economic status

Figure 24 – Figure 26 reveal distributions of the three anthropometric indices for the surveyed children among household economic quintiles. There was an apparent trend (increasing) in all of the indices, except WAZ, across from the quintile 1 (one fifth poorest) to the quintile 5 (one fifth richest). Table 22 shows that the prevalence of stunting and prevalence of underweight was inversely proportional to household economic status. The proportion of stunting in the poorest group was three times greater than that in the richest group and the proportion of underweight children in the poorest group was two times greater than that in the richest group. It seems that wasting was not depended on household economic status.

Figure 24. HAZ distributions for surveyed children by household economic status

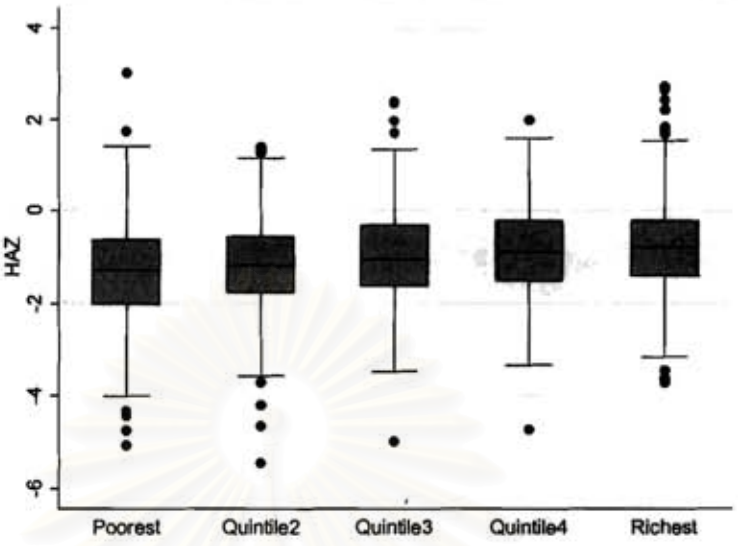


Figure25. WAZ distributions for surveyed children by household economic status

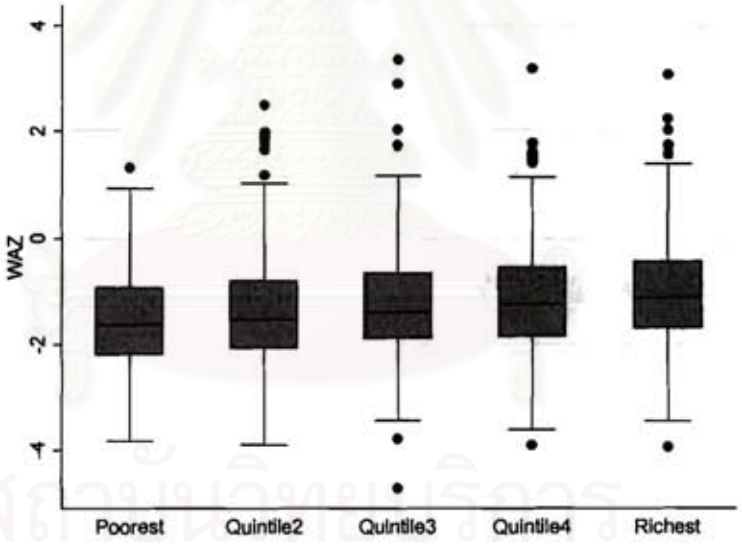


Figure 26. WHZ distributions for surveyed children by household economic status

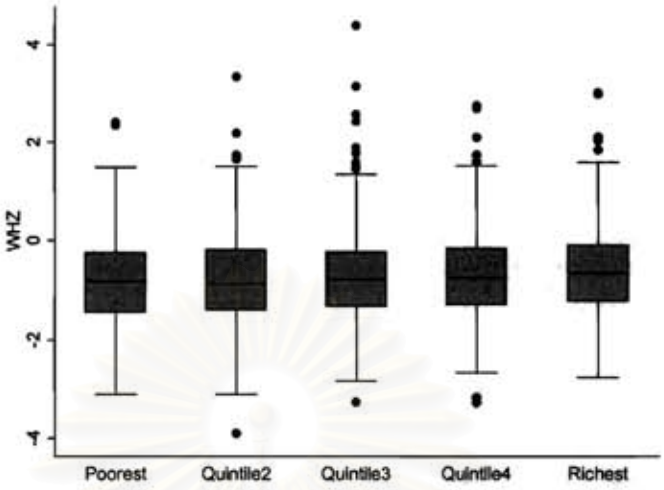


Table 21 Prevalence of stunting, underweight, and 95% confidence intervals by household economics status

