Nutrition status and risk factors for under-nutrition in young children in North Maluku, Indonesia, in 2004 following a period of civil unrest

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Thesis submitted for fulfillment of the award of:

Doctor of Philosophy

The University of Newcastle, Australia

Submitted June 2012

I hereby certify that the work embodied in this thesis is the result of original research and has not been submitted for a higher degree to any other University or Institution.

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Date: 8th August 2012 ____________________________

ACKNOWLEDMENTS

My Deepest Gratitude to My Great Grandfather, **"YMM. AYAHANDA GURU MAULANA SS. KH. AMIRUDDIN KY BIN MOH. KHOIR HASYIM AL KHALIDY AN NAQSYABANDY"** who always blessed and looked after me since I was born and guided me to have a better education and life.

I would like to express my deepest gratitude to the Centre for Food, Nutrition and Health, Hasanuddin University, Makassar Indonesia which provided me with the secondary data for my study and to those who helped me and contributed to the successful completion of this Thesis.

I would also like to express my gratefulness to the University of Newcastle for awarding me a University of Newcastle Postgraduate Research Scholarship (UNRS External) and also other support which allowed me to finish my study.

From the bottom of my heart, I would like to express my special gratitude to my main supervisor Dr. Kerry Inder who always cheers me up in my difficult time to finish this thesis. Her help and encouragement boosted my spirit to finish and resubmit this thesis. Without her help and motivation, I will not be able to accomplish the resubmission of this thesis.

I would also like to express my gratefulness to Co-Supervisor, Steve Bowe whose expertise in data analysis was invaluable in the process of doing and completing my thesis. Also, my special thanks to my second Co-Supervisor Dr. Zu Ming for his contribution in this thesis.

Special thanks also to Dr. Michael Dibley who helped and encouraged me to come to Newcastle to continue my study and guided me at the beginning of my study until my first thesis submission. Unfortunately he moved to another university in Australia before I accomplish my study at University of Newcastle.

My gratefulness and love to Professor Cate D'Este for her support and attention and to all staff of the Centre for Clinical Epidemiology and Biostatistics at the University of Newcastle, Australia, for their friendliness, understanding and help related to my study.

My appreciation and profound gratitude to Ross Broadbent, the Director of Broman Services, who always helped and encouraged me to finish my Thesis, and without his help and support, I would not have finished it. Special thanks go to Jane Gibson and her husband Jeff Fisher who always helped and supported my study and made me feel like part of their own family in Australia.

Special thanks to Earl Beattie and Shane Frost, my best friends and my house mates for looking after me and being friends since eight years ago and also to all my friends at Waratah Golf Club: Gordon, Paul, George, Margaret, Scott, Anne, Madeline, Melinda, Elaine, Martin, Tanya, Don, Kent and everyone I have missed (but you know who you are) for your support and kindness since I worked with you eight years ago.

I would also like to express an unforgettable feeling towards all friends at Indonesian Australian Students Association and to all my adopted families at Indonesian Australian Community Association for the period 2008: Rona Hoysted, Tiur Siregar, Catherine, Nanda,Yuli Fisher, Rifka, Maria, Martina, Mami, Max, Linda, Sri and also their family, throughout my four year period living in Australia; we have shared knowledge, laughing, happiness and kindness together.

Deep in my heart I am forever indebted to my family in Indonesia for their love, and support during my study. In particular, I would like to thank all my friends at The School of Public Health Hasanuddin University: Prof. Razak Thaha, Prof. Veny Haju, Dr. Junaedy M Dahlan, Dr. Citra Kesumasari, Nurhaedar Jafar, Apt, Aminuddin SKM, Dr. Ridwan Thaha, Dr. Sany Silwana, Tanti and to my best friends Dr. Ida Leida Maria, Dr. Riana Syarif, Dr. Anca for their help to finish my study, I really appreciate your contribution over the years.

I would like to express my sincere love to MY BELOVED MOTHER " I Sakka" who passed away in November 2009, for her unlimited prayers, her understanding and unaccountable help on every step in my life and my study. "Mum, This Thesis is for you and I love and miss you so much and I wish I can go now to see you in heaven and be with you in peace and last forever.

My special thanks to my beautiful wife Dra. Yustiaty Yusuf SE, Msi and to My sons Abdillah Ahfan and Abdul Ghafur Ramli. Thanks for your support from Indonesia. Your prayer helped me to accomplish this thesis. To my cousin Herawati Abbas who also study at Newcastle University and her husband Budi Gunawan, thanks for your care/support and to all my relatives in Indonesia, thanks for your pray/support while I am away from home.

Also special thanks to Maroba Lodge CEO Viv Allason, Hostel director Leeanne Dove, Sharon Denton and to all the nurses, kitchen, maintenance and activity

staffs at work and to all the residents who always help and cheers my life while working and studying.

Last but not least, I would like to express my deepest gratitude to those who helped me and contributed to the successful completion of my study.

My Holy Grand Father always says
"Life is actually easy, only our mind make it complicated"

"Remember HIM all the time and
your life will always be with HIM"

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Introduction

North Maluku is a new province in Indonesia, which separated from Maluku Province following a period of civil unrest. Malnutrition became a major issue in North Maluku especially for children aged less than five years old. Post-conflict, it is a matter of great concern that the health and nutrition of pre-school aged children remains poor. This current research provides data to inform and assist the local government to establish appropriate local nutrition programs and to promote a better life and enhanced nutritional status for young children.

Aim

The aim of this study was to assess the nutritional status of pre-school aged children in North Maluku Province, Indonesia, following a period of civil unrest, and to examine the risk factors for stunting and wasting, including socioeconomic factors, to inform the development of intervention programs.

Methods

Using data from the North Maluku Province Health survey, this study examined the prevalence of children who were underweight, severely underweight, stunted, severely stunted, wasted and severely wasted in the North Maluku province of Indonesia in 2004. Data on being severely underweight, severely stunted and severely wasted in young children is often not reported in other studies of child nutrition in Indonesia and more widely.

The total sample size from the original cross sectional health survey was 3,000 households from within the eight districts of North Maluku province. From this sampling frame, the current work involved the analysis of quantitative data from families with children aged between 0 to 59 months. Demographic and socio-economic data were collected by questionnaire from 2,168 children and households. Economic status of the household was assessed via an inventory of household assets and facilities. Anthropometric data were taken by trained enumerators, measured in accordance with standard anthropometric techniques (WHO 1995). All the anthropometric indicators of a child's nutritional status used in the survey were expressed as the Standard Deviation Score (Z-Score) to describe categories of low weight-for-age (or underweight), low height-for-age (or stunting) and low weight-for-height (or wasting) with reference to the 2006 World Health Organisation (WHO) international child growth standards.

Prevalence with 95% confidence intervals (95%CI) was calculated for categorised underweight, stunting and wasting, and distributions were calculated for six-month age groups, sex, and geographical district and across family and child level factors. Multivariate logistic regression was used to model socioeconomic risk factors associated with stunting and wasting in children aged 0-59 months for family and child level characteristics. A comparison of nutritional status indicators using the current 2006 WHO international child growth standards and the former 1978 National Centre for Health Statistics (NCHS)/ WHO international child growth references was undertaken.

Results

Of the 2,168 children, 33% were underweight or severely underweight, 56% were stunted or severely stunted and 18% were wasted or severely wasted, indicating significant under-nutrition of the children in this new province. The prevalence of underweight (25%) was categorised as high (20-29%) and the prevalence of stunting (38%) was categorised as high (30 to 39%) according to WHO criteria. The prevalence of severely underweight children, and children with severe stunting and severe wasting were categorised as low.

The prevalence of all anthropometric indicators: underweight, severely underweight, stunting, severe stunting, wasting and severe wasting; were higher in boys than in girls and generally lower in the urban district of Tidore compared with other districts.

The height-for-age Z-score distribution, weight-for-height Z-score distribution and weight-for-age Z-score distribution for children 0 to 59 months in North Maluku were each shifted to the left below the reference indicating higher levels of underweight, stunting and wasting compared to the 2006 WHO reference population.

The following factors were statistically significantly associated with stunting on multivariate analysis in children aged 0 to 59 months: household wealth, gender of the child, the child's age in months and visits to the local health service in the previous three months. The following factors were statistically significantly associated with severe stunting on multivariate analysis in children aged 0 to 59 months: father's occupation, household wealth, gender of the child and the child's age in months.

There were no family level or child level characteristics statistically significantly associated with wasting on multivariate analysis in children aged 0 to 59 months, however gender was significantly associated with severe wasting in children aged 0 to 59 months with girls have reduced odds of severe wasting compared to boys.

The prevalence of nutritional status indicators using the former 1978 NCHS/WHO growth reference compared with the current 2006 WHO growth standards in children less than five years of age in North Maluku Province Indonesia in 2004, were not statistically significantly different for any of the nutritional indicators.

Conclusions

As a new province in Indonesia, it was anticipated that North Maluku would benefit from appropriate and timely investigation into the nutrition status and risk factors for under-nutrition in young children. This study provides valuable information for local government regarding childhood nutrition, which in turn can inform the implementation of appropriate nutritional programs in the future to provide vital information on preventable ill-health and to identify where health gains can be made to prevent under-nutrition. This study can also provide evidence which allows policy-makers to direct resources to the most vulnerable segments of the population, and thus better utilise resources.

LIST OF ABBREVIATIONS AND DEFINITIONS

ADB	Asian Development Bank
Anthropometry	Human body measurements.
BMI	Body Mass Index
CBS	Central Bureau of Statistics
CFNH-UH	Centre for Food, Nutrition and Health, Hasanuddin University
CI	Confidence Interval
cm	centimetres
FAO	Food and Agriculture Organization
HFA	height (or length) for age
Kg	Kilograms
Km	Kilometres
KMS	Kartu Menuju Sehat of Health Card Children to monitor

	their nutrition status for the age 0-59 months
MUAC	Mid Upper Arm Circumference
NCHS	National Centre for Health Statistics
OR	Odds Ratio
Polindes	Village Delivery Posts
Puskesmas	Indonesian Health Centre for District level
Pustus	Indonesian Health Posts for village level
r	Correlation coefficient
SD	Standard deviation
Sq	Square
Stunting	Height-for-age below -2 SD from the National Centre for Health Statistics/WHO reference median value.

Continued…

Susenas	Type surveys in Indonesia which are integrated into routine Central Bureau of Statistics annual surveys consist of social and economic variables.
TV	Television
UN	UNITED NATION
Underweight	Weight-for-age below -2 SD from the National Centre for Health Statistics/WHO reference median value.
UNICEF	The United Nations International Children's Fund
Wasting	Weight-for-height below -2 SD from the National Centre for Health Statistics/WHO reference median value
WFA	weight-for-age
WFH	weight-for-height
WHO	World Health Organization
Z-score (or SD-score)	The deviation of an individual's value from the median value of a reference population, divided by the standard deviation of the reference population.
IBT	Indonesia Bagian Timur (Eastern Indonesia island

	survey);
SUVITA	Survey Vitamin A
SKIA	Mother and child survey
NSS	Nutrition & health surveillance survey
SKRT	National health and household survey
Ev. JPS	survey on impact of social safety net project

CHAPTER 1

NUTRITION STATUS AND RISK FACTORS FOR UNDER-NUTRITION IN YOUNG CHILDREN IN NORTH MALUKU INDONESIA, IN 2004 FOLLOWING A PERIOD OF CIVIL UNREST

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1.1 Introduction

Malnutrition in children is internationally recognised as an important public health indicator for monitoring nutritional status and health in populations, with devastating effects of malnutrition on human performance, health, and survival well established (Caulfield LE et al., 2004; Chang SM et al., 2002), A recent global analysis of malnutrition in children demonstrated that childhood malnutrition is the leading cause of the global burden of disease (Ezzati M et al., 2002; WHO, 2002). As a result of the increased recognition of nutrition as a basic pillar for social and economic development, monitoring trends in childhood malnutrition has gained increasing importance in assessing progress made by nations in achieving international goals, including the Millennium Development Goals: 1. Eradicate extreme poverty and hunger, 2. Achieve universal primary education, 3. Promote gender equality and empower women, 4. Reduce child mortality, 5. Improve maternal health, 6. Combat HIV/AIDS, malaria and other diseases, 7. Ensure environmental sustainability, and 8. Develop a global partnership for development (UN, 2006).

Childhood malnutrition remains a common problem in much of the developing world and the causes of childhood malnutrition are complex, multidimensional, and interrelated ranging from fundamental factors such as political instability and slow economic growth to specific factors such as respiratory infection and diarrhoeal disease (Smith LC, 1999). In turn, the implied solutions vary from wide spread measures to improve the stability and economic performance of countries to efforts to enhance access to sanitation and health services in individual communities. Debates continue to flourish over what the most important causes of malnutrition are and what types of interventions will be most successful in reducing the number of malnourished children (Smith, 2000).

1.2 Rationale of the study

North Maluku province is a new province in Indonesia, which separated from the Maluku Province following a period of civil unrest. When the religious based conflict happened, the government made the decision to declare that North Maluku became a separate province given its supply of mineral resources. When the province divided from ‘Maluku province’ into two provinces: ‘Maluku’ and ‘North Maluku’, Ambon remained the capital of Maluku and the new North Maluku province had two capital cities: Tidore (the old capital city of North Maluku) and Ternate (the new capital city of North Maluku).

Conflict in North Maluku began in 1999 with clashes between Makian (Moslem) and Kao (majority of Christian) communities in the province, then part of the Maluku province. The 1999 conflict started with a riot in northern Tobelo, where many people were killed and places for worship were burned. Following this, the conflict expanded throughout the province, with the destruction of private housing, public facilities, and infrastructure. In total, around 2000 people died, 160,000 people migrated to other places within the province and approximately 40,000 migrated to North Sulawesi (Razak et al., 2004). Refugee camps were established by the local government in the new capital city of North Maluku, Ternate, and the old capital city Tidore.

Prior to the conflict the majority of Christians lived in Ambon and the majority of Moslem people lived in North Maluku. During the conflict the Moslems living in the Ambon area moved to Tidore and Ternate and the Christians living in North Maluku moved to Ambon. Transport between Maluku and North Maluku was by boat. Moslems from Ambon with family in North Maluku would be invited to stay with family. If no family to stay with they would move to refugee camps. If Moslems from North Maluku lost their homes during the conflict they also moved to the camps. Houses vacated by Christians who move to Maluku were allocated to Muslim refugees from Maluku. The majority of the population remained in North Maluku living in this accommodation.

Health became a serious problem in the refugee camps where a lack of food and medicine, and poor environmental sanitation increased vulnerability to infectious diseases. As a result of this conflict, the health and nutritional status of residents, particularly infants, children, and pregnant women, deteriorated. By mid-2002, some normalcy was restored and many people returned to their homes. However, the destruction of almost all facilities prevented many communities from recommencing a normal life again, problems remained which adversely affected the health and nutrition of many at-risk groups, including children (Razak et al., 2004).

Any organization wanting to help the people of North Maluku needed permission from the Central Government in Jakarta. The United Nations Children's Fund (UNICEF), AusAid and World Health Organisation (WHO) are organizations which were approved to provide help in addition to a number of religious-based non-government organizations. Armed forces came from the United States of America and Australia to help restore order and provide security.

As a new province in Indonesia, it was envisaged that North Maluku would benefit from appropriate investigation into the nutritional status and risk factors for malnutrition in young children. From this investigation, local government would receive valuable information on childhood nutrition to inform the implementation of appropriate nutritional programs in the future. An appropriate and intensive program was needed immediately to ameliorate some of the adverse affects suffered by children as a result of religious and communal conflict.

The North Maluku Province Health Survey was established with collaboration between The Centre for Food, Nutrition, and Health (CFNH) at Hasanuddin University, Makassar, Indonesia and the United Nations Children's Fund (UNICEF). This community-based survey was conducted to help the local government in North Maluku obtain information on education, health, nutrition, water, sanitation and child protection. The survey was undertaken approximately seven months after the main riot. This research was conducted to establish baseline data on childhood nutrition for the new province of North Maluku to guide the development and evaluation of appropriate and relevant interventions to improve the nutritional status of young children in the new province. The results from this survey would assist policy-makers to direct resources to the most vulnerable segments of the population, and thus make better use of limited resources.

This thesis analyses data specifically related to the nutritional status of young children in North Maluku, Indonesia, using data collected by the North Maluku Province Health Survey, to inform the local health department and guide the development of appropriate nutritional programs.

1.3 Aims of this study

The broad aim of this study is to assess the nutritional status and identify risk factors for under-nutrition in preschool children, residing in North Maluku, a new province in Indonesia, in 2004 following a period of civil unrest.

More specifically, the study will:

- Assess the prevalence of underweight, stunting and wasting in children less than five years of age in North Maluku, Indonesia, by the following anthropometric indicators - low weight-for-age, low height-for-age and low weight-for-height, respectively.
- Examine the difference in nutritional status of children less than five years of age in North Maluku, Indonesia, according to age, gender and district.

- Assess the socioeconomic factors associated with children less than five years of age with stunting in North Maluku, Indonesia.
- Assess the socioeconomic factors associated with children less than five years of age with wasting in North Maluku.
- Compare the nutritional status of children in North Maluku, Indonesia, based on the 1978 National Centre for Health Statistics (NCHS)/WHO child growth reference and the 2006 World Health Organization (WHO) international child growth standards.

1.4 Thesis structure

This Thesis contains eight chapters. Following this introduction to the study and outline of the Thesis, Chapter 2 provides detailed background information on nutritional assessment and anthropometric indicators, and explores the literature on nutritional status of young children in developing countries, with particular attention paid to Indonesia, and North Maluku. In addition it describes the methods for assessing nutritional status in young children and the use of international child growth references.

Chapter 3 details the methodology of a secondary data analysis, using nutritional data from the North Maluku Province Health Survey, the study location and design, sample selection and size, data collection methods, survey organisation, training, quality control, data management and statistical analyses. A description is given of those instruments used: including a questionnaire and anthropometric measurements.

Chapter 4 describes the nutritional status of preschool children in the North Maluku study population according to age, gender, geographic location and wealth index distribution.

Chapters 5 and 6 detail the socio-economic factors associated with stunting and wasting of children in North Maluku Indonesia, respectively.

The comparison of nutritional status of preschool children with the former 1978 National Centre for Health Statistics international child growth reference and the more recent 2006 World Health Organization Child growth standards are provided in Chapter 7.

Chapter 8 discusses the results of Chapters 4, 5, 6 and 7, including limitations of this study and recommendations for future research.

1.5 Significance of this Thesis

This Thesis provides valuable information about the nutritional status of young children living in North Maluku, as a new province in Indonesia following a period of civil unrest. It is anticipated that this Thesis will provide useful evidence for the local government health planners and policy makers to develop appropriate responses and programs and establish a strategy to improve the nutritional status of children in the North Maluku province.

1.6 References

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CHAPTER 2

LITERATURE REVIEW

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2.1 Introduction

Chapter 1 provided a rationale for the conduct of this study on the nutritional status of young children in North Maluku province of Indonesia. Chapter 2 reviews the literature on the nutritional status of young children in developing countries, including Indonesia and specifically in North Maluku province, and provides background information on nutritional assessment including anthropometric indicators. It also provides a review of the methods for assessing nutritional status in young children and the availability and suitability of international child growth references.

2.2 Malnutrition

Malnutrition is a nutritional disorder resulting from not having enough food, or not enough of the right food, over a prolonged period of time. The WHO defines malnutrition as a condition that results from lack of food or from infections that cause loss of appetite while increasing the body’s nutrient requirements and losses. For young children malnutrition has many short-term and long-term physical and mental effects, including growth retardation, lowered resistance to infection, and increased mortality rates (WHO, 1995d).

The United Nations International Children’s Fund (UNICEF) defines malnutrition as a broad term commonly used as an alternative to under-nutrition but technically it also refers to over-nutrition (UNICEF, 2007). People are malnourished if their diet does not provide adequate calories and protein for growth and maintenance or they are unable to fully utilise the food they eat due to illness (under-nutrition). They are also malnourished if they consume too many calories (over-nutrition). In this thesis, the literature review will focus on malnutrition in terms of under-nutrition only.

Under-nutrition has been defined as a pathological condition brought about by inadequacy of one or more of the nutrients essential for survival: growth, reproduction and capacity to learn and function in society (Latham, 1997). Children whose diets fall short of standard levels of intake for essential nutrients suffer from under-nutrition that can be mild, moderate or severe, depending on the level of deficiency (FAO, 2004a). It was estimated that nearly 30% of infants, children, adolescents, adults and the elderly in the developing world are suffering from one or more of the multiple forms of under-nutrition (WHO 1999).

The underlying causes of under-nutrition vary across regions. In Asian countries the causes can include poverty, the low status of women, poor care during pregnancy, high rates of low birth weight, high density living, unfavourable child caring practices and poor access to health care. In Sub-Saharan Africa, extreme poverty, inadequate caring practices for children, low levels of education and poor access to health services are among the major factors causing under-nutrition. Conflicts and natural disasters in many countries have further exacerbated the situation. The increase in the number of undernourished children in Africa also reflects a rapid rate of population growth (UNICEF, 2006b).

Under-nutrition is closely associated with a large proportion of childhood deaths in developing countries (Schroeder and KH, 1994), (Rice AL et al., 200), and undernourished children are more likely to suffer ill health and be more vulnerable to disease than properly nourished children (Tomkins A and Watson, 1989), (Cunha, 2000), (Pelletier et al., 1995a). Undernourished children are also more likely to come from poorer households, where they do not get enough food and are exposed to poor living conditions, which lead to disease and further under-nutrition (WHO, 1997).

Under-nutrition has long been recognised as a consequence of poverty. It is widely accepted that higher rates of under-nutrition will be found in areas with chronic widespread poverty (ADB, 2001). Under-nutrition is the result of marginal dietary intake compounded by infection. In turn, marginal dietary intake is caused by household food insecurity, lack of clean water, lack of knowledge on good sanitation and lack of alternative sources of income. It is also compounded by inadequate care, gender inequality, poor health services and poor environment (Setboonsarng, 2005).

Many factors can cause under-nutrition, most of which relate to poor diet or severe and repeated infections, particularly in underprivileged populations. Inadequate diet and disease are closely linked to the general standard of living, environmental conditions, and whether a population is able to meet its basic needs such as food, housing and health care. Under-nutrition is thus a health outcome as well as a risk factor for disease and it can increase the risk both of morbidity and mortality (Blössner et al., 2005). Under-nutrition occurs when dietary intake is inadequate and health is unsatisfactory. In developing countries, infectious diseases, such as diarrhoeal diseases and acute respiratory diseases, are responsible for most nutrition-related health problems (Gross et al., 2000). Readily available food, appropriate health systems and a "healthy" environment are ineffective unless these resources are used successfully. As a result, the absence of proper care in households and communities is the third necessary element of the underlying causes of under-nutrition.