	Household economics					Total (N=1994)
	Poorest (N=406)	Poor (N=397)	Average (N=397)	Better off (N=399)	Richest (N=395)	
Stunting (HAZ<-2)						
n	103	73	60	48	34	318
Crude %	25.4	18.4	15.1	12.0	8.6	16.0
Adjusted %	29.2	18.7	16.6	13.7	10.4	17.7
95% CI	]28.4-30.1]	[18.2-19.3]	[16.3-17.0]	[13.3-14.2]	[9.9-10.9]	[17.3-18.2]
Wasting (WHZ<-2)						
n	23	29	21	22	21	116
Crude %	5.7	7.3	5.3	5.5	5.3	5.8
Adjusted %	4.6	8.3	7.1	6.5	7.0	6.7
95% CI	[4.2-4.9]	[7.9-8.8]	[6.4-7.9]	[6.1-6.9]	[6.5-7.6]	[6.3-7.1]
Underweight (WAZ<-2)						
n	128	112	84	77	60	461
Crude %	31.5	28.2	21.2	19.3	15.2	23.1
Adjusted %	35.2	30.3	21.4	21.8	17.4	25.2
95% CI	[34.5-35.9]	[29.8-30.7]	[20.9-21.9]	[21.4-22.2]	[16.4-18.6]	[24.7-25.6]

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

CHAPTER VII

DISCUSSION, CONCLUSION AND RECOMMENDATION

7.1 Discussion

7.1.1 Methodology

The targeted group of this research was children aged 6 to 17 months. The starting point of 6 months of age is also the starting time of complimentary feeding. As seen in the Growth Monitoring Chart, it is during this period of time that the child grows the most. Further more, according to National Nutrition Survey 2000 in Vietnam among this age the prevalence of child malnutrition increases most sharply. Therefore, this time is the most important time for the process of child growth.

This research uses WHO reference population for calculating child anthropometric indices. Many feel that the reference population is not appropriate for Asians. However, it is appropriate in my research for the following reasons. Firstly, some countries in the region have approached the reference population e.g. Japan, South Korea, and Singapore. The prevalence of underweight of children under 5 in Singapore in the year 2000 was less than 3.3 per cent [53], compared with 2.5 per cent of reference population. Therefore, the reference population is a goal that Vietnam could achieve in the future. My research aims to provide evidence for making long-term policies. As almost all child nutrition surveys in Vietnam has been done using WHO reference population for calculating child anthropometric indices, to compare the results I had to use the same methodology.

For analysing the association between child nutritional status and other variables, this research performed multilevel modeling analysis. This is a new development statistic method and very complicated in calculating. However, the development of computer statistics software (MLwiN, SAS, STATA) helps us execute the analysis very quickly and easily. This method can be applied in many kinds of research to avoid errors when analysing hierarchical data. As seen, almost all public health research creates data hierarchies such as subjects grouped by geographic characteristics. Many designed experiments also create hierarchical data, for example clinical trials carried out in several randomly chosen centres or groups of individuals. Not only observation studies but also longitudinal studies also can apply this method.

7.1.2 Nutritional status of children

Among the five surveyed provinces, the research found that child nutrition status in DaNang was best in terms of all three anthropometric indices. The middle group was HungYen an BenTre. PhuYen and LaoCai were the lowest group. DaNang is a big city, where every characteristic is much better than the others. HungYen and BenTre located in Red river delta and Mekong delta are in the most favourable agriculture areas of Vietnam. LaoCai, a mountainous province, is the one of poorest and most difficult provinces in Vietnam. PhuYen is half mountainous half coastland. The mountainous part has conditions similar to those in LaoCai, the coastland suffers severe natural disasters each year. Therefore, findings are as was expected.

There were no figures of child malnutrition reported for the age group (6 to 17 months) in the selected provinces. However compared with the figures of children aged under two years in Vietnam in 2000, the findings in this research are consistent with what was found in the Vietnam Nutritional Survey 2000 [54], namely that the prevalence of stunting, underweight and wasting was 30 per cent, 25 per cent and 9 per cent respectively.

This research found that there were apparent differences of nutritional status among girls and boys in the surveyed sample. That was also reported in some national surveys like Vietnam National Protein Energy Malnutrition Survey 1998, Vietnam Household Living Standard Survey 1998 [13] and international analysis [1].

Regarding child age, the findings show that the child nutritional status decreased rapidly from 6 to 17 months of age. This has been observed in every research study undertaken at both a local and international level. In detail, compared with height-for-age, weight-for-age reduced much more in the age interval 6 to 11 months. After that, the two indices decreased at a similar velocity. This result shows that the period 6 to 11 months is the time when children start to lack protein energy. As usual, the effect is seen in child weight first, then child height. The findings confirm that this interval of age (6 to 17 months) is the one of most important time for intervention on reducing prevalence of child malnutrition.

7.1.3 Contributing factors to child nutritional status

The multilevel modeling analysis found the association between some community characteristics and child nutritional status in the targeted provinces beside child, caregiver and household characteristics. The association of child characteristics (sex, age, birth weight, and antenatal care), caregiver characteristics (age, education,

and ethnicity), and household economic status and child nutritional status that was reported in previous research was confirmed in this research in the five provinces. The community characteristics found to have association with child nutritional status were location of the commune, commune basic service index and commune health care index.