2.2.1 Conceptual framework for causes of malnutrition

The UNICEF conceptual framework of causes of malnutrition (Figure 2.1) is the most commonly used framework in this field (UNICEF, 2007). The framework was developed in 1990 as part of the UNICEF nutrition strategy and recognises that human and environmental resources, economic systems and political and ideological factors are basic causes that contribute to malnutrition, including under-nutrition. The framework adopts a biological approach in which the human being is the starting point and shows that the causes of malnutrition are multi-sectoral; embracing food, health and caring practices. The framework can be used at all levels of authority to help plan effective actions to improve nutrition. It serves as a guide in assessing and analysing the causes of nutrition problems and helps to identify the most appropriate action.

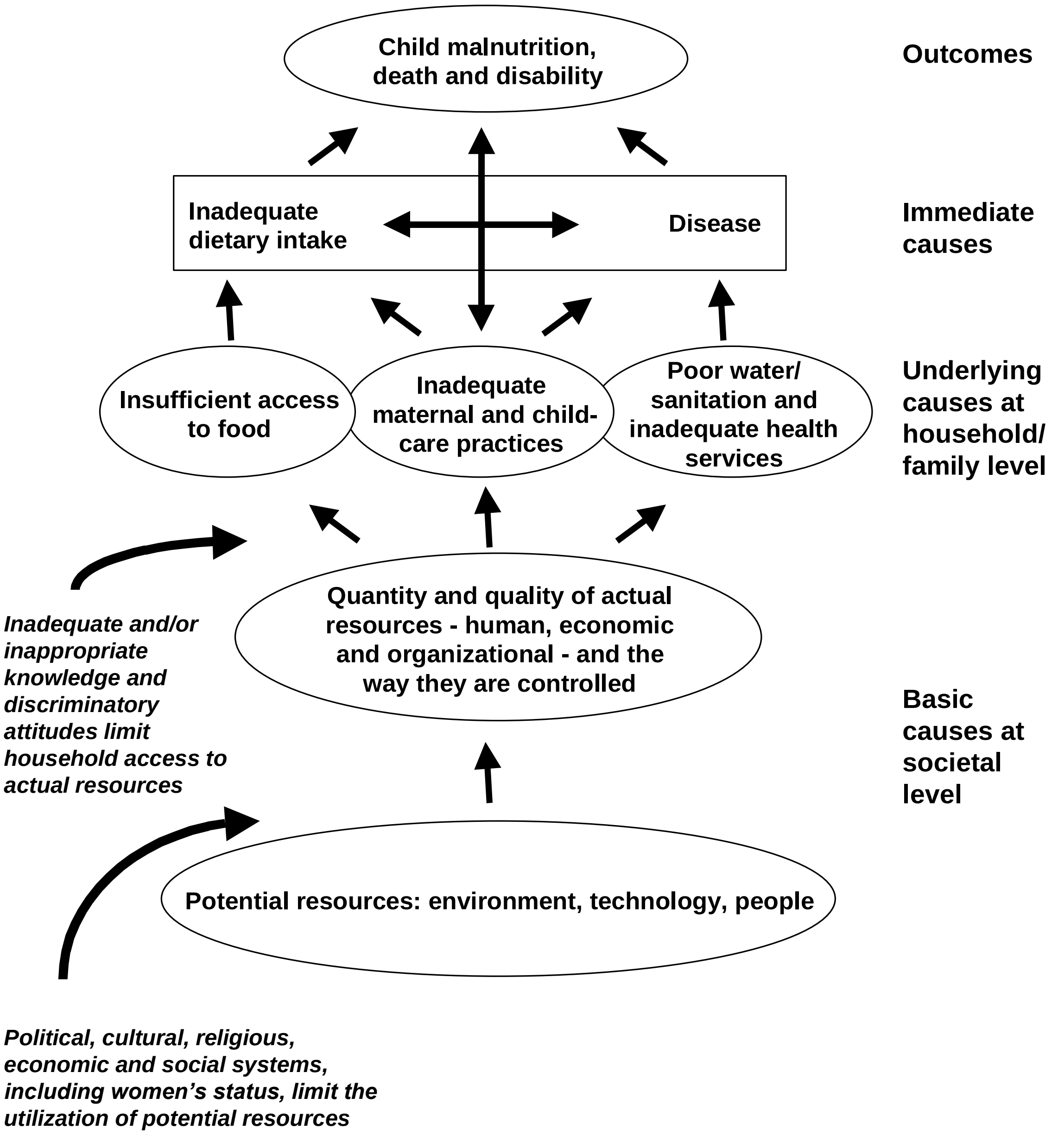

Figure 2.1: The UNICEF conceptual framework of causes of malnutrition

Source: UNICEF. The State of the World's Children. 1998. Oxford University Press: New York (UNICEF, 1998a)

The conceptual framework underlying this study is based on that of UNICEF conceptual framework (UNICEF, 1998a). The framework is comprehensive, incorporating both biological and socioeconomic causes of malnutrition, and it encompasses causes at both the micro and macro levels. Although more refined versions of this framework have since been developed, (i.e. adding female education just below the underlying causes and distinguishing human, economic and organisational resources), all of them contain the basic elements (UNICEF, 1998a). In the UNICEF framework malnutrition and child death are viewed as two of the manifestations of a multi-sectoral development problem that can be analysed in terms of the (a) immediate, (b) underlying and (c) basic causes.

The immediate determinants of child nutritional status manifest themselves at the level of the individual human being by dietary intake (energy, protein, fat, and micro nutrients) and health status. These factors themselves are inter-dependent. A child with inadequate dietary intake is more susceptible to disease. In turn, disease depresses appetite, inhibits the absorption of nutrients in food, and competes for a child’s energy.

Dietary intake must be adequate in quantity and in quality, and nutrients must be consumed in appropriate combinations for the human body to be able to absorb them. The immediate determinants of childhood nutritional status are in turn influenced by three underlying determinants manifesting themselves at the household level. These are (i) food security, (ii) adequate care for mothers and children and (iii) a proper health environment, including access to health services, and are discussed below. Associated with each determinant is a set of resources necessary for their achievement (Smith LC, 2000).

(i) **Food security** is achieved when a person has access to enough food to lead an active and healthy life (World Bank, 1986). 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). No matter how much food is available, no child grows without nurturing from other human beings. This aspect of child nutrition is captured in the concept of care for children and their mothers who give birth to children, who are commonly their main care takers after they are born.

(ii) **Care**, the second underlying determinant, is the provision by households and communities of “time, attention, and support to meet the physical, mental, and social needs of the growing child and other household members” (WHO, 1997). Examples of caring practices are child feeding, health-seeking behaviours, 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 care giver’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.

(iii) 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 he or she is unable to satisfy basic needs for food, health, water, shelter, primary education, and community participation (Frankenberger, 1996). The effects of poverty on child under-nutrition 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 (Smith LC, 2000).

The causes of child under-nutrition are complex, multidimensional and inter related. They range from factors as broad in their impact as political instability and slow economic growth to those as specific in their manifestation as respiratory infection and diarrheal disease. In turn, the implied solutions vary from wide spread measures to improve the stability and economic performance of countries to efforts to enhance access to sanitation and health services in individual communities. Debates continue to flourish over what the most important causes of under-nutrition are and what types of interventions will be most successful in reducing the number of undernourished children (Smith LC, 2000).

2.2.2 Consequences of childhood under-nutrition

Under-nutrition itself can have far-reaching impacts on the environment, and can induce a cycle leading to additional health problems and deprivation. For example, under-nutrition can create and perpetuate poverty, which triggers a cycle that hampers economic and social development, and contributes to unsustainable resource use and environmental degradation (WEHAB, 2002). Breaking the cycle of continuing poverty and environmental deterioration is a prerequisite for sustainable development and survival.

Under-nutrition commonly affects children between the ages of six months and five years in many developing countries. Children between 12 and 36-months old are especially at risk of under-nutrition since they are the most vulnerable to infections such as gastroenteritis and measles.

One in three pre-school children in the developing world is undernourished: they are also more likely to have impaired immune systems, poorer cognitive development, and lower productivity as adults, and greater susceptibility to diet-related chronic diseases such as hypertension and coronary heart disease later in life (Smith LC, 2000). Under-nutrition is both a distinctive cause and a damaging consequence of poverty.

Children from homes with low food security have poorer overall health status; they are sick more often and hospitalised more often. This leads to higher absenteeism from school and can result in children being less prepared (or able) to learn. As a result, the relationship between hunger, health and learning becomes very importance (Jolly D.L., 1991). Further exacerbating this interactive impairment of young bodies and minds are the emotional and behavioural impacts that accompany food insecurity and hunger. At risk children are more likely to have poorer mental health, be withdrawn or socially disruptive, and suffer greater rates of behavioural disorders. Even moderate nutritional vulnerability can impede cognitive development and impair children's capacities over a lifetime (Brown, 2002).

Severe under-nutrition has many short-term and long-term physical and mental effects, including growth retardation, lowered resistance to infection, and increased mortality rates in young children. Under-nutrition during early childhood has a negative impact on cognitive, motor skill, physical, social and emotional development. Death rates are high among children with under-nutrition, with the risk of dying increasing with the severity of the condition: it is not uncommon for deaths to result from electrolyte imbalance, hypothermia, or complicating infections (WHO, 2000), even after receiving treatment.

The mortality rate among children under five years of age is considerably higher than for any other age group (WHO, 2002). It is particularly high in emergency-affected populations due to the combination of a high prevalence of under-nutrition and increased incidence of communicable diseases. Even for children who are only mildly undernourished, the risk of death from illness is twice that of well-nourished children. The risk is greater still for those who are severely undernourished.

2.3 Nutritional status

Nutritional status is a complex concept that can be difficult to define. Adequate nutritional status can perhaps be best defined as the maintenance of a normal pattern of growth and normal body composition, brought about by consumption of appropriate amounts and types of food. However, in terms of malnutrition, although severe under-nutrition is easily recognised, the distinction between adequate nutrition and mild-to-moderate under-nutrition is not as clear (Foster and Leonard, 2004).

Inadequate nutritional intake can ultimately alter functional capacity, resulting in adverse health outcomes that are distinct expressions of under-nutrition's different levels of severity. Initially, children adapt to inadequate diets through reduced physical activity and slowed rates of growth. At moderate degrees of under-nutrition, activity and growth rates are affected to a greater degree and in some cases signs of wasting and some biochemical abnormalities (e.g. reduction in serum albumin) begin to show. At advanced stages of severity, all linear growth ceases, physical activity is severely curtailed, body wasting is marked, and clinical signs (e.g. oedema, hair and skin changes) are noticeable even to the untrained eye (de Onis et al., 2000).

2.3.1 Anthropometric measurements of nutrition status

Nutritional status can be assessed using clinical signs of under-nutrition, biochemical indicators and anthropometry (Fishman. S, 2004). Anthropometry has an important advantage over other nutritional indicators as biochemical and clinical indicators are useful for the extremes of under-nutrition where as body measurements are sensitive over the full spectrum of malnutrition. In addition, anthropometric measurements are non-invasive, inexpensive, require relatively unskilled personnel and the method can be precise and valid (Gibson, 2005), accurate and relatively easy to obtain. However, the main disadvantage of anthropometry is its lack of specificity, as changes in body measurements are also sensitive to several other factors, including intake of essential nutrients, infection, altitude, stress and genetic background (Gibson, 2005). (de Onis, 2000).

Anthropometric measures of height, weight and age are regularly collected. At the individual level, anthropometry is used to assess the person as being in need of special interventions. At a population level, anthropometric data is used to make decisions about the need for intervention, the type of intervention needed and to whom it should be delivered.

Specific data need to be collected in order to complete the overall anthropometric measurement: age, weight, height (or length of babies), mid upper-arm circumference (MUAC) and gender. Length is usually measured before a child is two years old, and height thereafter. Anthropometric indices are a combination of measurements. For example, measurement of weight and height may be combined to produce the body mass index (BMI) (weight/heigt^2) or a ponderal index (weight/height^3), or weight may be related to height through the use of reference data.

When two of these variables are used together they are called an index. There are three indexes commonly used in assessing nutritional status (a) weight-for-age (WFA), (b) height (or length) for age (HFA) and (c) weight-for-height (WFH) (or length, WFL). When these indexes are compared to a reference standard of anthropometry to assess the magnitude, distribution and severity of a nutritional problem in a country, they are called an anthropometric indicator (WHO, 1997).

(a) Weight-for-age (WFA) is an indicator of body mass relative to chronological age. It is influenced by both the height of the child and the weight of the child relative to height, thus making its interpretation complex. Low weight-for-age, or underweight, indicates insufficient weight gain relative to age or weight loss (underweight), while high weight-for-age indicates an excess gain of weight relative to height (overweight).
(b) Height-for-age (HFA) reflects achieved linear growth and its deficits indicate long-term, cumulative inadequacies of health or nutrition (WHO, 1995a). Low height-for-age or stunting indicates a pathological process that has impaired linear growth and is the result of both poor nutrition and poor health. However some children with low height-for-age are genetically short. Where the

prevalence of low height-for-age is very high then it is reasonable to assume that the majority of these children are stunted.

(c) Weight-for-height (WFH) reflects body weight relative to height. Low weight-for-height or wasting indicates an insufficient weight gain relative to height or a loss of weight. Wasting implies a recent severe process that has led to weight loss such as acute illness or acute starvation. Some children with low weight-for-height are normally thin but if the prevalence of low weight-for-height is high it may be assumed that most of these children are wasted. High weight-for-height or overweight indicates an excess weight gain relative to height, or an insufficient gain in height relative to weight (WHO, 1995a).

Stunting is an indicator of chronic under-nutrition, the result of prolonged food deprivation and/or illness. Wasting is an indicator of acute under-nutrition, the result of more recent food deprivation or illness. Underweight is used as a composite indicator, to reflect both acute and chronic under-nutrition.

2.3.2 Methods for assessing nutritional status in young children

Nutritional status is particularly important in children, because it influences growth, sexual development, and neurocognitive development (Cameron JL, 1996; Martin, 1973). Anthropometry is an important tool in the epidemiological assessment of health and nutritional status of populations of children. It can be used also in health programs to monitor health and nutritional status of individual children. For these types of evaluation, accurate and valid anthropometric classification is an essential step (Dibley et al., 1987b).

In children, the three most commonly used anthropometric indices are weight-for-height, height-for-age and weight-for-age (WHO, 1995b). In combination these data can provide important information about a child's nutritional status. In terms of measuring children, anthropometry is capable of detecting stunted growth and body wasting. Height-for-age and weight-for-height can discriminate between different biological processes, unlike weight-for-age, which could be low because of stunting (short stature) and/or wasting (recent weight loss). Hence weight-for-age cannot discriminate between short and long-term forms of under-nutrition given that children classified on its basis may have stunting or wasting.

The designation of a child as having impaired growth implies some means of comparison with a "reference" child of the same age and sex. Thus, in practical terms, anthropometric values need to be compared across individuals or populations in relation to an acceptable set of reference values. This makes it possible to compare the growth status of children of different ages and makes it feasible to assess anthropometric status in population studies and in surveillance programs (Dibley et al., 1987b).

2.3.3 Growth Data and Z-Scores

There are three different systems by which a child or a group of children can be compared to the reference population: Z-scores (standard deviation scores), percentiles, and percent of median. Growth data are usually expressed as Z-scores, calculated as the deviation of the value for an individual from the reference population at that age, divided by the standard deviation (SD) for the reference population (WHO, 1997). For population based assessment - including surveys and nutritional surveillance - the Z-score is widely recognised as the best system for analysis and presentation of anthropometric data because of its advantages compared to the other methods (WHO, 1995a). At the individual level, however, although there is substantial recognition that the Z-score is the most appropriate descriptor of malnutrition, health and nutrition centres (e.g. supplementary feeding programmes in refugee camps) have been reluctant to adopt its use for individual assessment to demonstrate that the Z-score is the most appropriate descriptor for malnutrition (de Onis and Blossner, 2003).

The Z-score system expresses the anthropometric value as a number of standard deviations or Z-scores below or above the reference mean or median value. A fixed Z-score interval implies a fixed height or weight difference for children of a given age. For population-based applications, a major advantage is that a group of Z-scores can be subjected to summary statistics such as the mean and standard deviation. There are two ways of expressing child growth survey results using Z-scores for population-based applications. One is the commonly used cut off- based prevalence; the other includes the summary statistics of the Z-scores: mean, standard deviation, standard error, and frequency distribution (de Onis and Blossner, 2003).

Interpreting the results in terms of Z-scores has several advantages. Firstly, The Z-score scale is linear and therefore a fixed interval of Z-scores has a fixed height difference in centimetres (cm), or weight difference in kilograms (kg), for all children of the same age. For example, on the height-for-age distribution for a 36-month-old boy, the distance from a Z-score of -2 to a Z-score of -1 is 3.8 cm. The same difference is found between a Z-score of zero and a Z-score of +1 on the same distribution. In other words, Z-scores have the same statistical relationship to the distribution of the reference around the mean at all ages, which makes results comparable across age groups and indicators. Secondly, Z-scores are also sex-independent, permitting the evaluation of children's growth status by combining sex and age groups. Thirdly, these characteristics of Z-scores allow further computation of summary statistics such as means, standard deviations, and standard error to classify a population's growth status (de Onis and Blossner, 2003).

For consistency with clinical screening, prevalence-based data are commonly reported using a cut-off value, often less than -2 and greater than +2 Z-scores. The rationale for this is the statistical definition of the central 95% of a distribution as the "normal" range, which is not necessarily based on the optimal point for predicting functional outcomes (WHO, 1995b). The WHO Global Database on Child Growth and Malnutrition (WHO, 2002) uses a Z-score cut-off point of less than minus two standard deviations (<-2.00 SD) to classify low weight-for-age, low height-for-age and low weight-for-height as moderate and severe under-nutrition. Less than minus three standard deviations (<-3.00 SD) is used to define severe under-nutrition. The cut-off point of greater than plus two standard deviations (>+2 SD) classifies high weight-for-height as overweight in children.

The use of -2 Z-scores as a cut-off implies that 2.3% of the reference population will be classified as undernourished even if they are truly "healthy" individuals with no growth impairment. Hence, 2.3% can be regarded as the baseline or expected prevalence. To be precise, the reported values in the surveys would need to subtract this baseline value in order to calculate the prevalence above normal. It is important to note, however, that the 2.3% figure is customarily not subtracted from the observed value. In reporting underweight and stunting rates this is not a serious problem because prevalence in deprived populations is usually much higher than 2.3%. However, for wasting, with much lower prevalence levels, not subtracting this baseline level undoubtedly affects the interpretation of findings (de Onis and Blossner, 2003).

The observed SD value of the Z-score distribution is very useful for assessing data quality. With accurate age assessment and anthropometric measurements, the SD of the observed height-for-age, weight-for-age, and weight-for-height Z-score distributions should be relatively constant and close to the expected value of 1.0 for the reference distribution. A SD that is significantly lower than 0.9 describes a distribution that is more homogenous (or more narrow) compared to the distribution of the reference population. If the surveyed standard deviation of the Z-score ranges between 1.1 and 1.2, the distribution of the sample has a wider spread than the reference. Any standard deviation of the Z-scores above 1.3 suggests inaccurate data due to measurement error or incorrect age reporting (de Onis and Blossner, 2003).

Table 2.1 illustrates the expected ranges of standard deviations of the Z-score distributions for the three anthropometric indicators. For quality data assessment the observed SD value of the Z-score distribution is very useful.

Table 2.1: Expected ranges of standard deviations of the Z-score distributions, for the three anthropometric indicators

Indicator	SD Z-Score
Weight-for-age Z-score	1.00 to 1.20
Height-for-age Z-score	1.10 to 1.30
Weight-for-height Z-score	0.85 to 1.10

Source: World Health Organization. 1995a. Physical status: The use and interpretation of anthropometry. Technical Report Series no. 854. Geneva, Switzerland: World Health Organization. (WHO, 1995a)

The prevalence ranges shown in

Table 2.2 are used by WHO (WHO, 1995b) to classify severity levels of stunting, underweight, and wasting.

Table 2.2: Classification for assessing severity of malnutrition by prevalence ranges among children under five years of age

Indicator	Severity of malnutrition by prevalence ranges (%)			
	Low	Medium	High	Very high
Underweight	<10	10-19	20-29	≥30
Stunting	<20	20-29	30-39	≥40
Wasting	<5	5-9	10-14	≥15

Source: World Health Organization. 1995a. Physical status: The use and interpretation of anthropometry. Technical Report Series no. 854. Geneva, Switzerland: World Health Organization. (WHO, 1995a)

2.3.4 Child growth standards and references

To develop meaningful indicators of nutrition and health status, growth reference curves are needed to compare the observed anthropometric measurements with expected values for age and sex. Reference curves are useful for monitoring growth and provide criteria to select children for further clinical investigation when attained growth deviates from that expected in a healthy population. Reported changes in growth rates or size at around two years of age are sometimes an artefact of the discontinuity of the growth curves at this age.

In population studies growth reference curves are used to define the extent and severity of abnormal anthropometric status, to monitor trends in growth and nutritional status, and to evaluate the impact of nutritional interventions. Finally, growth reference curves are useful to describe nutritional outcomes in epidemiological studies (Dibley et al., 1987a).

Growth references for children are among the most widely used instruments in public health and clinical medicine. At the population level, growth references have diverse applications. For example, they are useful for predicting emergencies related to food and nutrition, assessing the equity of economic resources as distributed within and between communities, evaluating the suitability of weaning practices, and screening and following groups at risk for deficient or excessive growth. For individuals, growth references are the mainstay of growth monitoring and promotion; they help identify the optimal time to introduce complementary foods, are often used to assess lactation performance, and help in the diagnosis of growth faltering, failure to thrive, and excessive growth (Garza and De Onis, 1999).

For clinical or individual-based application, reference values should be used as a screening tool to detect individuals at greater risk of health or nutritional disorders; and should not be viewed as a self-sufficient diagnostic tool (de Onis and Habicht, 1996). For population based application, the reference values should be used for comparison and monitoring purposes. In a given population, a high prevalence of anthropometric deficit will be indicative of significant health and nutritional problems, however, it is not only individuals below the cut-off point who are at risk; the entire population is at risk, and the cut-off point should be used only to facilitate the application of the indicator (WHO, 1995b).

The choice of a growth reference population is an important issue that has received considerable attention in the last decades (WHO, 1995a). One essential consideration is the appropriate use of the reference data. The way in which a reference is interpreted, and the clinical and public health decisions that will be based upon it, can be considered more important than the choice of reference itself. The reference should be used as a general guide for screening and monitoring and not as a fixed standard that can be applied in a rigid fashion to individuals from different ethnic, socioeconomic, and nutritional and health backgrounds.

The 1977 National Centre for Health Statistics (NCHS) growth reference, recommended by WHO for international use in 1978 has served many useful purposes and is referred to in this thesis as the 1978 NCHS/WHO growth curves (WHO Multicentre Growth Reference Study Group, 2006). Among the most important are: the provision of a single set of growth references for the assessment of the general nutritional status of populations of children in diverse settings, as an ancillary tool to screen children for health and nutrition disorders, and as a basis for educational materials that promote improved child care by families.

The 1978 NCHS/WHO growth curves were constructed by combining two distinct data sets compiled in different time periods (WHO Multicentre Growth Reference Study Group, 2006). For children less than two years of age the data came from the Fels Longitudinal Study carried out in Yellow Springs, Ohio, from 1929 to 1975 (WHO, 1995d). The Fels curves reflect the growth of children who were fed primarily infant formula and in whom complementary feeding was often initiated before four months. The group was of homogeneous genetic, geographic, and socio-economic backgrounds. For older children, the data came from nationally representative cross-sectional surveys of children in the United States and included all ethnic groups and social classes (de Onis et al., 1997).

The 1978 NCHS/WHO estimates relied exclusively on weight-for-age, which reflects body mass relative to chronological age, which is influenced by both the height of the child (height-for-age) and weight of the child (weight-for-height). Furthermore, the younger children were measured supine (length) and older children were measured standing (height). As a result there is a marked discrepancy in estimated height status immediately before and after 24-months of age, where the two curves ideally should merge seamlessly. This disjunction of about 0.5 SD or 1.8 cm, complicates the interpretation of growth data from nutrition surveys and surveillance activities The different measurement method alone does not account for the disjunction – it is because the data for younger children is not representative of United States (US) populations and they are intrinsically taller and heavier than the general US child population (WHO, 1995b). In addition, there is a positive skew in the weight distribution, reflecting a substantial level of childhood obesity. This upward skewness reflects an "unhealthy" characteristic of the 1978 NCHS/WHO reference population and may result in the misclassification of overweight children as "normal” (WHO, 1995b).

More importantly, concern also has been expressed that the 1978 NCHS/WHO curves are inappropriate for healthy, breastfed infants. Research shows that infants fed according to recommendations by the WHO (WHO, 1995e) who live under conditions that favour the achievement of genetic growth potentials, grow less rapidly than, and deviate significantly from, the NCHS reference (WHO, 1994),(WHO, 1995c). The negative deviations are large enough to lead health workers to make faulty decisions regarding the adequate growth of breastfed infants, and thus to mistakenly advise mothers to supplement unnecessarily or to stop breastfeeding altogether. Given the health and nutritional benefits of breastfeeding, this potential misinterpretation of the growth pattern of healthy breastfed infants has great public health significance. The premature introduction of complementary foods can have life-threatening consequences for young infants in many settings, especially where the role of breastfeeding in preventing severe infectious morbidity is crucial to child survival (de Onis et al., 1997).

Given the capital importance of these issues to child health and survival a comprehensive review by WHO of the use and interpretation of anthropometric data was undertaken and concluded that the 1978 NCHS/WHO international growth reference for infants does not describe physiological growth adequately. Thus, a new anthropometric reference was recommended to enhance the nutritional management of young children from birth to five years. The approach taken by the WHO for development of a new reference was guided by the principle that anthropometric reference data must always reflect the functional context of their intended uses and an awareness of the consequences of their application. This recommendation was endorsed in 1994 by the World Health Assembly. The development of a new growth reference was regarded as long overdue by most members of the scientific and public health communities with interests in infant and child health.

To construct a sound reference of lasting value, WHO concluded that a multi-country growth study specifically designed to develop a growth reference was necessary. The new reference sample was to be based on breastfed infants living in healthy environments that did not limit their genetic growth potential. Measurements were recommended to be taken at sufficiently frequent intervals to allow proper characterisation of growth patterns using appropriate up-to-date curve-fitting techniques and the sample size was to be large enough to ensure that centile curve estimation was stable (de Onis et al., 1997).

Applying the committee's prescription for the formulation of an international reference drawn from several countries was expected to improve the estimate of the variability of physiologic growth and help evaluate reasons for differences between the variability in growth in the current NCHS/WHO reference and in the initial analyses conducted by WHO (WHO, 1994). Such an approach would minimise difficulties that could arise from the use of a single country's child-growth data as a reference and, by default, as a worldwide "standard" for optimal growth.

Together with the development of a new growth reference, emphasis was placed on its appropriate use. Ways in which a reference is interpreted and the clinical and public health decisions taken on its basis are of fundamental importance. For clinical or individual-based applications reference values should be used as a screening tool to detect individuals at greater risk of health or nutritional disorders. For population-based applications, reference values should be used for comparison and monitoring purposes. In populations, a high prevalence of anthropometric deficits implies that the entire population is at risk of significant health and nutritional problems. Thus, even children who are not below conventional cut-off points for defining malnutrition are at increased risk and should be taken into account in intervention programs. The protocol for the development of a new growth reference was prepared by an international group of experts brought together by WHO. This effort was linked to the development of effective community-based interventions for the improvement of child growth and development, another WHO initiative (de Onis et al., 1997).

The new child growth standards are the result of an intensive study initiated by WHO in 1997 to develop a new international standard for assessing the physical growth, nutritional status and motor development in all children from birth to age five. The WHO and its principal partner, the United Nations University, undertook the Multi-centre Growth Reference Study (MGRS) which was a community-based, multi-country project involving more than eight thousand children from diverse geographic sites around the world including Brazil, Ghana, India, Norway, Oman, and the United States of America (WHO, 2006). The children in the study were selected based on an optimal environment for proper growth: recommended infant and young child feeding practices, good healthcare, mothers who did not smoke, and other factors associated with good health outcomes. Data were collected on infants who were exclusively or predominantly breast-fed for less than or equal to four months and compared with infants who continued breast-feeding throughout the first year, and a cross-sectional study of infants and young children aged 18 to 71 months. The adopted protocol provides a single international reference that represents the best standard possible of optimal growth for all children less than five years of age. Furthermore, documentation is sufficient to allow for possible future revision of the reference as substantial new biological information on the growth of infants and young children becomes available (Garza, 1999).

The new international Child Growth Standards for infants and young children were released on 27th April 2006 by WHO (WHO, 2006) and provide evidence and guidance for the first time about how every child in the world should grow. The new standards confirmed that children born anywhere in the world and given the optimum start in life have the potential to develop to within the same range of height and weight. Naturally there are individual differences among children, but across large populations, regionally and globally, the average growth is remarkably similar. For example, children from India, Norway and Brazil all show similar growth patterns when provided healthy growth conditions in early life. The new standards state that differences in children's growth to age five years are more influenced by nutrition, feeding practices, environment, and healthcare than genetics or ethnicity. These new standards help to inform parents, doctors, policymakers and child advocates about the nutrition and healthcare needs of children, and particularly when they are not being met. Under-nutrition, overweight and obesity, and other growth-related conditions can then be detected and addressed at an early stage.

The first new growth charts released included growth indicators such as WFA, length/HFA, WFH/length and for the first time, a BMI standard for children up to age five years. In addition, the Windows of Achievement standard for six key motor development milestones such as sitting, standing and walking were included (WHO, 2006). The new 2006 WHO child growth standards are based on the breastfed child as the norm for growth and development. This brings coherence for the first time between the tools used to assess growth, and national and international infant feeding guidelines which recommend breastfeeding as the optimal source of nutrition during infancy. This will now allow accurate assessment, measurement and evaluation of breastfeeding and complementary feeding (WHO, 2006).

A notable effect of using the 2006 WHO child growth standards is that stunting will be more identifiable throughout childhood, compared to the previous 1978 NCHS/WHO growth reference, there will be a substantial increase in underweight rates during the first half of infancy (zero to six months), and a decrease thereafter because in the past, growth of breast fed infants after the first three months was judged as inadequate using the 1978 NCHS/WHO reference. For wasting, the main difference between the 2006 WHO child growth standards and the 1978 NCHS/WHO growth reference is during infancy wasting rates will be more identifiable using the 2006 WHO child growth standards (up to about 70 cm length). With respect to overweight, use of the 2006 WHO child growth standards will result in a greater prevalence that will vary by age, sex and nutritional status of the index population (WHO, 2006). The 2006 WHO child growth standards can help stimulate change that facilitates these improvements. Therefore, the very first step should be implementing the new standard in every country and ensuring that every child has his/her own chart against which his/her growth is assessed with appropriate follow up (WHO, 2006). The Standards can be widely used as a tool in public health, medicine and by governmental and health organisations for monitoring the well-being of children and for detecting children or populations not growing properly or under or overweight and may require specific medical or public health responses. The introduction of the 2006 WHO growth standards has been accompanied by the release of software that allows for the calculation of the prevalence of malnutrition by using Z-scores with both the 2006 WHO growth standards and the 1978 NCHS/WHO reference data (World Health Organization, 2005).

2.3.5 Nutritional status of young children in developing countries

Proper identification of growth faltering remains important, as a major determinant of human development. It is reported that 6.6 million out of 12.2 million deaths among children under five years of age or approximately 50% of child mortality in developing countries is associated with under-nutrition, the majority of which is due to the potentiating effect of mild-to-moderate under-nutrition as opposed to severe malnutrition (Bailey K, 1998). Thus, strategies that focus only on severely undernourished children are insufficient to improve child survival globally and inadequate in addressing malnutrition's toll on human development. The most significant impact can be expected when all grades of malnutrition are targeted. This underscores the need for a technically sound growth reference that supports the identification of the earliest signs of poor growth.

Worldwide, an estimated 852 million people were undernourished in 2000 to 2002, with most (815 million) living in developing countries (FAO, 2004b). Under-nutrition contributes to over six million child deaths each year, 55 per cent of the nearly 12 million deaths among children aged less than five years in developing countries (UNICEF, 1998b). Developing-country under-nutrition on its current scale of one-third of all children causes untold human suffering. Under-nutrition is associated with more than half of all child deaths worldwide (Pelletier et al., 1995b). It is the source of a major waste of resources and lost productivity because children who are undernourished are less physically and intellectually productive as adults (Gillespie and Haddad., 2001). Under-nutrition is thus a primary obstacle to the development process itself. It is a violation of the child’s human rights, yet virtually all of it can be prevented (Mason et al., 1999; Oshaug et al., 1994). Figure 2.2 shows that more than one-quarter (27%)

of all children aged less than five years in the developing world are underweight.

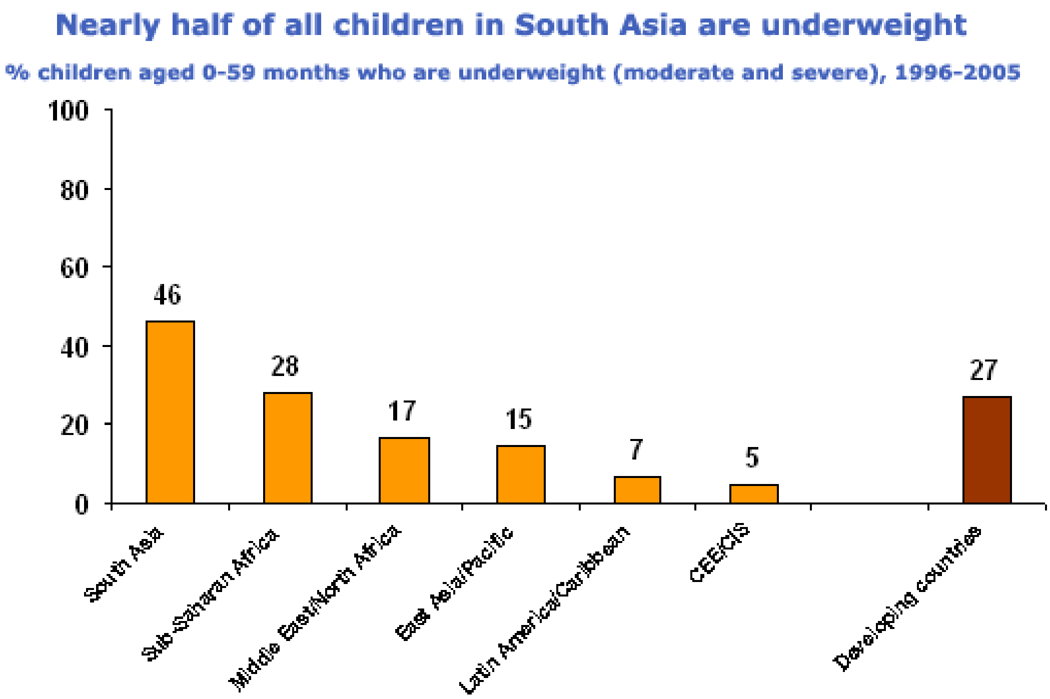

Figure 2.2: The state of the world's children 2006

Source: The State of Worlds Children 2006. (UNICEF, 2006b)

This accounts for about 146 million underweight children in developing countries. Of these 146 million underweight children, nearly three-quarters (73%) live in just 10 countries. Significant variation in underweight prevalence exists among children aged less than five years in the developing world. The highest prevalence is found in South Asia, where almost half (46%) of all children aged less than five years are underweight. Three countries in the South Asia region drive the high levels - India, Bangladesh and Pakistan - which alone account for half of the world's total underweight children. These three countries are home to 29% of the developing world's population of children aged less than five years.

In Sub-Saharan Africa more than one-quarter (28%) of all children aged less than five years are underweight. Nigeria and Ethiopia alone account for more than one-third (37%) of all underweight children in Sub-Saharan Africa. In Ethiopia, nearly half (47%) of all children are underweight (UNICEF, 2006b). The lowest prevalence is found in Latin America and the Caribbean, where seven percent are underweight, and in Central Eastern Europe / Commonwealth of Independent State where five percent are underweight.

Nutritional status is the best global indicator of well-being in children. Although many surveys of children have been conducted since the 1970s, lack of comparability between them has made it difficult to monitor trends in child under-nutrition. The prevalence of stunting has fallen in developing countries from 47% in 1980 to 33% in 2000 (i.e. by 40 million), although progress has been uneven. Stunting has increased in Eastern Africa, but decreased in South-eastern Asia, South-central Asia and South America; Northern Africa and the Caribbean show modest improvement; and Western Africa and Central America present very little progress (FAO, 2002). Despite an overall decrease of stunting in developing countries, child malnutrition still remains a major public health problem in these countries. In some countries rates of stunting are rising, while in many others they remain disturbingly high (de Onis et al., 2000). The prevalence of stunted children in developing countries remains high (Figure

2.3). Nearly one third of children under five are stunted. The highest prevalence is found in South Asia including Indonesia.

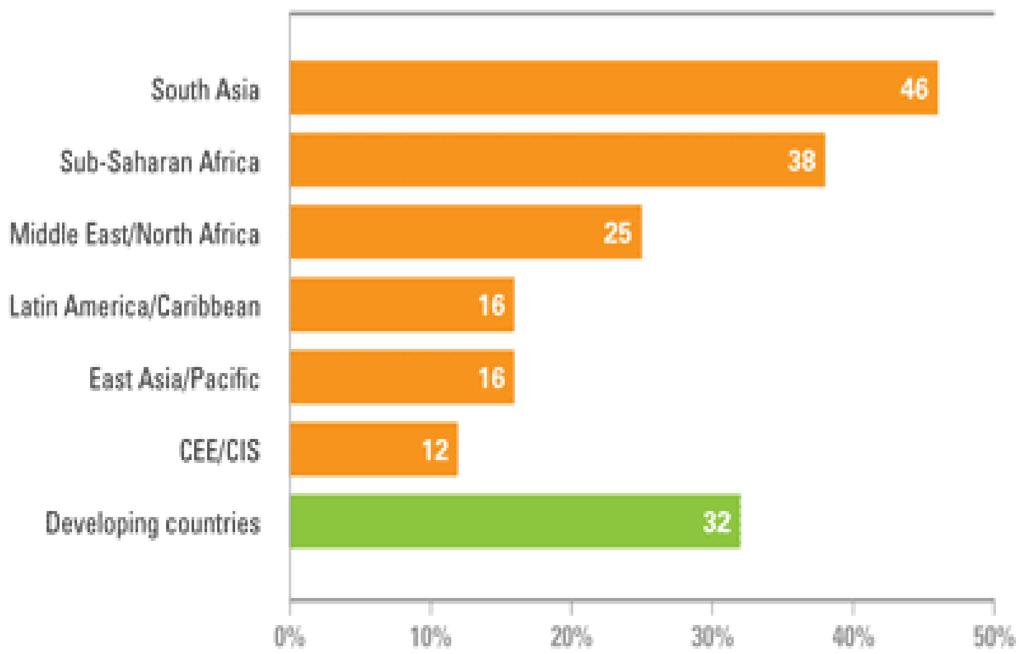

Figure 2.3: Prevalence of stunting in children aged less than five years of age, by region 2000-2006

According to UNICEF, 150 million young children in developing countries were stunted and/or underweight at the end of the twentieth century. Recent estimates also show that these children are at risk of developmental delay but little is known about the causes of the developmental delay in these children (Kuklina, 2004).

At the millennium summit in 2000 (UN, 2006), representatives from 189 countries committed themselves toward a world in which sustaining development and eliminating poverty would have the highest priority. The increased recognition of the relevance of nutrition as a basic pillar for social and economic development placed childhood under-nutrition among the targets of the first Millennium Development goals developed by United Nation to "*eradicate extreme poverty and hunger*" (UN, 2006). The specific target goal is to reduce by 50% the prevalence of being underweight among children less than five years between 1990 and 2015. Childhood underweight is internationally recognised as an important public health problem and its devastating effects on human performance, health, and survival are well established. A recent study estimated that about 53% of all deaths in young children are attributable to underweight, varying from 45% for deaths due to measles to 61% for deaths due to diarrhoea (de Onis et al., 2004).

The full implementation of the objectives of the Global Strategy for Infant and Young Child Feeding (2002) developed by UNICEF would go a long way in creating supportive environments for mothers to breastfeed their children (UNICEF, 2006b). For the first six months, mothers need to be informed and empowered to practice exclusive breastfeeding. Children should be provided with safe, wholesome, and nutritionally appropriate foods during the period of complementary feeding and after the second year when breastfeeding has ceased. Appropriate national guidelines should be developed to aid caregivers in choosing nutritious local foods in correct combinations and amounts to feed their children in order to maintain optimal growth in later childhood. Vaccinations and good health care should be available and accessible to all infants and young children. Families and their communities should do all they can to insure that mothers have a good pregnancy.

2.4 Nutritional status of young children in Indonesia

Approximately 50% of Indonesians suffer from various forms of nutritional deficiencies, and 15% of the adult population are overweight with increasing incidence of chronic non-communicable diseases such as coronary heart disease, various cancers, diabetes, and osteoporosis. Combating nutritional problems in Indonesia requires a range of strategies. Malnutrition affects all age groups across the entire lifespan, including a spectrum of nutrient-related disorders, deficiencies and conditions creating major public health problems: intra-uterine growth retardation, protein energy malnutrition, iodine deficiency disorders, vitamin A deficiency, iron-deficiency anaemia, obesity and other diet-related non-communicable diseases. Other specific nutritional deficiencies have also started to expose Indonesian communities such as: folate deficiency, zinc deficiency, calcium deficiency and osteoporosis. (Atmarita, 2005).

2.4.1 Country profile for Indonesia

Indonesia is an archipelago in Southeast Asia consisting of 17,000 islands (6,000 inhabited), straddling the equator. The total area is 741,096 sq mi (1,919,440 sq km). The largest islands are Sumatra, Java, Kalimantan, Sulawesi and Papua. Until 1999, the country was divided into 27 provinces, 296 districts/municipalities, 3625 sub-districts, and 67,033 villages. Starting in the year 2000 some areas divided to form new provinces, districts, sub-districts and villages. Indonesia is currently divided into 33 provinces, 440 districts, 5117 sub-districts and 72,000 villages.

Indonesia is the world's fourth most populous country after China, India, and the United States. The total population based on 2000 census data (Atmarita, 2005) was 203.4 million people (214.6 million in 2004), which increased by 41% from the 1971 census. The adult population (15 to 49 years old) comprised more than half (55%) of the country's population while children aged from zero to four years comprised 8.9% of the total population. The proportion of children aged zero to 14 years old is declining, just as the proportion of older persons (those age 50 years or over) is increasing. In 2003, 42% or 90 million Indonesians live in the cities. With an annual growth of 1.3%, the total population is estimated to reach 280 million by 2025 (Atmarita, 2005).

2.4.2 Nutritional status monitoring through socio-economic surveys in Indonesia

Nutrition is part of the Indonesian government's development program, which was included in the first five-year national development plan between 1979 and 1984. Data on several dimensions of nutritional status are routinely collected. Commencing in 1985, the Nutrition Surveillance System was gradually established and expanded to all provinces by the 1990s. There were three data collections assigned to monitor child malnutrition: (a) nutritional status monitoring through socio-economic surveys (Susenas); (b) nutritional status monitoring for sub-district level; and (c) nutritional status monitoring for first-grade school children (Setboonsarng, 2005).

The Susenas-type surveys which are integrated into routine Central Bureau of Statistics (CBS) annual surveys consist of social and economic variables. Every year the survey collects information from 220,000 households, representing the district level (core survey). In addition to the core survey, every three years a special module, such as health, agriculture or education, is implemented as a part of Susenas. The module has a sample size of 65,000 households, representing national and provincial levels.

Anthropometric measurement for preschool children was introduced to the Susenas-type-module for the first time in 1989. Weight-for-age was the anthropometrics index chosen to identify the prevalence of child malnutrition nationally as well as for regional/provincial areas. This anthropometric information is available for the years 1989, 1992, 1995 and 1998. From 1999 to 2001, the Ministry of Health supported a Susenas-type survey for the purpose of evaluating the consumption of iodized salt. The anthropometric measurement for preschool children was also expanded to cover the district level. The Susenas-type-surveys do not classify the areas into poor or non-poor, but into urban or rural and by gender differential.

2.4.3 Nutritional status monitoring system at sub-district level and for first-grade school children in Indonesia.

The Ministry of Health in Indonesia has its own Nutritional Status Monitoring System for classifying sub-district level nutritional status. The purpose of the data collection is to provide an indication of nutritional status in sub-district areas affected by program development. The underweight data in this system is collected to determine the levels and trends of undernourished children at sub-district levels. The monitoring has been implemented annually since 1995 to support district government's prioritising of the highest risk areas within districts.

The calculation of sample sizes was determined based on the previous prevalence of child malnutrition, and preschool children were chosen based on multi-stage simple random sampling. Data are available at the central level as well as district and sub-district level. There has been a problem with continuation of data collection because of budget limitations, especially since 2001 when the decentralisation system started (Setboonsarng, 2005).

In 1994, the Ministry of Health commenced evaluation of nutritional outcomes as an impact of the nutrition program development. National surveys have been implemented for measuring all first grade school age children. Height-for-age is the anthropometric index used to measure the children. The data have been collected every five years to represent the prevalence of stunted children at the district level. Two data sets are available for the years 1994 and 1999 consisting of height measurements for children aged five to eight years. The data can be assessed to determine the prevalence of stunting for urban and rural areas and by gender. A simple random sample was assigned to select elementary schools at the village level, and from selected schools, children in first grade were measured (Setboonsarng, 2005).

2.4.4 Village nutritional program data in Indonesia

At the village level, the nutrition program is implemented at Posyandu, the Integrated Health Post, covering 50 to 100 households. This growth promotional program includes activities such as immunisation, basic health services for mother and children, nutrition counselling, family planning, and food supplementation. The activities are implemented once a month by cadres (volunteer health services) and supervised by health staff from health centres. Using the growth card (Figure 2.4 and Appendix 2.1 located at the end of this Chapter), all three anthropometric indexes: wasting, stunting and underweight are collected for children visiting the Health Post. The monitoring includes growth charts, and growth faltering is detected when a child's growth curve declines at less than the curve from the growth chart. If it could be assumed that all mothers and children of the village make use of the services regularly, then the village health post would be the most complete source of information on children's nutritional status in Indonesia.