The first community characteristic associated with child height-for-age was *location of the commune*. The analysis shows that the plain communes had the advantage over the mountainous commune. This is consistent with what was found by Stefanie, et al [13]. It is easy to recognize the difference between mountainous areas and lowland areas in Vietnam in almost every aspect (economics, education level and infrastructure). Therefore, it is also easy to explain the association of the location of the commune and child nutritional status.

The second community variable involved in the multilevel modeling analysis was the *commune basic service index*, a proxy variable. This index was combined from dummy variables: *having any shop selling basic provisions, available public telephone system, piped water system, available daily market inside commune variable.* The findings show that children living in the commune having more basic services tended to have higher height-for-age Z-scores. These services show the development level of the commune. Therefore, they are strongly associated with child nutritional status.

The last community variable was *commune health care service index*. This was also a proxy variable combined from the variables: *distance to the nearest public hospital, commune health centre provided fee reduction services for children, 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.* All of these characteristics represent the ability to access health care services of the people living in the commune. The findings reveal that the higher ability to access health care services, the better child nutritional status is. This evidence confirms the role of health care on child growth.

7.2 Conclusions

This research examined the nutritional status of children in five provinces (PhuYen, BenTre, LaoCai, HungYen and DaNang) and its potential contributing factors based on a representative sample of 1994 children aged 6 to 17 months. Nutritional status was assessed on the basis of three anthropometric measures, namely weight-for-height, weigh-for-age, and height-for-age. Potential contributing factors were examined by multilevel modeling analysis. Below are conclusions drawn from the results of the analyses.

Overall child nutritional status in all of the five provinces was lower than that of the WHO reference population. In detail, the prevalence of stunting of children aged 6 to 17 months in DaNang, BenTre, HungYen, PhuYen and LaoCai was 9 per cent (95%CI[8.3-9.9]), 11 per cent (95%CI[10.4-11.3]), 14.3 per cent (95%CI[13.9-14.8]), 18.7 per cent (95%CI[17.6-19.8]) and 32 per cent (95%CI[31-33]) respectively. The prevalence of underweight of children aged 6 to 17 months in DaNang, BenTre, HungYen, PhuYen and LaoCai was 15.4 per cent (95%CI[14.7-16.1]), 24.8 per cent (95%CI[24.1-25.5]), 20.6 per cent (95%CI[19.9-21.4]), 31.7 per cent (95%CI[30.5-33.0]) and 30.6 per cent (95%CI[30.0-31]) respectively. The prevalence of wasting of children aged 6 to 17 months in DaNang, BenTre, HungYen, PhuYen and LaoCai was 4.6 per cent (95%CI[4.4-4.8]), 13.7 per cent (95%CI[13.0-14.3]), 3.3 per cent (95%CI[3.3-3.6]), 9.4 per cent (95%CI[8.6-10.2]) and 2.2 per cent (95%CI[2.1-2.3]) respectively.

Female children had the nutritional edge over male children in the surveyed provinces. The other characteristic of child nutritional status in the provinces is that it continuously decreased by a considered magnitude the higher the age. As expected, prevalence of malnourished children in poor families was much higher than that in the rich families.

There was evidence of a strong association between some community characteristics and child nutritional status in the five provinces. Geography (mountainous or plain), available basic services and the health care environment significantly associate with child nutritional status.

7.3 Recommendations

Based on the findings of this research, some recommendations below are given for controlling child malnutrition in the five provinces as well as other parts of Vietnam:

- Child malnutrition still remains a major public health problem in the five provinces. Because of its serious consequences, the government and NGOs should pay more attention and resources to reduce the prevalence of malnourished children.
- Prevalence of stunting and underweight children although varying across provinces remains sufficiently high to justify programmes to prevent childhood malnutrition in all provinces. However, mountainous areas should receive special attentions because of the severity level in these areas.
- Intervention programmes on changing child nutritional status should be directed toward preventing early growth retardation that occurs in children under 2 years of age.
- Intervention by providing basic services and adequate health care at community level could affect child nutritional status strongly. Such intervention at a community level usually has more beneficiaries and remains more sustainable than the interventions at an individual level.

7.4 Research in the future

The findings of this research are interesting. However, the research has also raised some more questions below which could be the subject of future studies:

- Why does the prevalence of malnutrition increase so rapidly from 6 to 17 months?
- Why is the prevalence of malnutrition in male children higher than female children?
- Is it more cost effective to intervene by improving health care and basic services at a community level to improve child nutritional status compared with intervention at an individual level?

This kind of research (examining the role of community factors on child nutritional status) should be done at the national level. The data of some national surveys like Vietnam Household Living Standard Survey, Vietnam Demographic and Health Survey, Notational Health Survey could be used to do this research.

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