Figure 2.4: Example of Indonesian growth card provided by Health Ministry of Indonesia

Source: Setboonsarng, S. (2005). An Evaluation in the Context of Different Development Interventions in Indonesia. ADB Institute Discussion Paper No. 21. (Setboonsarng, 2005)

Indonesia achieved a high annual average rate of poverty reduction from 1970 to 1990 (World Bank, 1993). The number of absolute poor reduced from 70 million people in 1970 to 22.5 million in 1996. In 1997, the economic crisis increased the number of the poor in Indonesia to 37.5 million people (Irawan and Romdiati, 2000). National food consumption surveys from 1995 to 1998 found that many households consumed less than 1500 Kcal and 32.2 grams of protein per capita per day (less than 70% recommended daily allowance). They showed an increasing prevalence of energy deficit from 48% in 1997 to 51% in

1998. In line with the food insecurity problem at household level, the Food and Nutrition Surveillance System from all provinces in Indonesia reported an increasing number of cases of severely undernourished children aged less than five years from 1997 to 1999 (Atmarita et.al, 2000).

Approximately half of infant and child mortality may be attributed to coincident malnutrition, often preceded by low birth weight. Underweight status of children aged less than five years has declined nationally but exceeds 40% in the east, again with striking disparities. Stunting and wasting remain high, around 34% and 16% respectively. Exclusive breastfeeding of infants remains low at 40% in the first six months, due to the traditional early introduction of foods, challenges of modernisation and increasing workforce participation of mothers (UNICEF, 2006a).

2.4.5 Underweight, stunting and wasting among Indonesian pre-school children

Despite efforts by the Indonesian nutritional program to empower communities, and ensure that the country had sufficient energy available for consumption, the weight of pre-school children remained below the international reference standard (refer to Table 2.3). Also, while the rates of moderate under-nutrition (underweight children) decreased through the 1990's, the prevalence of severely underweight children increased. Overall, efforts over the last 14 years have reduced the proportion of underweight of pre-school children by about only 10 percentage points: 37% (1989) to 27% (2003) or with average rate of reduction less than 1% per year. With a diverse population of 210 million, underweight rates vary across districts.

Table 2.3: Trends in prevalence of underweight children in Indonesia 1989-2003

	1989	1992	1995	1998	1999	2000	2001	2002	2003
< -2.00 SD (Underweight)	37	35	32	29	26	25	26	27	27
< -3.00 SD (Severely underweight)	6.3	7.2	12	10	8.1	7.5	6.3	8.0	8.3

Note: weight for age < -2.00 SD and < -3.00 SD

Source: Susenas Data sets, Nutritional Status Component, 1989-2003 (Atmarita, 2005)

Figure 2.5 shows the prevalence differences between districts that estimates the proportion of preschool children who are moderately or severely underweight to range from under 20% to over 40% (Atmarita, 2005). The trend data on stunting among pre-school children also shows no change over time. The prevalence has been increasing to more than 40% since the 1990s. The higher rate is observed not only for underweight and stunting but also wasting. This implies that nutrition problems in pre-school and school children remain a serious public health problem.

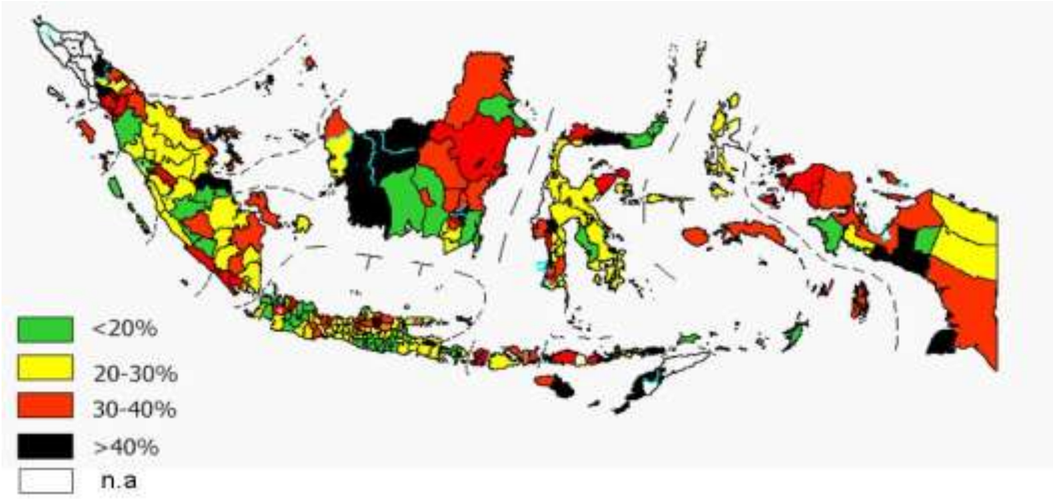

Figure 2.5: Prevalence of underweight among pre-school children 2003

Source: Atmarita M. (2005). Nutrition problems in Indonesia. In: An integrated international seminar and workshop on lifestyle related diseases. Gajah Mada University, Yogyakarta Indonesia (Atmarita, 2005).

Table 2.4 and Table 2.5 present the prevalence of stunting and wasting respectively among pre-school children from several studies in Indonesia. Considering this problem has implications for the children's education, the seriousness of nutritional problems should also be considered as an education problem (Atmarita, 2005).

Table 2.4: Prevalence of stunting in pre-school children 1990-2001 according to surveillance survey

	IBT, 1990	Suvita, 1992	SKIA, 1995	NSS, 2001
Boys	47	42.5	46.5	46.6
Girls	41.9	40.2	45.2	45.5
Urban			36.5	
Rural			49.9	
Total	44.5	41.4	45.9	45.6

IBT: Indonesia Bagian Timur (Eastern Indonesia island survey); Suvita (Survey Vitamin A); SKIA (Mother and child survey); NSS (Nutrition & health surveillance survey)

Source: Eastern island survey National vitamin A survey ; Mother and child survey); Nutrition & health surveillance survey – HKI, Rural areas (Atmarita, 2005)

Table 2.5: Prevalence of wasting in pre-school children 1990-2001 according to surveillance survey

	IBT, 1990	Suvita, 1992	SKIA, 1995	SKRT, 1995	Ev.JPS, 1999	SKRT, 2001
Boys	10.8	9.5	13.9	13.3		16.9
Girls	8.7	7.6	12.7	10		14.5
Urban			13.5		14	15.2
Rural			13.3		13.7	16.2
Total	9.7	8.6	13.4	11.6	13.7	15.8

IBT: Indonesia Bagian Timur (Eastern Indonesia island survey); Suvita (Survey Vitamin A); SKIA (Mother and child survey); NSS (Nutrition & health surveillance survey); SKRT (National health and household survey); Ev,JPS (survey on impact of social safety net project)

Source: Eastern island survey National vitamin A survey Mother and child survey National health and household survey, survey on impact of social safety net project (Atmarita, 2005)

2.4.6 Nutritional status of young children in North Maluku

North Maluku is a province of Indonesia, covering the northern part of the Maluku Islands which are split between it and the province of Maluku. Maluku province previously covered the entire group. The planned provincial capital is Sofifi, on Halmahera, but the current capital and largest population centre is the island of Ternate. In the 16th and 17th centuries, the islands of North Maluku were the original "Spice Islands". At the time, the region was the sole source of cloves. The Dutch, Portuguese, Spanish, and local kingdoms including Ternate and Tidore struggled for control of the lucrative trade in these spices. Clove trees have since been transported and replanted all around the world and the demand for clove from the original Spice Islands has ceased, greatly reducing North Maluku's international importance. The population of North Maluku is 870,000 making it the least populous province in Indonesia (Central Bureau of Statistics, 2003).

The Centre for Food, Nutrition, and Health (CFNH), Hasanuddin University, Indonesia, conducted a survey on nutritional status of infants and children aged less than five years in Ternate in 2001, after the civil unrest. Results indicated that 22% of children aged less than five years were undernourished (Razak et al., 2004) (WFA less than two SD from the mean) and 3.9% of children were severely undernourished (WFA less than three SD from the mean). In addition, 23% were stunted (HFA less than two SD from the mean) and 9.7% were wasted (WFH less than two SD from the mean). Prevalence of wasting was higher in children aged six to 11 months (11%) and 12 to 23 months (19%). This showed that acute malnutrition was prevalent, based on wasted children, due to conditions in the Ternate areas, where the refugee camps were established. The prevalence of underweight, stunting and wasting were categorised as high, medium and low respectively, compared with WHO 1995 criteria (refer to Table 2.1 and Table 2.2) (Thaha Razak, 2004).

A study in Thailand in 1997 indicated that children who suffer from malnutrition in Laotian refugee camps in Ubon (indicated by mid upper arm circumferences of less than 12.5 cm) experienced far more episodes of acute illness than children not living in refugee camps. The results indicated that the feeding centers are more likely to have a higher percentage of children with under nutrition than children not living in the camps. (O'Sullivan et al., 1980). Various circumstances have created and perpetuated under-nutrition in refugee camps such as civil conflict, natural disaster, funding shortages, and environmental degradation. Even though the refugee camps provide food and other basic needs, the problem of under-nutrition and other health problems have been evidenced in refugee camps (Goette J, 2005). The Australian Government provides funding for new refugees who arrive in Australia, however a policy and framework for early childhood services, which comprehensively addresses the special needs of refugee children, does not exist. Despite this a few innovative organizations have produced resource materials in the field of refugee nutrition (Goette J, 2005).

Following the civil unrest in North Maluku, normal living conditions were almost achieved and a number of people returned back to their homes by mid-2002. However, destruction of many facilities resulted in adversely affected health and nutritional conditions of all risk groups, including children less than five years old. A child health and nutrition survey conducted in 2004 by CFNH, Hasanuddin University, revealed that malnutrition continued to be an important public health problem in this province. The prevalence of stunting in the province for children less than five years was high at 33%, and similarly the prevalence for underweight was 29% and wasting 13% (Razak et al., 2004).

The current study, detailed in this thesis, was conducted in 2004 with the local situation back to relative normalcy. At the time the survey was conducted it is estimated that children from two of the eight districts of North Maluku (Ternate and Tidore) were living in refugee camps for easier access to food and transport. It is estimated that 25% of the population in these two districts were still living in the camps at the time the survey was undertaken. However, during the data collection phase those living in the refugee camps and those not living in refugee camps were unable to be distinguished as there was no defined area containing the refugee camps and there was not a specific question in the survey asking about refugee status.

This study was significant in providing baseline data for children less than five years old in North Maluku, and helps the local government set up an appropriate nutrition program for their children for improved health and a better life.

2.5 Summary

Under-nutrition malnutrition remains a major public health problem for children in developing countries. Multiple and interrelated determinants are involved in why under-nutrition develops, and a similarly intricate series of approaches, multifaceted and multi-sectoral, are needed to deal with it. This chapter reviewed the literature on nutritional status, malnutrition, consequences of childhood under-nutrition, conceptual frameworks for causes of malnutrition, anthropometric measurements of nutrition status, methods for assessing nutritional status in young children, children growth standards and references, nutritional status of young children in developing countries, nutritional status monitoring of young children in Indonesia, at national, district and village levels and describes what is already known about the nutritional status of the young children in North Maluku.

There are few studies investigating malnutrition in children in North Maluku, Indonesia where under-nutrition remains a major public health problem and the first priority for health policymakers.

Chapter 3 describes the methodology of the North Maluku Province Health Survey, used to assess the nutrition status and risk factors for malnutrition in young children in North Maluku Indonesia. This study covers all eight districts in North Maluku and provides baseline data to establish nutritional programs in this new province.

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Appendix 2 1 Example of Indonesian growth card provided by Health Ministry of Indonesia

AIR SUSU IBU
MAKANAN BAYI TERBAIK

Sampai Bayi umur 4 bulan, jangan beri makanan dan minuman lain selain AIR SUSU IBU, yaitu ASI Eksklusif

ASI saja menjamin pertumbuhan dan perkembangan bayi umur 0-4 bulan

PEDOMAN PEMBERIAN MAKANAN YANG SEHAT

Umur	ASI	Makanan Lumat	Makanan Lembik	Makanan orang Dewasa
0 – 4 bulan				
4 – 6 bulan				
6 – 12 bulan				
12 – 24 bulan				
24 bulan ke atas				

CONTOH KELOMPOK BAHAN MAKANAN SESUAI GIZI SEIMBANG

KMS

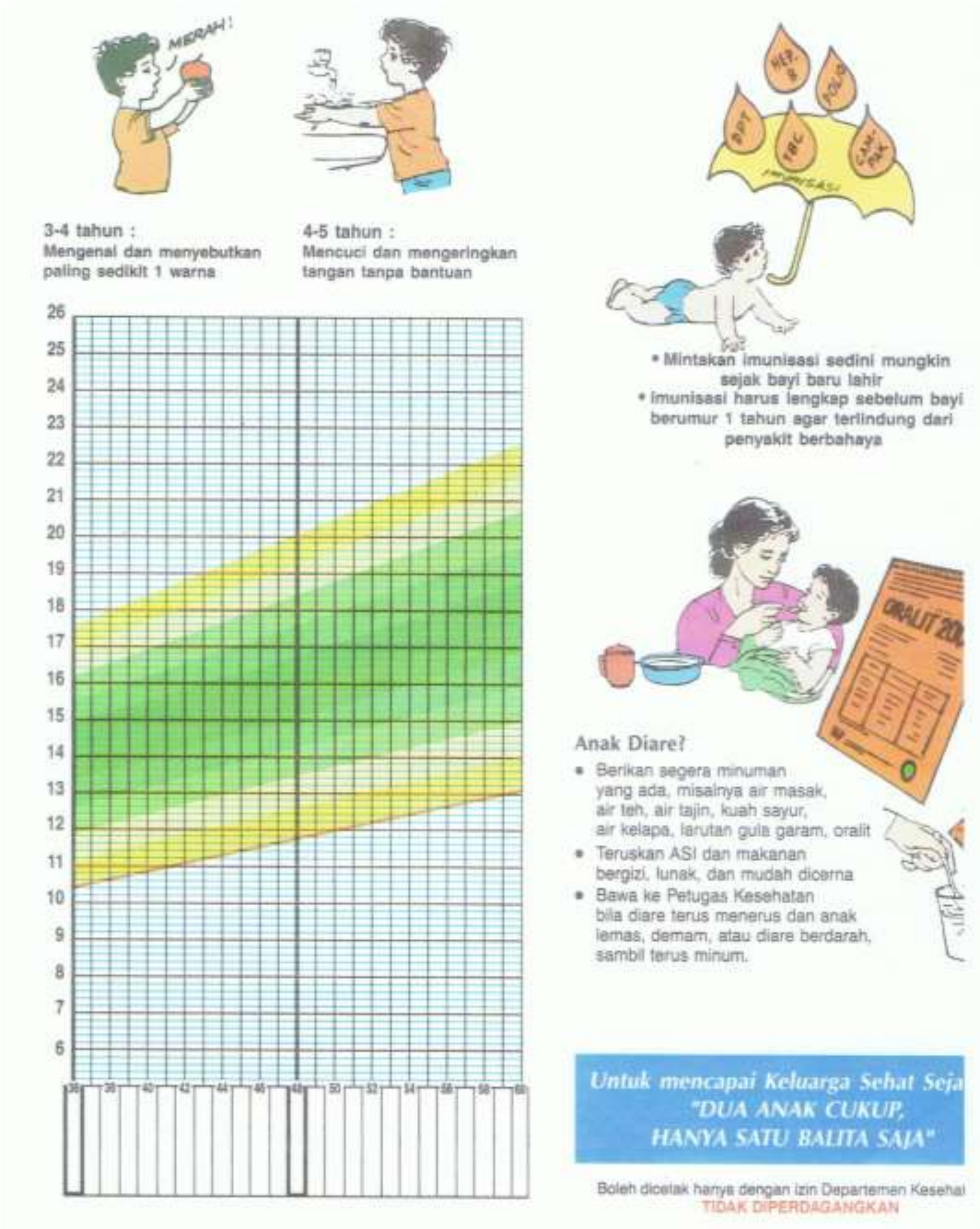
KARTU MENUJU SEHAT

Nama Anak: .... No. Pendaftaran:

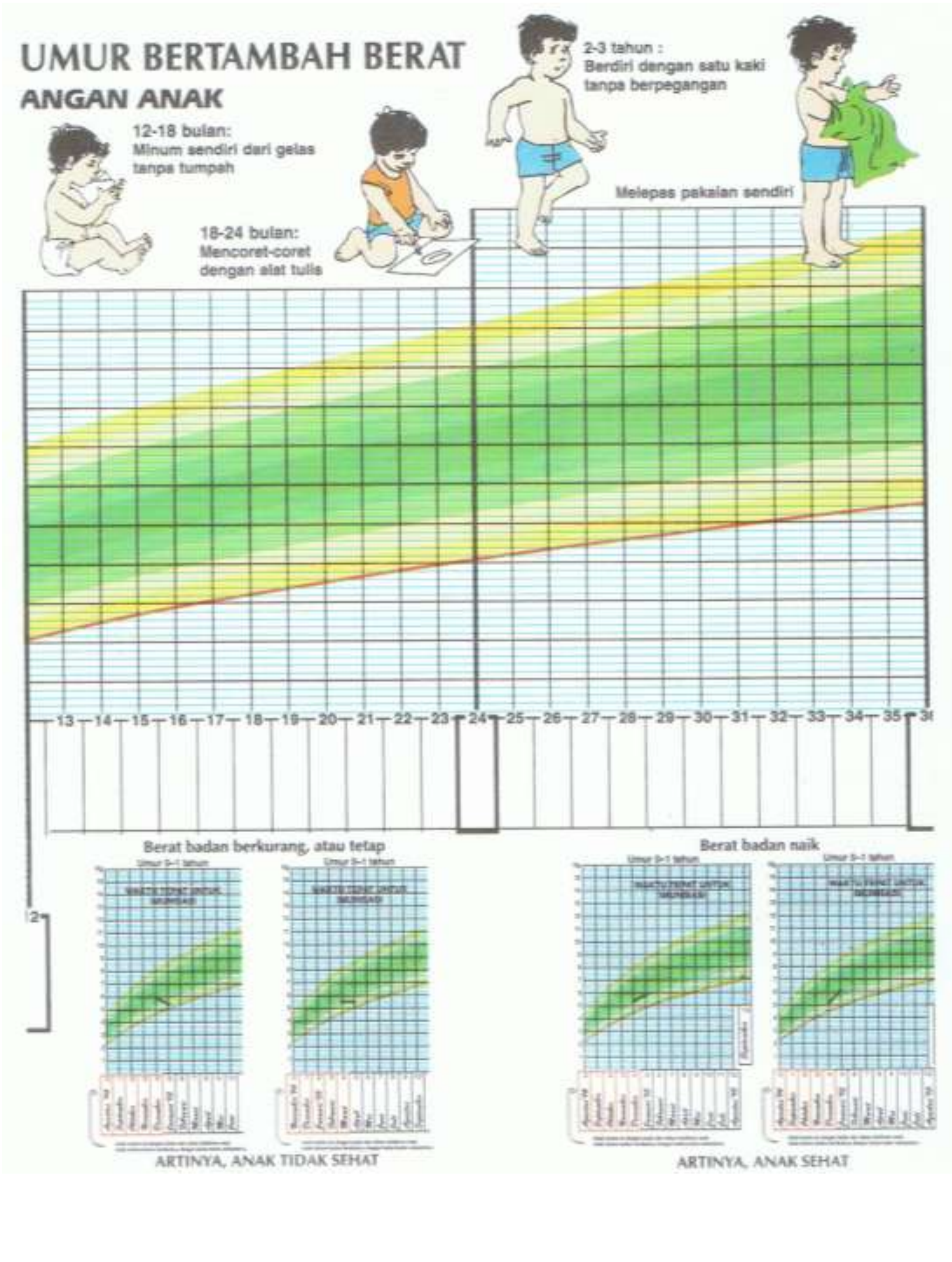
BAWALAH KMS SETIAP KALI BERKUNJUNG KE POSYANDU DAN SARANA PELAYANAN KESEH

Diperbanyak oleh :
Dinas Kesehatan Provinsi Maluku Utara
Proyek Perbaikan Gizi Masyarakat
Tahun Anggaran 2003

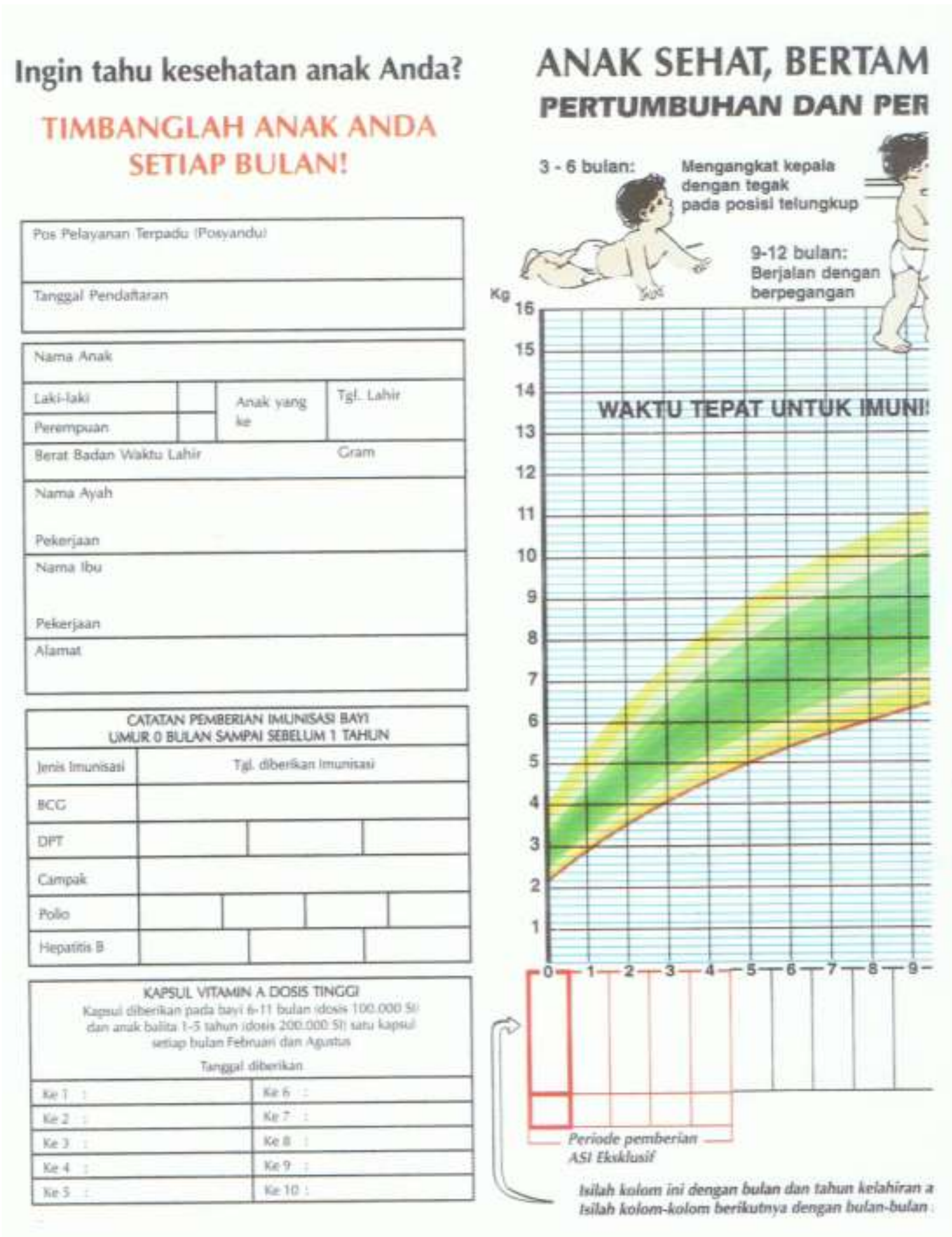
Appendix 2.1 Example of Indonesian growth card provided by Health Ministry of Indonesia (Continued)



Appendix 2.1 Example of Indonesian growth card provided by Health Ministry of Indonesia (Continued)



Appendix 2.1 Example of Indonesian growth card provided by Health Ministry of Indonesia (Continued)



CHAPTER 3

METHODOLOGY

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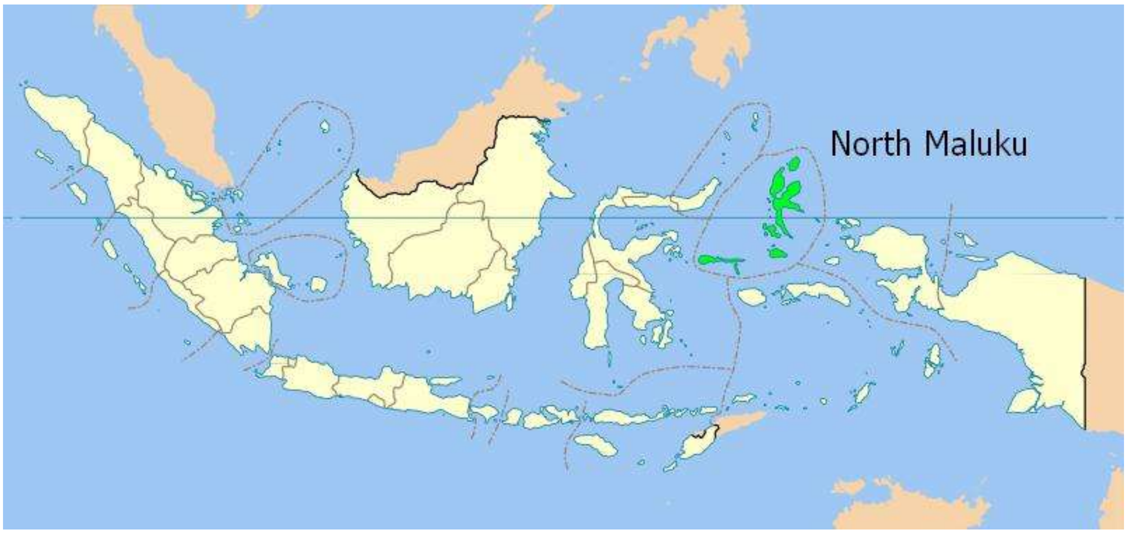
3.1 Introduction

Chapter 2 reviewed the literature on the causes and consequences of under-nutrition, nutritional status and assessing nutritional status in young children using international child growth references. Literature on the nutritional status of young children in developing countries, specifically in Indonesia and North Maluku province, was reviewed and the need for more detailed information appropriate to a larger section of the population across the new province of North Maluku was explored.

This current Chapter describes the methodology applied to conduct the North Maluku Province Health Survey, a cross-sectional survey assessing the health of households in North Maluku, Indonesia in 2004 and the analysis of the data on nutritional status and risk factors for under-nutrition of the pre-school children living in this province at the time.

3.2 Study location

The North Maluku Province Health Survey, funded by UNICEF, was conducted throughout all areas of the North Maluku province of Indonesia (as shown in Figure 3.1) during 2004. The province of North Maluku consists of eight districts and four island groups with a total population of 784,395 people (Razak, 2004), (refer to Figure 3.2). The first island group consists of the districts of Ternate and Tidore with a total population of 192,074 people. The second island group consists of the districts of Central Halmahera and East Halmahera with a total population of 69,320 people. The third island group consists of the districts of West Halmahera and North Halmahera with a total population 238,299 people. The forth island group consists of the districts of South Halmahera and Sula Island with a total population of 284,702 people (Maluku-Utara, 2008).



Note: The province of North Maluku is highlighted in green, Indonesia is highlighted in white. Source: Wikipedia, 2008

Figure 3.1: Map of Indonesia showing North Maluku Province

Source:www.geocities.com/ambon67/noframe/halmahera2k.htm, 1998

Figure 3.2: Map of North Maluku Province

3.3 Study design

The North Maluku Province Health survey used a cross sectional study design to collect baseline data on education, health, nutrition, water and sanitation, and child protection from household members in North Maluku Province, Indonesia during 2004. The North Maluku Health Province survey used a “dominant-less-dominant” approach (Creswell, 1994) where research is conducted within a single dominant paradigm, with a smaller component drawn from an alternative paradigm. Within the North Maluku Province Health survey, the quantitative component was the dominant paradigm and a qualitative component was the non-dominant paradigm.

This present body of work reports upon the methodology and secondary data analysis of part of the quantitative component of the North Maluku Province Health survey using the nutritional data on pre-school aged children only. Quantitative data was obtained through the administration of structured questionnaires and through the taking and recording of anthropometric measurements of children to assess nutritional status.

The Center for Food, Nutrition, and Health, Hasanuddin University coordinated the North Maluku Province Health survey. The Candidate worked at the Center for Food, Nutrition, and Health, Hasanuddin University in the role of data manager which involved enumerator recruitment, and training. The Candidate represented East Indonesia (Makassar) as data manager at a national level and undertook training to develop skills for using the gold standard of anthropometric measurement conducted by the World Health Organization (WHO). The responsibility of the data manager was to train the enumerators prior to collecting data in the field.

3.3.1 Research question and hypotheses

The main research question was what is the nutritional status of children in North Maluku in 2004 following a period of civil unrest?

For pre-school children, aged less than five years living in North Maluku province in 2004 we hypothesised that:

1. The prevalence of underweight, stunting and wasting measured by low weight-for-age, low height-for-age and low weight-for-height, respectively, will be higher in children aged 24 to 59 months compared to children aged 0-23 months.
2. Boys will have a higher prevalence of underweight and stunting than girls;
3. Girls will have a higher prevalence of wasting than boys;
4. Children living in urban geographical locations will have better nutritional status compared with children living in rural geographical regions;
5. Children from wealthier families, measured by the household wealth index will have lower odds of stunting compared to children from poorer households;
6. Children from wealthier families, measured by the household wealth index will have lower odds of wasting compared to children from poorer households;

7. Nutritional status indicators based on the 2006 World Health Organization (WHO) international child growth standards will be similar to nutritional status indicators based on the 1978 National Centre for Health Statistics (NCHS)/WHO child growth reference with the exception of stunting in children aged from zero to six months where the prevalence will be higher using the new reference compared with the previous reference.

3.4 Study sample

3.4.1 Sampling Frame

The four island groups of North Maluku province were used as the sampling frame, from which the study areas were identified for the North Maluku Province Health. Each island group was divided into clusters with each cluster consisting of approximately 100 households. For the purpose of this study a household was defined as all persons who occupy a housing dwelling including members of a family who live together plus any non-relatives who reside in the dwelling. Based on the population for each island group, the number of clusters per island group and within each village was calculated based on estimating that on average one household consisted of ten people.

3.4.2 Sample size

The sample size for this study was calculated using a formula developed by the Center of Bureau of Statistics and the Ministry of Health responsible for conducting health surveys at province and district level (known as Surkesda) (Razak, 2004). According to this formula, the total sample of households required from each island group was 617. Allowing for a 20% refusal rate, 750 households per island group were required to provide a total sample of approximately 2,500 to 3,000 households throughout North Maluku. Assuming a sample size of 3000 children and an alpha of 0.05 and statistical power of 0.80, a change in the standard deviation of covariates will be detected for this secondary data analysis.

3.4.3 Sample selection

Study areas were selected according to systematic random sampling procedures (Razak, 2004) whereby each cluster in the population has a known and equal probability of selection. Random household selection within each cluster was undertaken by using the sampling frame of every 10th household, referenced from the household nearest to the village health service (Pustu). A total of 50 households were collected in each cluster.

In order to select study areas, a non-proportional procedure was employed. The study required 50 households in each cluster and 15 clusters in each of the four island groups resulting in a total of 60 clusters overall. In addition, village health services were included when available in the selected clusters. Table 3.1 provides the name of clusters for each island group.

Table 3.1: Study locations related to district, subdistrict, community public health services and villages in North Maluku, Indonesia

No.	District	Sub District	Puskesmas*	Village
Island group I				
1.	Ternate	1. South Ternate	1. Gambesi	1. Gambesi
			2. Kalumata	2. Kalumata 3. Bastiong 4. Mangga Dua
			3. Kalumpang	5. Gama Lama 6. Kalumpang
			4. Kota	7. Kota Baru
		2. North Ternate	5. Siko	1. Sangaji 2. Dufa-Dufa
2.	Tidore	3. North Tidore	6. Soasiu	1. Gamatutlange 2. Mafututu
			7. Ome	3. Rum 4. Ome
		4. South Tidore	8. Tomolou	1. Tolowa 2. Tomolou
Island group II				
3.	Central Halhamera	6. Weda	9. Weda	1. Weda 2. Sagea 3. Kobe
		7. Wairoro	10. Wairoro	1. UPT Wairoro SP2a 2. UPT Wairoro SP3
		8. Patani	11. Patani	1. Banemo 2. Tepeleo 3. Yeisawo 4. Peniti
4.	East Halmahera	9. Wasile	12. Subaim	1. Bumi Restu 2. Ake Daga
		10. Maba	13. Buli	1. Buli Karya 2. Buli Asal
			14. Wayamuli	1. Wayamli 2. UPT Marata Jaya SP1

No.	District	Sub District	Puskesmas*	Village
Island group III				
5.	West Halmahera	11. North Jailolo	15. Jailolo	1. Tauro 2. Soa Konara
		12. Sahu	16. Sahu	1. Sasur 2. Sasupu
		13. Ibu	17. Ibu	1. Gamici 2. Gamkonora
6.	North Halmahera	14. Malifut	18. Malifut	1. Tagono 2. Tahame
		15. Kao	19. Kao	1. Soamaltek 2. Kao-Kao
		16. Tobelo	20. Tobelo	1. Gura 2. Wari
		17. South Tobelo	21. Kupa-kupa	1. Tomalahu
		18. Galela	22. Galela	1. Soasiu 2. Saluta
Island Group IV				
7.	South Halmahera	19. Kayoa	23. Kayoa	1. Guarapi 2. Laluin
		20. Central Bacan	24. Labuha	1. Labuha 2. Jiko
		21. East Bacan	25. Babang	1. Wayana 2. Babang
		22. West Bacan	26. Loleojaya	1. Loleojaya 2. Nandang
		23. Obi	27. Laiwui	1. Madopolo 2. Laiwui
8	Sula Island	24. Dofa	28. Dofa	1. Dofa 2. Waikafia
		25. Sanana	29. Kabau	1. Fatcei 2. Mangon 3. Pahea

** Puskesmas are Community Public Health Services*

3.4.4 Cluster selection procedure

Clusters were randomly selected based on the Centre Bureau of Statistics North Maluku data at the Nutrition and Health Research Centre, Hasanuddin University. For each cluster 25 households were identified (Razak, 2004). If the village had only one cluster then 25 households in the village were randomly selected. Where a village had more than one cluster and the village population is distributed normally[♣] the cluster was randomly selected. Where a village had more than one cluster and the village population was not distributed normally the area with more households was identified and added to the area with less, to form a cluster combination. The cluster was then randomly selected and the households included in the segment combination were defined. Where a village had less than one cluster they were added to another cluster, so the households in the village had an equal chance of being selected.

At Puskesmas (District Health Center) level, the Puskesmas provided a list of households for each village who would participate in this study. Twenty five households with children under five years old in their family were randomly selected to participate in this study. If the household had more than one child under five, the youngest child was selected to be invited to become a participant in this study.

[♣] *Normal distribution of the population in the village was based on information obtained from the leader of the village, because leader of the village recorded and updated the population in the village.*

With assistance from the village staff a map of each household within each village was drawn. Where there were remote areas in the village, the number of households had to be estimated based on the district or village health services coverage area. If the randomly selected village had four clusters, based on the map, one cluster was randomly selected. The next step, based on the cluster list produced by the Centre for Nutrition and Health Research at Hasanuddin University, was to randomly select 50 households from that cluster's population.

3.5 Study Instrument

3.5.1 Questionnaire

In this study, a household member (mother, father or other family member) who actively looked after a child aged less than five years was asked to answer a questionnaire that investigated household economic data, access to water and sanitation facilities, house condition, household wealth index, Posyandu (community based preventative care) visits, education, occupation and the number of children in the family. A copy of the original and a translated questionnaire can be found in Appendices 3.1 and 3.2 respectively. Completion of the questionnaire was estimated to take between 45 and 60 minutes to complete.

This thesis reports data on specific aspects of this survey thought to be associated with nutritional status of pre-school children: the parents' education and occupation, the number of household members, the number of family meals per day, the household wealth index (described in detail in Section 3.8.2.2), the geographical location in terms of district and region and selected characteristics of the child including age in months, gender, immunisation status, recent illness and recent visits to local health services. Age was measured by referring to the child's birth certificate.

3.5.2 Anthropometric measurements

The nutritional status of children less than five years of age was measured anthropometrically. Three anthropometric measurements were performed: weight, height and length. Each anthropometric measurement was checked by a second person.

Weight was measured using Salter scales to the nearest 0.1kg, with each child wearing minimal clothing under a sarong. Height was measured for those aged two years and older by using Microtoice tape to the nearest 0.1cm (WHO, 1995a). The equipment was made and modified at the Hasanuddin University Research Center using wooden equipment to maximise the child's comfort while they were being measured (refer to Figure 3.4).

Length was measured for children aged less than two years old using a wooden stadiometer to the nearest 0.1cm (WHO, 1995a), see Figure 3.5. The measurement of length was made with the child lying down (recumbent) using a length board, placed on a flat, stable surface such as a table. Height and length was measured three times by the same person and the average of these measurements was recorded as the height or length of the child.

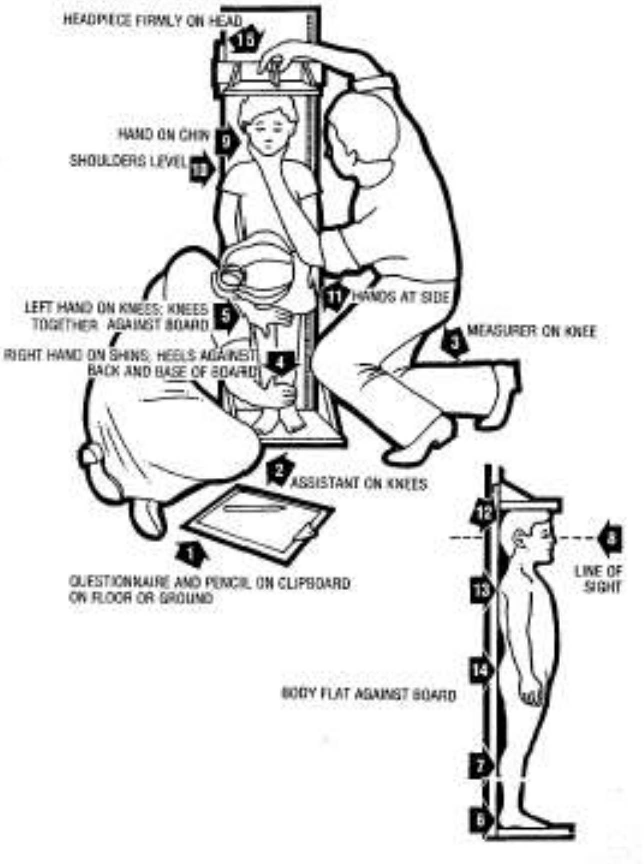


Figure 3.3 Height Measurement equipment

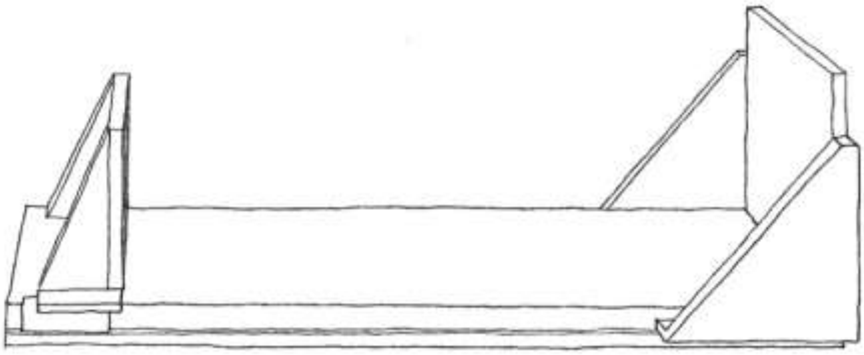


Figure 3.4 Wooden Stadiometer

3.6 Data collection

3.6.1 Training

Training of field supervisors and field workers was conducted prior to data collection activities. Supervisors for this study were identified from alumni of the School of Public Health, Hasanuddin University, based on their experience in community data collection. Field workers were civil servants in health district services or alumni of the School of Public Health, Hasanuddin University and were also required to have previous experience in data collection. A five-day theory and practice training program for supervisors and field workers was implemented, including questionnaire administration, anthropometry and fieldwork principles. Three study investigators attended all training sessions.

3.6.2 Survey organisation

The data collection for the nutrition survey was undertaken by five field workers and one field supervisor within each of the four island groups. Each field worker was responsible for administering the structured questionnaire and measuring the nutritional status of children within each household. Two local people assisted the field worker during the data collection process. A cooking oil and body soap gratuity were left with each participant, following data collection.

3.6.3 Quality Control

To ensure the quality of questionnaire data, a team of trained supervisors were allocated to each island group to monitor the performance of field workers. During the first few days the supervisors observed about 30% of all measurements make by field workers. Once the supervisor was confident about the field workers' skills they reduced the direct monitoring to approximately 10% of measurements. At the end of each day the supervisors reviewed the data, checking for incomplete forms, or unclear data entries, particularly regarding age, weight and height measurements.

Completed questionnaires were firstly collated by the field supervisor in a single file for each cluster. Secondly, all questionnaires from one district were grouped together and sent to the district coordinator in the Health District Office at Ternate. Then, thirdly, all questionnaires for each island group were bound prior to being sent to the data management office at the Research Centre, Hasanuddin University. The number of questionnaires that arrived safely in the data management office, according to district, is reported in Table 3.2.

Table 3.2: Number of completed questionnaires received by the Data Management Office, Research Centre, Hasanuddin University

No.	Districts	Number of questionnaire/sample					
		Puskesmas	Patient	Nurses	SD	SMP	RT
1	Ternate	5	10	10	9	4	550
2	Tidore	3	6	6	6	3	300
3	Central Halmahera	3	6	6	9	4	450
4	East Halmahera	3	6	6	6	4	300
5	West Halmahera	3	6	6	6	3	300
6	North Halmahera	6	12	12	8	5	350
7	South Halmahera	5	10	10	10	5	500
8	Sula Island	2	4	4	5	2	250
	Total	**30**	**60**	**60**	**59**	**30**	**3000**

Puskesmas = Community Health Services; SD = Elementary School, SMP = Senior High School, RT= Household

3.7 Data management and initial data analysis

From the main project, data was collected from 3000 households distributed across eight districts and 60 villages. For analysis of data for this thesis from the original North Maluku Province Health survey each household required at least one child aged less than five years to be eligible for inclusion. From these 3000 randomly selected households, there were 2,175 children aged less than five years and 3,335 school-aged children (5-18 years). From the 2,175 households with at least one child aged less than five years, complete data was available on 2,168 children. Data related to basic health services was collected from 30 health centers (Puskesmas).

The analysis for this study combined three data files from the North Maluku Province Health Survey: (1) Mother’s data file, (2) Child’s data file and (3) the Household data file; to merge all the variables with selected households where there was at least one child aged less than five years in the house. Data analysis was undertaken using Stata 9.2 (StataCorp, 2007).

The data for this analysis was collected in 2004 and data analysis commenced in 2005. Data were entered into a computerised database and cleaned using the data entry program EPIINFO (Dean et al., 2000). Initially data on nutritional status were analysed based on the 1978 NCHS/WHO international child growth reference using EPIINFO. Subsequently, the new 2006 WHO child growth standards were published and the data was re-analysed using the new reference. using STATA version 9.2 (StataCorp, 2007). A comparison of international child growth reference populations using the standard deviation Z-score is the focus of Chapter 7.

All the anthropometric indicators of a child's nutritional status used in the survey were expressed as Z-scores. The Standard Deviation Score (Z-Score) is the deviation of an individual's anthropometric measurement orientated from the median value of a reference population, divided by the standard deviation of the reference population (WHO, 1995a). The formula used is:

$$z\ score = x - \ \mu\ /\sigma$$

where *x* is the observed value, μ is the mean reference value and σ is the standard deviation of the corresponding reference data. A z-score is a value from the standard normal distribution.

The Z score range used in this study to describe categories of low weight-for-age (or underweight) is shown in Table 3.3. The Z score range used in this study to describe categories of low height-for-age (or stunting) is shown in Table 3.4 and for the Z score range used in this study to describe categories of low weight-for-height (or wasting) refer to Table 3.5.

Table 3.3: Z-score range to describe categories of underweight

Z-score range	Meaning

-2.00 to -2.99	Moderate underweight
-3.00 to -3.99	Severe underweight

Table 3.4: Z-score range to describe categories of stunting

Z-score range	**Meaning**
-2.00 to -2.99	Moderate stunting
≤ -3.00	Severe stunting

Table 3.5: Z-score range to describe categories of wasting

Z-score range	Meaning
-2.00 to -2.99	Moderate wasting
≤ -3.00	Severe wasting

The Z-score for the anthropometric indices were based on growth charts from the Centres for Disease Control and Prevention, WHO, and the National Centre for Health Statistics. The expected ranges of standard deviations of the Z-score distributions for the three anthropometric indicators were: (1) height-for-age Z-score: 1.10 to 1.30, (2) height-for-age Z-score: 1.00 to 1.20 and (3) weight-for-height Z-score: 0.85 to 1.10. The Z-score is used as a standard of the unweighted standard deviations for anthropometric measurement. Accurate age assessment and anthropometric measurements, the SD of the observed height-for-age, weight-for-age, and weight-for-height Z-score distributions should be relatively constant and close to the expected value of 1.0 for the reference distribution (WHO, 1995a). Table 3.6 shows details the expected ranges of standard deviations of the Z-score distributions for the three anthropometric indicators.

Table 3.6: Expected ranges of standard deviations of the Z-score distributions for the three anthropometric indicators

Indicator	SD Z-Score
Height-for-age Z-score	1.10 to 1.30
Weight-for-age Z-score	1.00 to 1.20
Weight-for-height Z-score	0.85 to 1.10

Source: World Health Organization. 1995a. Physical status: The use and interpretation of anthropometry. Technical Report Series no. 854. Geneva, Switzerland: World Health Organization. (WHO, 1995a)

The Composite Index of Anthropometric Failure (CIAF) was developed to categorise under-nutrition into seven mutually exclusive categories, including single failures (stunting, underweight, or wasting) and multiple failures (stunting and underweight, stunting and wasting, underweight and wasting, and stunting and underweight and wasting). Refer to Table 3.7.

Table 3.7: Classification of children with anthropometric failure

Group Name	Description	Underweight	Stunting	Wasting
A	**No failure:** Children whose height and weight are above the age specific norm (I,e, above -2 z-scores) and do not suffer from any anthropometric failure.	No	No	No
B	Wasting only: Children with acceptance weight and height for their age but who have subnormal weight for height.	No	No	Yes
C	**Wasting and underweight:** Children who above norm heights but whose wqeight for age and weight for height are too low	Yes	No	Yes
D	**Wasting Stunting and underweight:** Children who suffer from anthropometric failure on all three measures	Yes	Yes	Yes
E	**Stunting and underweight:** Children with low weight for age and low height for age but who have acceptable weight,for their height	Yes	Yes	No
F	**Stunting only:** Children with low height for age but who have acceptable weight,both for their age and for their short height	No	Yes	No
Y	**Underweight only:** Children who are only underweight	Yes	No	No

Note: Another theoretical combination would be "wasted and stunted" but this is physically not possible since child cannot simultaneously experience stunting and wasting and not be underweight

Source: Nandy et al., 2005

3.8 Statistical methods

3.8.1 Nutritional status in young children in North Maluku, 2004 using the current 2006 WHO international growth standards

The anthropometric indicators of nutritional status in children in North Maluku, 2004 using the current 2006 WHO growth standards were expressed as the deviation of the individual anthropometric measurement from the median value of the WHO growth standard for that child's height or age divided by the standard deviation for the reference population (WHO, 1995b).

Prevalence with 95% confidence intervals (95%CI) was calculated for categorised underweight, stunting and wasting, and distributions (central tendency and spread) were calculated for six-month age groups, sex and each of the geographic areas (districts) surveyed. The prevalence of underweight, stunting and wasting was weighted by age and gender for the total population of children in the province. Therefore, the findings from this study should accurately reflect the actual nutritional status problems in North Maluku.

Using two-tailed significance tests, categorical data were tested with Pearson chi-square; while normally distributed continuous data were tested using the Student’s t-test. Potential clustering effects from observations within districts were adjusted for accordingly using a three-stage stratified cluster sampling design and the “svyset” command in STATA (StataCorp, 2007).

The following table of prevalence groups was used to describe and classify the survey results for different nutritional status indicators and has been modified according to recommendations by a WHO Expert Committee that reported on the use and interpretation of anthropometry (WHO, 1995a). The prevalence ranges shown in Table 3.8 are those currently used by the WHO to classify levels of underweight, stunting and wasting. Results of the analysis of nutritional status in young children in North Maluku in 2004 using the current 2006 WHO international growth standards are presented in Chapter 4.

Table 3.8: Classification for assessing severity of malnutrition by prevalence ranges among children under five years of age

Severity of under-nutrition by prevalence ranges (%)	**Indicator**		
	Low weight-for-age (Underweight)	**Low height-for-age (Stunting)**	**Low weight-for-height (Wasting)**
Low	< 10	< 20	< 5
Medium	10 - 19	20 - 29	5 - 9
High	20 - 29	30 - 39	10 - 14
Very high	≥ 30	≥ 40	≥ 15

3.8.2 The association of socio-economic factors with stunting and wasting in pre-school aged children in North Maluku Province, Indonesia 2004

3.8.2.1 Outcomes

Children with stunting

Stunting represented the proportion of children under five years old whose height for age was lower than minus two standard deviations (-2.00 to -2.99 Z-score) from the median of the international reference population. Severe stunting was the proportion of children under five years old whose height for age was lower than minus three standard deviations (≥ -3.00 Z-score) from the median of the international reference population recognised by the WHO for international use. Univariate analysis and multivariate logistic regression were used to examine the association between children with stunting (Z-score range -2.00 to -2.99), children with severe stunting (Z-score ≤ 3.00), and socio-economic status. To determine the level of stunting and severe stunting the dependent variable was expressed as a dichotomous variable: category 0 if not stunted (≥-2.00SD) or severely stunted (≥-3.00SD) and category 1 if stunted (<-2.00 SD) or severely stunted (<-3.00SD).

Children with wasting

Wasting represented the proportion of children under five years old whose weight for height was lower than minus two standard deviations (-2.00 to -2.99

Z-score) from the median of the international reference population. Severe wasting was the proportion of children under five years old whose weight for height was lower than minus three standard deviations (≥ -3.00 Z-score) from the median of the international reference population recognised by the WHO for international use. Univariate analysis and multivariate logistic regression were used to examine the association between children with wasting (Z-score range -2.00 to -2.99), children with severe wasting (Z-score ≤ 3.00), and socio-economic status. To determine the level of wasting and severe wasting the dependent variable was expressed as a dichotomous variable: category 0 if not wasted (≥-2.00SD) or severely wasted (≥-3.00SD) and category 1 if wasted (<-2.00 SD) or severely wasted (<-3.00SD).

3.8.2.2 Explanatory factors or potential risk factors

Variables from the survey that were related to the socio-economic status of the household were obtained from the North Maluku Province Health Survey study coordinator for this data analysis. From the available data collected in the survey, the following socio-economic factors were considered as potential risk factors for stunting and wasting: parental education, parental occupation, the number of household members, and the number of family meals per day, geographical region, district and household wealth index, as informed by the literature. These factors were considered as family-level characteristics.

Data from one selected child (the youngest child aged less than five years) from each household included: age and gender, immunisation status, recent sickness and access to health services; were the child-level characteristics. These variables have also been previously reported in the literature and are explained in further detail below.

Additional data on breast feeding and from 24 hour food diaries was obtained however there was a substantial amount of missing data which would not allow adequate interpretation and therefore these potential risk factors were omitted from the analysis.

The categories within each characteristic used in the analysis are detailed below:

Family Level Factors

1. Level of Education: the level of education of the child's mother and the child's father separately, and parental education were recorded and classified in the original survey as: never schooled, not completed elementary school, completed elementary school; completed junior high school; completed senior high school and completed university. Due to small numbers those who completed senior high school and university were combined into one category and those who did not attend school and those who did not complete elementary school were combined with completed elementary school, resulting in three categories: completed elementary school, completed junior high school and completed senior high school.

Completed elementary school was the reference category in the logistic regression.

2. Occupation: the occupation of the child's father and mother and the child's parents were classified by the original survey into six categories: Labour; Farmer (Fisherman); Street Vendor; Government Officer; Private Officer and Not Working. However due to insufficient numbers this was collapsed to four categories: Any labour (includes Labour and Street Vendor; Fisherman (or Fisherwoman); Government Officer or Private Officer (combined) and Not working. Any labour was the reference category in the logistic regression.

3. Family meals per day: the number of meals provided by the family each day were categorised into two meals per day or more than two meals per day. All respondents to the survey reported a minimum of two meals per day and this was used as the reference category.

4. Household wealth index: this variable was constructed from data collected in the household questionnaire, using methods recommended by the World Bank Poverty Network and United Nations Children's Fund (Filmer, 2001). The household wealth index, measure of household economic status, included ownership of nine types of assets: motorcycles, refrigerators, televisions, radios, video players, satellite dishes, parabolas, lounges, and cars and boats. The principal components method was used to assign a weight for each asset (described below). The index is based on the assumption that long-term household wealth is the major contributor to variation in the asset variables used to construct the wealth index.

The first principal component output was used as a scoring factor to weight each of the assets or facilities in the wealth index. The wealth index for each household (Wj) was calculated using the following formula:

$$Wj = f1 \times (aj1 - a1) / (s1) + ... + fN \times (ajN - aN) / (sN)$$

Where f1 is the “scoring factor” for the first asset as estimated by the first principal component, aj1 is the j^{th} household’s value for the first asset and a1 and s1 are the mean and standard deviation of the first asset variable over all households. The score for each asset is summed over the N assets used to construct the index. The index was ranked and divided into three categories with the bottom 40% of households referred to as the “poorest households”, the next 40% as the “middle-class households”, and the top 20% as the “richest households” using STATA 9.2 (StataCorp, 2007). This wealth index was used to rank families by their wealth status and to assess relationships between household wealth and nutritional status.

5. Districts and Geographical Regions: the eight districts within North Maluku were classified as urban or rural. The districts classified as urban were Ternate and Tidore and the districts classified as rural were Central Halmahera, East Halmahera, West Halmahera, North Halmahera, South Halmahera and Sula Island. Data on geographical region (urban versus rural) was included in addition to district as some districts include both rural and urban areas and availability of health services may be as a result of geographical location, rather than district. The urban district of Ternate was used as the reference category for the District variable. Urban was used as the reference category for the Urban versus Rural variable.

6. Household members: the number of family members and other persons residing with the family household. This variable was categorised as five or less household members (reference category) or six to 12 household members. Twelve was the maximum number of household members reported.

Child Level Factors

1. Age in months – age was recorded in single months taken from the birth certificate of the youngest child in the household aged less than five years.
2. The gender of the youngest child in the household aged less than five years of age as reported by the parent, with boys used as the reference category.
3. Immunisation status of the children was categorised as never immunised or ever immunised, with never immunised used as the reference category.
4. Recent child sickness was categorised as being sick in the previous two weeks or not sick in the previous two weeks, where not sick in the previous two weeks was used as the reference category.
5. Frequency of visits to the nearest local village health service (Posyandu) within the past three months was reported and was categorised as zero, once, twice, or three or more times, with zero as the reference category.
6. Data on breast feeding and data from food diaries was incomplete and was not able to be included in this analysis.

The socio-economic factors associated with stunting and severe stunting are reported in Chapter 5. The socio-economic factors associated with wasting and severe wasting are reported in Chapter 6.

3.8.2.3 Statistical analysis

Statistical methods used to describe the prevalence of nutritional status in North Maluku and the analyses on socio-economic factors associated with children with stunting and socio-economic factors associated with children with wasting in North Maluku Indonesia are described below.

Stunting

Univariate analysis was performed to examine the association between children with stunting and children with severe stunting in the age categories of 0 to 23 months (n=1183), 24 to 59 months (n=985) and overall 0 to 59 months, for family-level and child-level socioeconomic factors. The sample was stratified into two age groups and reported across three age groups (0 to 23 months, 24 to 59 months and 0 to 59 months) to allow comparison between young and older children to help identify priority areas for nutritional interventions. Where cells within categories included small numbers of data, variable categories were reviewed and collapsed where possible. In addition variables where large amounts of data were missing these variables were not included in the data set.

Correlation of explanatory variables was tested using Pearson's correlation coefficient for normally distributed variables and Spearman's rank correlation coefficient if they were not normally distributed. Collinearity was tested by examining variables for correlation. No highly correlated variables were found for this analysis.

The factors found to be associated with children with stunting and severe stunting on univariate analysis were examined in a multivariable logistic regression model, indicated by a univariate p-value of less than 0.250. A stepwise backward elimination approach was applied using the strategy described by Greenberg and Kleinbaum to adjust for confounding and to identify effect modification (Greenberg, 1985). Back ward elimination starts with all predictor variables and potential confounding variables in the model. The variable that is least significant, that is, the one with the largest p-value, is removed and the model is refitted. Each subsequent step removes the least significant variable in the model until all remaining variables have individual p-values less than 0.10. Backward elimination has the advantage of being relatively easy to carry out interactively using standard regression procedures, although programs to carry them out automatically are readily available. The disadvantage of the backward stepwise approach is that it can only be carried out with a limited number of variables. Interaction terms were tested between exposure variables and between outcome and potential confounding variables. No statistically significant interaction terms were found.

Variables which were statistically associated with stunting and severe stunting in children ($p < 0.100$) were selected to remain in the final model. The unadjusted odds ratio (OR) values from the univariate analysis and the adjusted odds ratio values from the logistic model were tabulated with the 95% confidence intervals and are presented in Chapter 6. The ‘SVY’ commands of STATA version 9.2 (StataCorp, 2007) were used for the secondary data analysis to adjust for cluster sampling design and appropriate sampling weights applied.

Wasting

Univariate analysis was performed to examine the association between children with wasting and severe wasting in the age categories of 0 to 23 months (n=1183), 24 to 59 months (n=985) and overall 0 to 59 months, for family-level and child-level factors. The sample was stratified into two age groups and reported across three age groups (0 to 23 months, 24 to 59 months and 0 to 59 months) to allow comparison between young and older childred to help identify priority areas for nutritional interventions. Where cells within categories included small numbers of data, variable categories were reviewed and collapsed where possible. In addition variables where large amounts of data were missing these variables were not included in the data set.

Correlation of explanatory variables was tested using Pearson’s correlation coefficient for normally distributed variables and Spearman’s rank correlation coefficient if they were not normally distributed. Collinearity was tested by examining variables for correlation. No highly correlated variables were found for this analysis.

The factors found to be associated with wasting and severe wasting on univariate analysis were examined in a multivariable logistic regression model, indicated by a p-value of less than 0.250, as described for stunting. A stepwise backward elimination approach was applied using the strategy described by Greenberg and Kleinbaum to adjust for confounding and to identify effect modification (Greenberg, 1985).

Back ward elimination starts with all predictor variables in the model and potential confounding variables. The variable that is least significant, that is, the one with the largest p-value, is removed and the model is refitted. Each subsequent step removes the least significant variable in the model until all remaining variables have individual p-values less than 0.10. Backward elimination has the advantage of being relatively easy to carry out interactively using standard regression procedures, although programs to carry them out automatically are readily available. The disadvantage of the backward stepwise approach is that it can only be carried out with a limited number of variables. Interaction terms were tested between exposure variables and between outcome and potential confounding variables. No statistically significant interaction terms were found.

Variables which were statistically associated with children with wasting and severe wasting ($p < 0.100$) were selected to remain in the final model. The unadjusted odds ratio (OR) values from the univariate analysis and the adjusted odds ratio values from the logistic model were tabulated with 95% confidence intervals and are presented in Chapter 7. The 'SVY' commands of STATA version 9.2 (StataCorp, 2007) were used for the secondary data analysis to adjust for cluster sampling design and appropriate sampling weights applied.

The variables used to determine risk factors for wasting were similar to stunting, with the exception that father occupation, parental education and employment from wasting data were excluded from the analysis due to the small numbers of each characteristic.

3.8.3 Comparing reference data from WHO

The anthropometric data were analysed twice by way of comparison with existing WHO data, both former and more recent. Former nutrition growth reference data were based on 1978 NCHS International reference and analysed using EPIINFO (Dean et al., 2000) and the recent reference data based on the 2006 WHO growth standards were analysed using STATA 9.2 (Stata Corp, 2008).

As discussed in Chapter 2, the 1978 NCHS/WHO growth curves were constructed by combining two distinct data sets compiled in different time periods from nationally representative cross-sectional surveys of children in the United States of America (USA) and included all ethnic groups and social classes. The 2006 WHO child growth standards used the Multi-centre Growth Reference Study (MGRS), a community-based, multi-country project involving more than eight thousand children from Brazil, Ghana, India, Norway, Oman, and the USA and conducted between 1997 and 2003. The children in the MGRS study were selected based on an optimal environment for proper growth: recommended infant and young child feeding practices, good healthcare, mothers who did not smoke, and other factors associated with good health outcomes. The newer growth reference is more representative of normal child growth.

Differences might be expected between the two populations because they are use different populations of children. The 1978 NCHS / WHO reference used only healthy children from the United States and the 2006 WHO growth standards used healthy children from six countries: Brazil, Ghana, India, Norway, Oman, and the United States of America.

The anthropometric indicators of nutritional status in children used in this study were expressed as the deviation of the individual anthropometric measurement from the median value of the WHO growth reference for that child's height or age divided by the standard deviation for the reference population (WHO, 1995b). This was undertaken once with the former 1978 NCHS/WHO growth reference and once for the current 2006 WHO growth standards.

Prevalence with 95% confidence intervals was calculated for categorised underweight, severely underweight, stunting, severe stunting, wasting and severe wasting, and distributions (central tendency and spread) were calculated for six-month age groups and for each of the geographic areas surveyed. Using two-tailed significance tests, categorical data were tested with Pearson chi-square, while normally distributed continuous data were tested using Student’s t-test. Potential clustering effects from observations within districts were adjusted for accordingly using a three-stage stratified cluster sampling design (refer to Appendix 3.3) and the “svyset” command in STATA (StataCorp, 2007).

The prevalence of under-nutrition in children aged 0-59 months in North Maluku is reported using a conventional index, which identifies six categories: underweight, severely underweight, stunting, severe stunting, wasting and severe wasting. Z-score curves of the former and current international growth references for each indicator of weight-for-age, height-for-age and weight-for-height are compared and are reported in Chapter 7.

3.9 Ethical considerations

The governor of North Maluku provided a letter of permission to conduct the North Maluku Province Health Survey research at the provincial level. Following this all the leaders of the eight districts within North Maluku Province signed a letter of permission for data to be collected in their districts. The leader of each sub district also provided permission to conduct this research. Within each district, all the village leaders were required to provide permission to allow data to be collected from their village families. The data collectors brought these letters of permission with them during data collection; otherwise the community will reject to be interviewed.

Children identified by the researchers as being severely under-nourished were routinely referred to the closest hospital or Community Health Centre as requested by UNICEF. The local health department from North Maluku provided this review to children without charge. A staff member from the nutrition department of the health department provided continuous monitoring and visited these children daily. These children were provided with a health card on hospital discharge to allow them to access local health services free of charge for three months initially with an option for renewal if required.

3.10 Summary

This Chapter described the methodology of the original North Maluku Province Health survey including the survey instruments and data collection plus the statistical analyses for this current secondary analysis.

The results of this secondary data analysis are presented in subsequent result chapters. Chapter 4 describes the nutritional status in young children in North Maluku, Indonesia, in 2004 using the 2006 WHO child growth standards. Chapter 5 presents the socio-economic factors associated with stunting in young children in North Maluku Indonesia in 2004. Chapter 6 presents the socio-economic factors associated with wasting in children in North Maluku Indonesia in 2004. Chapter 7 details the comparison of nutritional status for preschool children in North Maluku, Indonesia, using the 1978 NCHS/WHO child growth reference and the 2006 WHO child growth standards. Conclusions and implications from this study are detailed in Chapter 8.

3.11 References

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Appendix 3 1 Original language household questionnaire

COMMUNITY SURVEY EDUCATION, HEALTH, NUTRITION, WATER SANITATION AND CHILD PROTECTION ASSESMENT NORTH MALUKU

KUESIONER RUMAH TANGGA
RESPONDEN : IBU RUMAH TANGGA

	I. IDENTITAS RESPONDEN		
1	Nama Kabupaten	______	☐
2	Puskesmas/Kecamatan	______	☐
3	Nama Desa/ Kelurahan	______	☐
4	Nomor Urut KK	______	☐☐
5	Status Keluarga	*1. Gakin* *2. Non Gakin*	☐
6	Nama Responden (Ibu RT) Nama KK (Bapak) No. ID	______ ______	☐☐☐☐☐☐
	II. KETERANGAN PENCACAHAN		
1	Tanggal Wawancara: Pewawancara: Editorial: Editor:	Tgl/bln/thn ______ Tgl/bln/thn ______	☐☐/☐☐/☐☐ ☐☐/☐☐/☐☐
	III. DATA RUMAH TANGGA		
1	Banyaknya anggota rumah tangga	______ *orang*	☐☐
2	Jumlah anak: 0-4 bulan 5-6 bulan 7-18 bulan	______ *orang* ______ *orang* ______ *orang*	☐☐ ☐☐ ☐☐
3	Banyaknya wanita usia subur	*orang*	☐☐

IV. KETERANGAN ANGGOTA RUMAH TANGGA

No	Kode ART lama	Nama anggota RT (Tulis siapa saja yang biasanya tinggal dan makan di rumah tangga ini baik dewasa, anak-anak maupun bayi)	Hubungan dengan kepala rumah tangga	Umur (tahun)	Untuk Balita Umur (bulan)	*Jenis kelamin* 1 = Laki 2 = Perempuan	Untuk usia >5 tahun: Status Pendidikan	Untuk usia >5 tahun: Pendidikan yang ditamatkan	Untuk usia >5 tahun: Pekerjaan Utama	Untuk usia >10 tahun: Keadaan Wanita	Untuk usia >10 tahun: Status perkawinan
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
01	☐☐		1	☐☐	☐☐	☐	☐	☐	☐	☐	☐
02	☐☐		☐	☐☐	☐☐	☐	☐	☐	☐	☐	☐
03	☐☐		☐	☐☐	☐☐	☐	☐	☐	☐	☐	☐
04	☐☐		☐	☐☐	☐☐	☐	☐	☐	☐	☐	☐
05	☐☐		☐	☐☐	☐☐	☐	☐	☐	☐	☐	☐
06	☐☐		☐	☐☐	☐☐	☐	☐	☐	☐	☐	☐

Note: Questionnaire layout not exact due to formatting

07											
08											
09											
10											

Kode kolom 4 : Hubungan dengan kepala rumah tangga

1 = Kepala rumah tangga
2 = Istri/suami
3 = Anak
4 = Menantu
5 = Cucu
6 = Orang tua/Mertua
7 = Famili lain
8 = Pembantu rumah tangga
9 = Lainnya

Kode kolom 8 : Status pendidikan

1 = Tidak/belum pernah sekolah
2 = Masih sekolah
3 = Tidak sekolah lagi

Kode kolom 9 : Pendidikan

1 = tidak pernah sekolah
2 = Tidak tamat SD/MI
3 = Tamat SD/MI
4 = Tamat SMP/MTs
5 = Tamat SMU/MA
6 = Tamat Perguruan Tinggi

Kode kolom 10 : Pekerjaan utama

1 = Buruh harian
2 = Petani
3 = Berjualan/dagang/jasa
4 = Pegawai Negeri
5 = Pegawai swasta
6 = Tidak bekerja

Kode kolom 11 : Keadaan wanita berusia >10 tahun

1 = Hamil
2 = Nifas, tidak menyusui
3 = Nifas dan menyusui
4 = Menyusui
9 = Tidak cocok

Kode kolom 12 : Status perkawinan

1 = Belum kawin
2 = Kawin
3 = Cerai hidup
4 = Cerai mati
9 = Tidak cocok

V. MOBILITAS

1	Adakah anggota rumah tangga yang sedang pergi ke luar desa lebih dari 4 bulan atau kurang dari 4 bulan tetap tidak bermaksud kembali lagi 1 = ya 2 = tidak → **ke No 3**	
2	Jumlah anggota rumah tangga yang pergi…………orang	
3	Adakah ART yang baru datang dari luar kota dan tinggal di sini selama 4 bulan atau lebih, atau kurang dari 4 bulan dan bermaksud menetap di sini ? 1 = ya 2 = tidak → **ke VI**	
4	Jumlah ART yang baru datang …………orang	

VI. AKSES KE FASILITAS PENDIDIKAN DAN KESEHATAN

1	Berapa jauh (meter) fasilitas pendidikan dasar yang terdekat dari lokasi ini SD SMP	
2	Berapa jauh (meter) fasilitas kesehatan yang terdekat dari lokasi ini Pustu Puskesmas	

VII. KETERANGAN PERUMAHAN DAN STATUS EKONOMI

1	Barang/perabot yang dimiliki:	*1. Motor* *2. Kulkas* *3. Televisi* *4. VCD* *5. Parabola* *6. Radio* *7. Kursi tamu* *8. Peralatan motor*	*(0=Tidak; 1=Ya)* 1 2 3 4 5 6 7 8

2	Tempat yang digunakan untuk BAB:	*1. Kakus milik sendiri* *2. Kakus umum* *3. Sungai/empang/laut* *4. Semak-semak/tempat terbuka* *5. Lainnya, sebutkan!*	☐ ______
3	Sumber Air Minum :	*1. Empang/sungai/waduk* *5. Mata air* *2. Sumur bersemen* *6. Pompa tangan* *3. Sumur tidak bersemen* *7. Airledeng/PAM* *4. Tadah air* *8. Lainnya, sebutkan!*	☐ ______
4	Jarak rumah ke sumber air minum:	______ *meter*	☐☐☐☐
5	Bagian utama dari lantai rumah terbuat dari:	*1. Semen* *4. Kayu* *2. Batu* *5. Bambu* *3. Tanah* *6. Lainnya, sebutkan!*	☐ ______
6	Bagian utama dari dinding rumah terbuat dari:	*1. Semen* *4. Kayu* *2. Batu* *5. Bambu* *3. Seng* *6. Lainnya, sebutkan!*	☐ ______
7	Bagian utama dari atap rumah terbuat dari:	*1. Genteng* *3. Ijuk/rumbia* *2. Seng* *4. Asbes* *3. Sirap* *5. Lainnya, sebutkan!*	☐ ______

8	Bahan bakar yang dipakai untuk memasak:	*1. Kayu* *2. Minyak Tanah* *3. Gas* *4. Lainnya, sebutkan*	*(0=Tidak; 1=Ya)* ☐☐☐☐ ______
9	Berapa kali keluarga ini makan dalam sehari (makanan utama)?	*1. 1 kali* *3. 3 kali* *2. 2 kali* *4. > 3 kali*	☐
10	Apakah keluarga biasa manyajikan makan pagi?	*0. Tidak* *1. Ya*	☐
11	Berapa rata-rata pendapatan keluarga setiap bulan (dari seluruh anggota RT yang memperoleh penghasilan) ?	*Rp.* ______	☐☐☐☐☐☐☐
12	Berapa rata-rata pengeluaran keluarga untuk makanan setiap minggu?	*Rp.* ______	☐☐☐☐☐☐☐
13	Apakah keluarga ini mengkonsumsi garam beryodium? Berapa jenis garam yang digunakan? Uji garam beryodium (oleh petugas): Jenis garam yang paling sering digunakan	*0. Tidak* *1. Ya* *2. Tidak Tahu* *…………… jenis* *Garam 1. 1. 0 ppm 2. < 30 ppm 3. ≥ 30 ppm* *Garam 2. 1. 0 ppm 2. < 30 ppm 3. ≥ 30 ppm* *1. Jenis pertama 2. Jenis kedua*	☐ ☐ ☐ ☐ ☐
14	Bentuk garam beryodium yang digunakan:	*Garam 1. 1. Curah 2. Balok 3. Halus* *Garam 2. 1. Curah 2. Balok 3. Halus*	☐
15	Di mana ibu membeli garam tersebut?	*1. pasar* *3. warung* *2. toko* *4. lainnya, sebutkan*	☐
	VIII. DATA IBU (yang mempunyai Balita 0-59 bln)		
1	Riwayat kehamilan terakhir :	*G=gravid* *P=partus* *A= abortus*	______ ☐ ______ ☐ ______ ☐
2	Apakah ibu memeriksakan kehamilan yang terakhir ini?	*0. Tidak* *1. Ya*	☐
3	Bila Ya, siapa yang memeriksa kehamilan ibu?	*1. Bidan di Desa* *2. Bidan* *4. Dokter* *8. Dukun* *16. Lainnya, sebutkan!*	*(Jumlahkan)* ☐☐ ______
4	Bila ke petugas kesehatan, berapa kali Ibu memeriksakan kehamilan yang terakhir?	*…… kali*	☐☐
5	Bila ke petugas kesehatan, dimana Ibu memeriksakan kehamilan ?	*1. Pustu* *8. Rumah bidan* *2. Puskesmas* *16. Rumas sakit* *4. Posyandu* *32. lainnya, sebutkan!*	*(Jumlahkan)* ☐☐ ______
6	Kapan Ibu melahirkan ?	tgl/bln/thn	☐☐/☐☐/☐☐
7	Dimana Ibu melahirkan?	*1. Rumah sendiri* *3. Pustu* *2. Puskesmas* *4. Lainnya, sebutkan!*	______ ☐
8	Siapa yang menolong persalinan tersebut ?	*1. Bidan* *4. Dukun* *2. Dokter* *8. lainnya, sebutkan!*	*(Jumlahkan)* ☐ ______
9	Selama hamil terakhir, apakah ibu mendapat pelayanan?	*1. imunisasi* *2. penyuluhan gizi* *3. pemeriksaan tekanan darah* *4. pemberian tablet besi* *5. pengukuran berat badan/LILA*	*(0=Tidak; 1= ya)* ☐☐☐☐☐
10	Bila ibu mendapatkan tablet besi, berapa jumlah tablet yang diberikan oleh petugas kepada ibu?	*………. tablet*	☐☐☐

VIII. DATA ANAK			
8.1. STATUS GIZI DAN KESEHATAN ANAK			
1	Nama Anak :	________________	
2	Tanggal berapa anak dilahirkan ? Umur anak (dalam bulan) :	*Tgl/bln/thn* ______ *bulan*	☐☐/☐☐/☐☐ ☐☐
3	Jenis kelamin anak:	*1. Laki-laki* *2. Perempuan*	☐
4	Apakah anak pernah diimunisasi ?	***0.*** *Tidak* → ***ke No. 6*** *1. Ya*	☐
5	Jenis imunisasi: (cross-check dengan data pada bidan)	*1. DPT* *2. BCG* *3. Polio* *4. Campak (di atas 9 bulan)* *5. Hepatitis*	*(0= Tidak; 1= Ya; 2=Tidak tahu)* ☐☐☐☐☐
6	Pernahkah anak menderita sakit dalam 1 (satu) bulan terakhir ini?	*0. tidak pernah* → *ke No. 9* *1. pernah*	☐
7	Bila pernah, gejala yang diderita anak saat sakit tersebut :	*1. Demam* *2. Batuk* *3. Beringus* *4. Berak-berak* *5. Lainnya, sebutkan!*	*(0=Tidak; 1= ya)* ☐☐☐☐ ________________
8	Pada saat sakit terakhir tersebut, kemana ibu membawanya?	*1. Tidak diobati* *2. Rumah Sakit* *3. Puskesmas* *4. Pustu* *5. Mantri/bidan praktek swasta* *6. Dokter praktek* *7. Dukun* *8. Posyandu/Polindes* *9. Diobati sendiri* *10. Lainnya, Sebutkan!*	*(0=Tidak; 1= ya)* ☐☐☐☐☐☐☐☐☐☐ ________________
9	Dalam 3 bulan terakhir ini berapa kali ibu ke Posyandu?	*0. 0 kali* *1. 1 kali* *2. 2 kali* *3. 3 kali* *4. >3 kali*	☐
10	Pada kunjungan terakhir ke Posyandu, apakah anak ibu:	*1. Ditimbang* *2. Diberi imunisasi* *3. Diberi penyuluhan/konseling* *4. Pelayanan kesehatan* *5. Diberi PMT* *6. Lainnya:*	*(0=Tidak; 1= ya)* ☐☐☐☐☐☐
11	Apakah anak ibu mempunyai KMS:	***0.*** *Tidak* → ***ke 14*** *1. Ya*	☐
12	Bila ya, apakah ibu mengerti kondisi status gizi anak ibu dari KMS tersebut (validasi oleh pewawancara)	*0. Tidak mengerti* → ***ke No. 14*** *1. Mengerti*	☐
13	Bila ya, siapakah yang mengajarkan kepada ibu:	*1. Kader* *2. Petugas Gizi Puskesmas* *3. Lainnya, sebutkan!*	________________ ☐
8.2. STATUS GIZI DAN KESEHATAN ANAK (0-18 TAHUN)			
14	Apakah anak memiliki akses untuk menggunakan fasilitas KIA?	*0. Tidak* *1. Ya*	☐
15	Apakah tersedia jaminan pemeliharaan kesehatan/asuransi kesehatan untuk keperluan berobat jalan/rawat inap seperti:	*1. Askes* *2. Astek/Jamsostek* *3. Perusahaan/kantor* *4. JPKM* *5. Dana sehat* *6. Kartu sehat* *7. Lainnya, sebutkan!* ________________	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐
16	Apakah anak sakit dalam 1 bulan terakhir?	*0. Tidak* *1. Ya*	☐

17	Adakah keluhan seperti di bawah ini :		
	Keluhan		1 = ya 2 = tidak
	1. Panas/demam 2. Muntah 3. Mencret > 3 x dalam sehari 4. Mencret ingus atau darah	5. Bercak merah di kulit disertai pengelupasan 6. Batuk-batuk 7. Sesak napas 8. Pilek	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐

18	Penyakit yang diderita anak 4 minggu terakhir (diisi oleh Petugas Lapangan, tidak ditanyakan kepada responden):	1 = Diare 2 = ISPA 3 = Campak 4 = Demam	
19	Apakah keluhan tersebut mengganggu aktivitas anak sehari-hari?	*0. Tidak* *1. Ya*	
20	Apakah anak pernah berobat jalan 1 bulan terakhir?	*0. Tidak* *1. Ya*	
21	Bila ya, kemana anak berobat jalan?	1. RS Pemerintah 2. RS Swasta 3. Praktek dokter 4. Puskesmas 5. Pustu 6. Poliklinik 7. Praktek Petugas Kes. 8. Praktek Batra 9. Polindes 10. Posyandu	
22	Apakah anak pernah rawat inap dalam 1 tahun terakhir?	*0. Tidak* *1. Ya*	
23	Jika ya, dimana anak rawat inap?	1. RS Pemerintah 2. RS Swasta 3. Puskesmas 4. Polindes 5. Rawat inap tradisional 6. Lainnya, sebutkan! ____________	
	8.3. POLA PEMBERIAN ASI		
24	Apakah anak ibu pernah disusui?	*0. Tidak* → ***ke No. 28*** *1. Ya*	
25	Sesudah Anak lahir berapa lama kemudian anak disusui untuk yang pertama kali?	*0. Tidak ingat* *1. Ingat* ___*hari*___*jam*___*menit* (**diisi salah satunya**)	__ __/__ __/__ __
26	Apakah anak Ibu sekarang masih disusui?	*0. Tidak* *1. Ya* → ***ke No. 29***	
27	Bila tidak lagi menyusu, pada umur berapa anak Ibu disapih?	___*bulan*/___*minggu* (**diisi salah satunya**)	__ __/__ __
28	Pada umur berapa anak Ibu pertama kali diberi makanan selain ASI? *(bila masih belum='99')*	______ *bulan*	
29	Apa jenis makanan tambahan yang diberikan untuk pertama kalinya? (bila masih belum= '0')	*1. Nasi* *2. Pisang* *3. Bubur beras* *4. Bubur tepung* *5. Bubur instan dari pabrik (SUN, Promina, dll)* *6. Biskuit* *7. lainnya, sebutkan!*	____________
	Hasil pengukuran antropometri		
	Berat badan:	____, ____ *kg*	__ __. __
	Tinggi badan:	*I* ____, ____ *cm* *II* ____, ____ *cm* *III* ____, ____ *cm*	__ __ __. __ __ __ __. __ __ __ __. __

Appendix 3 2 English translation version of household questionnaire

COMMUNITY SURVEY EDUCATION, HEALT, NUTRITION, WATER SANITATION AND CHILD PROTECTION ASSESMENT NORTH MALUKU
HOUSEHOLD QUESTIONNAIRE
RESPONDENT: MOTHERS

I RESPONDENT IDENTIFICATION			
1	District		
2	Sub-district/PUSKESMAS		
3	Village		
4	Number of Household		
5	Family Status	1. Poor 2. Non Poor	
ID No.	Respondent Name Father' name No. ID		
II. Interview Detail			
1	Date of interview: Interviewer: Editorial: Editor:	dd/mm/yy dd/mm/yy	
III. Household Data			
1	Number of household member:		
2	Number of Children 0-4 months 5-6 months 7-18 months		
3	Number of fertile woman		

IV. Household member information (HMI)

No	HMI Code	Name of household member (Write down all the name of the household member in the house)	Relation with household member	age (years)	Children under five (Month)	Gender 1 = Male 2 = Female	For Children under five			For age >10 years	
							Education Status	Completed Education	Main Occupation	Woman condition	Marital Status
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
01											
02											
03											
04											
05											
06											
07											
08											
09											
10											

Note: Questionnaire layout not exact due to formatting

<table>
<tr><td colspan="2">Code for column number 4 : relation with household member
1 = Head of the household   6 = Parents/parents in law
2 = Wife/husband   7 = other family
3 = Son/daughter   8 = Servants
4 = Son/daughter in law   9 = others
5 = Grandchild
Code for Colum Number 8: Education Status
1 = No schooling
2 = Still Schooling
3 = Never
Code column 9 :Education
1 = Never Schooling   4 = Completed Junior high school
2 = Not complete Elementary School 5 = Completed Senior high school
3 = Completed Elementary School   6 = Completed University</td>
<td>Code for column number 10: Main occupation
1 = Labours   4 = Government Officer
2 = Farmers   5 = Private Officer
3 = Street Vendors 6 = Not Working

Code for column 11: Women status age >10 years
1 = Pregnant   4 = Breast feeding
2 = Just delivered, not breast feeding 9 = Others
3 = Just Delivered, still breast feeding

Code for column 12 : Marital Status
1 = Never Married 4 = Widow (Their wife or husband already passed away)
2 = Married   9 = others
3 = Window (Their wife or husband still alive)</td></tr>
<tr><th colspan="3">V. Family Mobility</th></tr>
<tr><td>1</td><td>Are they any family member go away in the last four months and never expect to come back again :
1 = yes   2 = No → go to question No. 3</td><td></td></tr>
<tr><td>2</td><td>How many family members are away...</td><td></td></tr>
<tr><td>3</td><td>Are they any new family member to live here in the last four months and they decide to live here?:
1 =yes   2 = No → go to section VI</td><td></td></tr>
<tr><td>4</td><td>The number of the new family member:............</td><td></td></tr>
<tr><th colspan="3">VI. Access to Health and education facilities</th></tr>
<tr><td>1</td><td>How far (Meters) the basic education facilities from here:
Elementary School
Junior High School</td><td rowspan="2"></td></tr>
<tr><td>2</td><td>How far (Meters) the nearest health facilities from here
Pustu (Village community Health services)
Puskesmas (Districts community Health Services)</td></tr>
</table>

VII. House Information and economic status data			
1	Does your family has :	1. Motorbike 2. Refrigerator 3. TV 4. VCD 5. Parabola 6. Radio 7. Lounge 8. Boat	(0=No; 1= Yes) 1. 2. 3. 4. 5. 6. 7. 8.
2	What is the toilet facility in your household?	1. Private Toilet 2. Public Toilet 3. River/sea 4. open place/bush 5. Others	(0=No; 1= Yes) 1. 2. 3. 4. 5.
3	The main water sources for your house hold?	1. River 2. Whole 3. Water Pump which directly into the house or garden 4. Spring water 5. Raining Water 6. Public Water Pump 7. Others	(0=No; 1= Yes) 1. 2. 3. 4. 5. 6. 7.
4	How many meters from the house to the water resources?	________ meters	
5	The household floor is made of : (The largest)	1. Cement/concrete brick 2. Brick layer 3. Land 4. Wood 5. Bamboo 6. Others	(0=No; 1= Yes) 1. 2. 3. 4. 5. 6.
6	The Household Wall is made of : (mainly)	1. Cement 2. Aluminums 3. Wood/Timber 4. Brick 5. Bamboo 6. Others	(0=No; 1= Yes) 1. 2. 3. 4. 5. 6.
7	The household roof is made of ? *(dominant)*	1. Brick 2. Aluminums 3. Leaves 4. Asbes 5. Others	(0=No; 1= Yes) 1. 2. 3. 4. 5.

8	The main source of fuel for cooking in the house?	1. Wood 2. Gasoline 3. Gas 4. Others	(0=No; 1= Yes) 1. 2. 3. 4.
9	How many meals the family served perday?	1. 1 time 3. 3 times 2. 2 times 4. > 3 times	
10	Do the family provide family breakfast?	0. No 1. Yes	
VIII. Mother Information (who have children 0-59 months)			
1	The last delivery history :	G=gravid P=partus A= abortion	
2	Do you check your last pregnancy?	0. No 1. Yes	
3	If yes, who assesss your pregnancy?	1. Village Midwife 2. Midwife 3. Doctor 4. Traditional Midwife 5. Others	
4	How many time do you check your last prenancy?	…….. times	
5	Where do you check your pregnancy?	1. Pustu 2. Midwife house 3. Puskesmas 4. House 5. Posyandu 6. Hospital 7. Others	
6	When the last tiem you were delivery your baby?	dd/mm/yy	
7	Where do you delivery your last baby?	1. At Home 2. Pustu 3. Puskesmas 4. Others	
8	Who help you for the last delivery your baby?	1. Midwife 2. Doctor 3. Traditional Midwife 4. Others	
9	The last pergnancy, do you get some help services?	1. Immunisation 2. Nutrition Information	(0=No; 1= yes) 1. 2.

VIII. Children Information			
8.1. Health and nutritional status of the children (0-59 months)			
1	Child's name:		
2	Date of Birth ? Children age in months	dd/mm/yy ______ months	
3	Gender:	1. Male 2. Female	
4	Do your schildren ever get the immunisation?	No→ Go to question Number 6 Yes	
5	Kind of Immunisation (Cross check the data with local midwife)	1. DPT 2. BCG 3.Polio 4. Measel (>9 months) 5. Hepatitis	(0= NO; 1= Yes; 2= No answer) 1. 2. 3. 4. 5.
6	Do your children sick in last month?	No → go to question number 9 Yes	
7	If yes, what was the syntoms of the sickness?	1. Fever 2. Cough 3. Colds 4. Diarrhea 5.Others	(0=No; 1= Yes) 1. 2. 3. 4. 5.
8	Where di you take your child when the last time he/she was sick?	1. No medical helps 2. Hospital 3. Puskesmas 4. Pustu 5. Private Midwife 6. Healer 7. Posyandu 8. Traditional medicine 9. Others	(0=Tidak; 1= ya) 1. 2. 3. 4. 5. 6. 7. 8. 9.
9	In the last three months how many times do you visit the village health services?	0. Never 3.. 3 times 1. Once 4. >3 times 2. 2 times	
10	The last visit to posyandu, did the child get :	1. Body weight measurement 2. Immunisation 3. Nutrition Information 4. Health Services 5. Additional Food Promotion 6. Others	(0=No; 1= Yes) 1. 2. 3. 4. 5. 6.
11	Does your child have health card monitoring?	No → go to question number 14 1. Yes	

12	If yes, do you understand your child nutritional status on the that card?	0. I don't Understand → go to question number 14 1. Understand	
13	If yes, who show/ teach you to read the helathy card monitoring?	1. Health Village volunteers 2. Nutrition staff in Puskesmas Others	
8.2	Health and nutritional status of the children (0-18 years)		
14	Does the child can access the facilitiy from Mother and children health program?	0. No 1. Yes	
15	Did the child sick in the last 4 weeks?	0. No 1. Yes	
17	Any synstoms as mentioned below?		
	Syntoms		1 = yes 2 = no
	1. Fever 2. Vomiting 3. Diarrhea (3 times a day) 4. Diarrhea with blood 5. Red spoot on the skin 6. Cough 7. Astma 8. Cold		1. 5. 2. 6. 3. 7. 4. 8.

18	The last sickeness of the children in the lat 4 weeks (This question were asked to the filed health worker)	1. Diarrhea 2. Acute upper respiratory track infection 3. Meusels 4. Fever	
19	Do the syntoms affect the children activities?	0. No 1. Yes	
20	Do the child visit jheal services in the last 4 weeks?	0. No 1. Yes	
21	If Yes, where do you take your children?	1. Government Hospital 2. Private Hospital 3. Poly Clinics 4. Nurse of midwife practices 5. Private docotor pratices 6. Puskesmas 7. Pustu 8. Posyandu	

		9. Polindes 10. Others	
22	Do the children hospitalised in the last 4 weeks?	0. No 1. Yes	
8.3. Breast Feeding pattren			
23	Have you ever breast feed your children??	No → go to question number 28. Yes	
24	Soon after delivery your baby, when the first time you breast feed your baby??	I don't remember I still remember it ___ Days___Hours__Minutes (fill the answer only one cvhoise)	
27	Do you still breast feed your child now??	0. No 1. Yes → go to question number 29.	
28	If your child not breast feed anymore, wha age you start to give the baby weaning food?	___months/____weeks	
29	What age of your children when the first tiem you give them solid food?	______ months	
30	What is the first solid food you give to your baby?? (Still breast feeding= '0')	1. Rice 2. Banana 3. Rice porage 4. flour porage 5. Factory instant food 6. Biscuit 7. Others	
Anthropomentry Measurements			
Body Weight: Hight:		_____, ____ kg I _____ , ____ cm II _____ , ____ cm III _____, _____ cm	

Appendix 3 3 STATA statistical software version 9.2 as used in sampling design

The STATA command “svyset” was used to imitate this sampling design:

svyset ir4 [pw=pw],fpc(tot_seg)|| _n

Where

“ir4” is a variable to identify the primary sampling units, namely the number of clusters sampled for the study,

“pw” is a variable to weight the results based on the population size of each strata in stage one,

“tot_seg” is the total number of clusters in each stratum which serves as a finite population correction (fpc) factor for the sampling in each stratum,

“n” is the total number of the children under five

The “svyset’ commands do not require the third stage to be defined because all children in the sampled household in the village were recruited into the study.

CHAPTER 4

NUTRITIONAL STATUS IN YOUNG CHILDREN IN NORTH MALUKU INDONESIA 2004

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4.1 Introduction

Chapter 4 describes the nutritional status of children aged less than five years of age in North Maluku, Indonesia in 2004, using the current 2006 WHO growth standards (WHO, 2006). Nutritional status, measured using anthropometry, was used to determine the proportion of children who were underweight, stunted and wasted and to examine the effect of age, gender and geographic location on these anthropometric indicators.

The aims of this Chapter are:

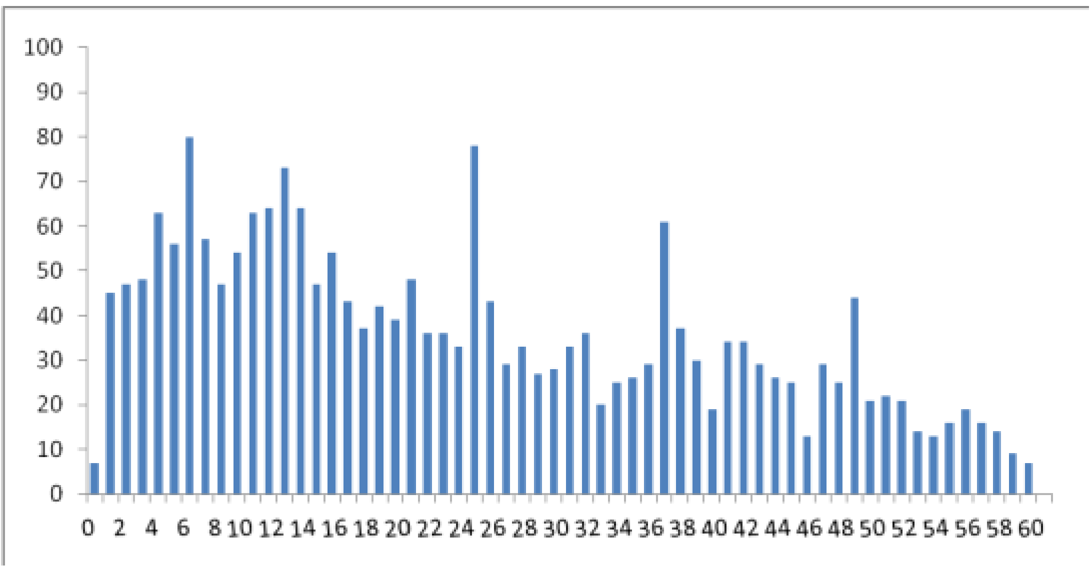
1. To assess the anthropometric status of North Maluku's children according to weight-for-age, height-for-age and weight-for-height indicators;
2. To assess the prevalence of under-nutrition in children in North Maluku according to underweight (low weight-for-age), stunting (low height-for-age) and wasting (low weight-for-height);
3. To examine the effect of age in months, gender and district on these anthropometric indicators in children aged less than five years, in North Maluku.

4.2 Results

4.2.1 Demographics

There were a total of 2168 children aged less than five years in this sample: 1115 boys (51%) and 1053 girls (49%). The mean age of the sampled children was 23.4 months (SD 15.7) and the median age was 21 months (inter-quartile range 10-36). A histogram of the percentage of children aged less than 60 months in each single month age interval is presented in Figure 4.1. Refer to Appendix 4.1 for the number and percentage of the single month age distribution for children aged less than five years in North Maluku Indonesia in 2004.

Figure 4.1: Histogram of the percentage of children aged less than five years in North Maluku Province Indonesia, in 2004, by single month age distribution



The age distribution of pre-school aged children in North Maluku province in 2004 in six-month age categories by gender is reported in Table 4.1. Overall, the highest proportion of children was in the six to 11 month category, accounting for 17% of the study population. The lowest proportion was in the 54 to 59 month category accounting for 3.7% of the study population. Proportions, ranging between 10% and 13% were found in the 0 to 5, 18 to 23, 24 to 29 and 36 to 41 month categories. The highest proportion of both girls and boys was in the six to 11 month category, accounting for 17% of the study population in each gender. The lowest proportion was in the 54 to 59 month category accounting for 4.1% for girls and 3.4% of boys in this study population. Refer to Appendix 4.2 for a histogram of six-month age group distribution data by gender.

Table 4.1 Percentage distribution of children with anthropometric measurement, by age in six month intervals and gender in North Maluku Province, Indonesia 2004

Age group in months	Girls		Boys		Total	
	n	%	n	%	n	%
0-5	120	11	146	13	266	12
6-11	175	17	190	17	365	17
12-17	159	15	159	14	318	15
18-23	120	11	114	10	234	11
24-29	112	11	126	11	238	11
30-35	75	7.1	94	8.4	169	7.8
36-41	108	10	107	9.6	215	9.9
42-47	81	7.7	66	5.9	147	6.8
48-53	60	5.7	75	6.7	135	6.2
54-59	43	4.1	38	3.4	81	3.7
Total	**1053**	**100**	**1115**	**100**	**2168**	**100**

The proportion of children aged less than five years within each of the eight districts within the province of North Maluku in 2004 varied from 446 children (21%) in the rural district of South Halmahera to 149 children (6.2%) in the urban district of Tidore as shown in Table 4.2. Refer to Appendix 4.3 for six-month age group distribution data by gender and district.

Table 4.2: Six-month age group distribution by district of children aged less than five months in North Maluku Province, Indonesia 2004

Child's age categories in Months	Ternate		Tidore		Central Halmahera		East Halmahera		West Halmahera		North Halmahera		South Halmahera		Sula Island		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
0-5.	41	11	27	18	42	15	30	11	17	9.6	34	12	55	12	20	12	266	12
6-11.	63	16	29	19	60	21	36	13	22	12	43	15	94	21	18	11	365	17
12-17.	60	16	22	15	25	8.9	58	21	17	9.6	40	14	69	15	27	16	318	15
18-23.	33	8.5	16	11	34	12	49	18	24	13	18	6.5	41	9.2	19	11	234	11
24-29.	45	12	16	11	23	8.2	40	14	12	6.7	30	11	52	12	20	12	238	11
30-35	30	7.8	11	7.4	28	10	18	6.4	15	8.4	28	10	25	5.6	14	8.3	169	7.8
36-41	45	12	10	6.7	30	11	25	8.9	26	15	24	8.6	44	9.9	11	6.5	215	9.9
42-47	25	6.5	5	3.4	14	5.0	8	2.9	22	12	21	7.5	31	7.0	21	12	147	6.8
48-53	30	7.8	8	5.4	17	6.1	9	3.2	11	6.2	29	10	22	4.9	9	5.3	135	6.2
54-59	15	3.9	5	3.4	7	2.5	7	2.5	12	6.7	12	4.3	13	2.9	10	5.9	81	3.7
Total	387	18	149	6.90	280	13	280	13	178	8.2	279	13	446	21	169	7.8	2168	100

4.2.2 Nutritional status indicators by age

For underweight children, the standard deviations of the Z score for those aged less than 30 months were higher than the expected range of 1.0 to 1.20, ranging from 1.22 to 1.35 (with reference to Table 3.6 in Chapter 3), and were within the expected range of standard deviations for children aged greater than 30 months ranging from 0.80 to 1.14. The standard deviations for children with stunting were also above the expected range of 1.10 to 1.30, ranging from 1.6 to 2.7, with the exception of children aged 54 to 59 months where the standard deviation was 1.2. For children with wasting all six-month age groups were outside the expected range of 0.85 to 1.10 ranging from 1.3 in the 30 to 35 month age group to 1.9 in the zero to five month age group. Table 4.3 shows the mean and standard deviations of the Z score for underweight, stunting and wasting in children aged 0 to 59 months in North Maluku Province in 2004.

Table 4.3: Mean and standard deviation Z-scores for underweight, stunting and wasting in children aged 0 to 59 months, by six-month age group in North Maluku, Indonesia 2004

Age Groups in months	Underweight			Stunting			Wasting		
	n	Mean	SD*	N	Mean	SD*	n	Mean	SD*
0-5	266	-0.25	1.35	266	0.11	2.7	259	-0.35	1.9
6-11	365	-0.86	1.35	365	-0.53	2.4	365	-0.59	1.5
12-17	318	-1.14	1.22	318	-1.23	2.1	318	-0.68	1.5
18-23	234	-1.26	1.31	234	-1.82	2.2	234	-0.47	1.4
24-29	238	-1.3	1.29	238	-1.86	1.9	237	-0.42	1.4
30-35	169	-1.48	1.13	169	-2.11	1.6	168	-0.45	1.3
36-41	215	-1.54	1.00	215	-2.18	1.9	213	-0.47	1.5
42-47	147	-1.73	1.11	147	-1.96	1.6	147	-0.83	1.4
48-53	135	-2.03	1.14	135	-2.37	1.9	134	-0.9	1.5
54-59	81	-1.88	0.8	81	-1.85	1.2	81	-1.15	1.4
Total	2168	-1.2	**1.31**	2168	-1.39	**2.2**	2156**	-0.58	**1.5**

*** SD =Unweighted Standard Deviation. ** There were 12 missing value for children with wasting**

Table 4.4 summaries the prevalence of underweight, stunting and wasting in children aged 0-23 months and 24-59 months respectively. The prevalence of both underweight and severely underweight children aged 0-23 months were 20% and 5.5% respectively, classified as medium (20-29%) and low (less than 20%) respectively. For children aged 24-59 months, the prevalence of underweight and severely underweight was 33% and 11% respectively, classified as high (30-39%) and low respectively.

The prevalence of aged 0-23 months with stunting was 30% classified as high (30-39%) and severe stunting was 15% classified as low (less than 20%). The prevalence of children aged 24-59 months with stunting was 50%, classified as very high (≥ 40) and severe stunting was 24%, classified as medium (20-29%).

The prevalence of children aged 0-23 months with wasting was 14%, classified as high (10-14%) and severe wasting was 5.2% classified as medium (5-9 %). The prevalence of children aged 24-59 months with wasting was 13%, classified as high (10-14%) and for severe wasting was 5.7%, classified as medium (5-9 %). Table 4.4 indicates that overall, the prevalence of nutritional status using the three nutritional indicators for children according to aged group was higher in children aged 24-59 months than in children aged 0-23 months.

Table 4.4: Prevalence of nutritional status by age in months for children aged less than five years in North Maluku Province Indonesia 2004

Age in months	**N**	**Underweight**		**Severe Underweight**		**Stunting**		**Severe Stunting**		**Wasting**		**Severe Wasting**	
		n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
0-23	**1115**	248	20	69	5.5	378	30	184	15	175	14	66	5.2
24-59	**1053**	300	33	99	11	454	50	214	24	114	13	52	5.7
Total	**2168****	548	25	168	7.7	832	38	398	18	289	13	118	5.5

**** There were 12 missing value for children with wasting**

4.2.3 Nutritional status indicators by gender

The unweighted standard deviation for boys for underweight was 1.34 and for girls was 1.28, both outside the expected range of 1.0 to 1.20. The unweighted standard deviation for boys for stunting was 2.33 and for girls was 2.16, also outside the expected range of 1.10 to 1.30. The unweighted standard deviation for boys for wasting was 1.60 and for girls was 1.43, outside the expected range of 0.85 to 1.10. The unweighted standard deviations for boys and girls for the three nutrition status indicators of underweight, stunting and wasting are shown in Table 4.5.

Table 4.5: Mean and standard deviation Z Scores for underweight, stunting and wasting in children aged 0 to 59 months, using anthropometric indicators, by gender, in North Maluku, Indonesia 2004.

Sex	Underweight			Stunting			Wasting		
	N	Mean	SD*	n	Mean	SD*	n	Mean	SD*
Boys	1115	-1.29	1.34	1115	-1.49	2.33	1110	-0.63	1.60
Girls	1053	-1.11	1.28	1053	-1.28	2.16	1046	-0.51	1.43
Total	2168	-1.20	**1.31**	2168	-1.39	**2.25**	2156**	-0.58	**1.52**

*** SD =Unweighted Standard Deviation**

**** There were 12 missing value for children with wasting**

4.2.4.1 Prevalence of anthropometric measures by gender

The prevalence of both underweight and severely underweight boys were 28% and 8.5% respectively, classified as high (30-39%) and low (less than10%) respectively. For girls, the prevalence of underweight and severely underweight was 22% and 6.9% respectively, classified as medium (20-29%) and low respectively.

The prevalence of boys with stunting was 41% classified as very high (≥ 40) and severe stunting was 21% classified as medium (20-29%) The prevalence of girls with stunting was 35%, classified as high (30-39%) and severe stunting was 16%, classified as low (less than 20%).

The prevalence of boys with wasting was 15%, classified as very high (≥15) and severe wasting was 6.9% classified as medium (5-9 %). The prevalence of girls with wasting was 12%, classified as high (10-14%) and for severe wasting was 3.9%, classified as low (<5%). Table 4.6 indicates that overall, the prevalence of nutritional status using the three nutritional indicators for children according to gender was higher in boys than girls.

Table 4.6: Prevalence of nutritional status by gender for children aged less than five years in North Maluku Province Indonesia 2004

		Underweight		**Severe Underweight**		**Stunting**		**Severe Stunting**		**Wasting**		**Severe Wasting**	
Sex	**N**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Boys	**1115**	317	28	95	8.5	461	41	229	21	165	15	77	6.9
Girls	**1053**	231	22	73	6.9	371	35	169	16	124	12	41	3.9
Total	**2168****	548	25	168	7.7	832	38	398	18	289	13	118	5.5

**** There were 12 missing value for children with wasting**

4.2.4 Nutritional status indicators by district

The unweighted standard deviations by district as shown in Table 4.7 illustrate that the standard deviation for the Ternate district was 1.2, within the expected range of 1.00 to 1.20 for underweight. The remaining seven districts were above the reference range for underweight children. The standard deviations for stunting and wasting in children aged less than five years in North Maluku province in 2004 were above the expected ranges of 1.10 to 1.30 and 0.85 to 1.10 respectively, for all districts.

Table 4.7: Mean and standard deviation Z-Scores for underweight, stunting and wasting in children aged 0 to 59 months, using anthropometric indicators, by district, in North Maluku, Indonesia 2004

Districts	Underweight			Stunting			Wasting		
	N	Mean	SD*	n	Mean	SD*	n	Mean	SD*
Ternate	387	-1.32	1.2	387	-1.48	1.9	387	-0.67	1.7
Tidore	149	-0.82	1.3	149	-0.90	2.1	148	-0.46	1.4
Central Halmahera	280	-1.17	1.3	280	-1.57	2.4	278	-0.34	1.2
East Halmahera	280	-1.19	1.3	280	-1.60	2.3	279	-0.45	1.7
West Halmahera	178	-1.19	1.1	178	-1.55	1.9	175	-0.53	1.2
North Halmahera	279	-1.14	1.3	279	-1.36	2.5	277	-0.47	1.4
South Halmahera	446	-1.18	1.4	446	-1.22	2.4	444	-0.65	1.6
Sula Island	169	-1.49	1.3	169	-1.26	1.9	168	-1.09	1.5
Total	2168	-1.20	**1.3**	2168	-1.39	**2.2**	2156**	-0.58	**1.5**

*** SD =Unweighted Standard Deviation. ** There were 12 missing value for children with wasting**

4.2.4.1 Prevalence of anthropometric measures by district

The prevalence of children who were underweight in the eight North Maluku districts was categorised as medium (10-19%) in the district of Tidore (16%) only. The districts of Ternate, Central Halmahera, East Halmahera, West Halmahera, North Halmahera were classified as having a high prevalence of underweight with prevalence rates between 20 and 29%. Sula Island district recorded the highest prevalence (32%) of children aged less than five years being underweight. The prevalence of children who were severely underweight was categorised as medium (10-19%) for East Halmahera and Sula island districts. The remaining six districts were classified as low prevalence (less than 10%) for severely underweight children aged less than five years.

The prevalence of stunting was very high (≥ 40%) in three districts; Central Halmahera (42%), East Halmahera (42%) and North Halmahera (41%). Four of the remaining districts were classified as high (30-39%0 with the district of Tidore recording the lowest prevalence of 25% (classified as Medium; 20-29%). The prevalence of severe stunting in pre-school children in North Maluku was categorised as medium (20-29%) in Central and East Halmahera districts. The remaining districts were classified as low prevalence of severe stunting (less than 20%).

Four districts were classified as having a very high prevalence (≥ 15%) of wasting: Ternate (17%), East Halmahera (15%), South Halmahera (16%) and Sula Island (20%). The districts of West Halmahera and Tidore had high (10-

14%) prevalence rates for wasting (10% each) and the districts of Central Halmahera and North Halmahera recorded medium prevalence rates (5-9%) for wasting. The districts of Tidore, Central, West and North Halmahera were classified as having low prevalence rates of severe wasting (less than 5%). Three districts recorded medium prevalence rates for severe wasting (5-9%) and the district of Sula Island recorded a high prevalence rate (11%) for severe wasting (10-14%).

Table 4.8: Prevalence of nutritional status indicators by district for children aged less than five years in North Maluku Province Indonesia 2004

		Underweight		Severe Underweight		Stunting		Severe Stunting		Wasting		Severe Wasting	
Districts	**N**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Ternate	387	102	26	28	7.2	141	36	62	16	65	17	25	6.5
Tidore	149	24	16	7	4.7	38	25	23	15	15	10	4	2.7
Central Halmahera	280	71	25	19	6.8	120	42	65	23	20	7.1	4	1.4
East Halmahera	280	71	25	29	10	119	42	66	24	42	15	18	6.4
West Halmahera	178	36	20	8	4.5	68	38	29	16	18	10	3	1.7
North Halmahera	279	65	23	17	6.1	116	41	48	17	22	7.9	12	4.3
South Halmahera	446	125	28	38	8.5	172	38	86	19	73	16	33	7.4
Sula Island	169	54	32	22	13	58	34	19	11	34	20	19	11

**** There were 12 missing value for children with wasting**

4.2.5 Prevalence of anthropometric measures by six-month age group

With reference to Table 3.8 in Chapter 3, the overall prevalence of underweight children aged 0 to 59 months in North Maluku in 2004 was 25%, categorised by WHO as high (20 to 29%) and the prevalence of severely underweight children was 7.8%, categorised by WHO as low (less than 10%) (WHO, 1995a). The overall prevalence of children aged 0 to 59 months with stunting and severe stunting was 38% and 18%, respectively, categorised as high (30 to 39%) and low (less than 20%) respectively. The overall prevalence of wasting and severe wasting in children aged 0 to 59 months was 13% and 5.4% respectively categorised as high (10 to 14%) and medium (5 to 9%) respectively. The prevalence of nutritional status using the three indicators of underweight, stunting and wasting for children by six-month age groups is presented in Table 4.9.

Table 4.9: Prevalence of nutritional status indicators by six-month age group for children aged 0 to 59 months in North Maluku Indonesia, 2004

Age Groups	Underweight		Severe Underweight		Stunting		Severe Stunting		Wasting		Severe Wasting	
	n	%	n	%	n	%	n	%	n	%	n	%
0-5	25	4.6	7	4.2	34	4.1	21	5.3	37	13	16	14
6-11	66	12	18	11	88	11	37	9.3	55	19	17	14
12-17	69	13	24	14	108	13	50	12.6	44	15	22	19
18-23	72	13	14	8.3	113	14	59	14.8	27	9.3	9	7.6
24-29	62	11	25	15	116	14	63	15.8	30	10	8	6.8
30-35	50	9.1	13	7.7	87	11	39	9.8	13	4.5	5	4.2
36-41	62	11	19	11	113	14	55	13.8	24	8.3	11	9.3
42-47	47	8.6	22	13	70	8.4	29	7.3	23	8.0	12	10
48-53	62	11	22	13	67	8.1	32	8.0	19	6.6	10	8.5
54-59	33	6.0	4	2.4	36	4.3	13	3.3	17	5.9	8	6.8
Total	548	25	168	7.8	832	38	398	18	289	13	118	5.4

**** There were 12 missing value for children with wasting**

4.2.6 Underweight

The prevalence of underweight children (weight-for-age < -2.00 Z-score) aged 0 to 59 months was 25% (95%CI 23, 28). There was a high prevalence (20-29%) of low weight-for-age in preschool aged children in North Maluku in 2004 based on WHO criteria (WHO, 1995a). The prevalence of severe underweight (<-3.00 Z-score) children aged 0 to 59 months was 7.7% (95%CI 6.6, 9.1). The mean weight-for-age Z-score for children 0 to 59 months was -1.2 indicating that the distribution of this anthropometric indicator had shifted significantly below zero, the expected value of the reference distribution (see Table 4.31 in Appendix).

4.2.6.1 Prevalence of children with underweight by six-month age group

There was a continuing increase in prevalence of underweight children through to the 18 to 23 months age group, with similar prevalence of underweight from 18 to 23 months through to 42 to 47 months, with a further increase in the older age groups as illustrated in Figure 4.2. The prevalence of severely underweight children increased from 0 to 5 months through to 12 to 17 months, and then varied in the older age groups as illustrated in Figure 4.3.

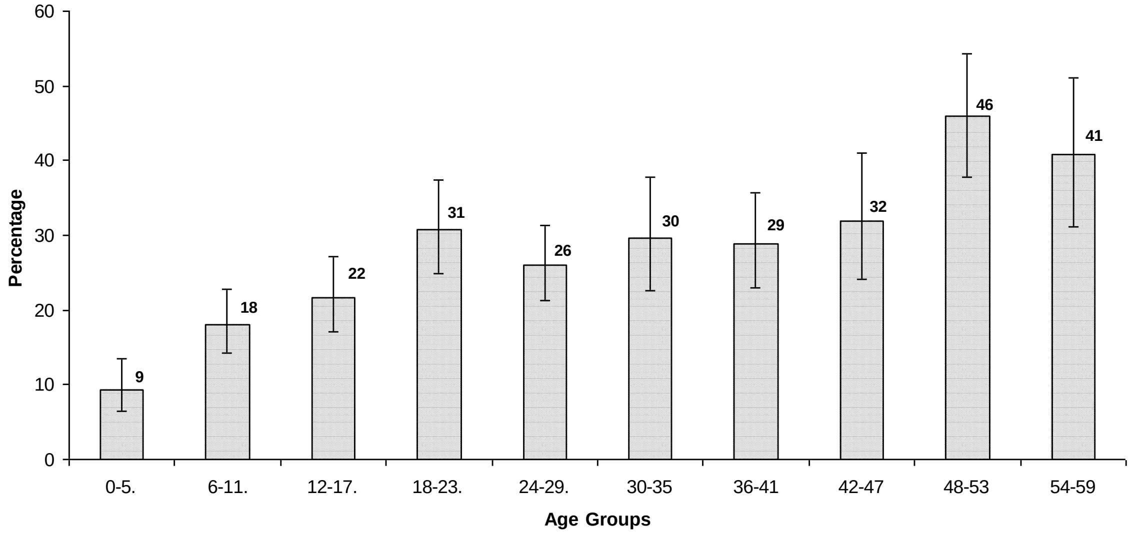


Figure 4.2: Prevalence of underweight children (height-for-age < -2.00 Z-score) & 95% confidence intervals by six-month age group (n=2,168), North Maluku, Indonesia 2004

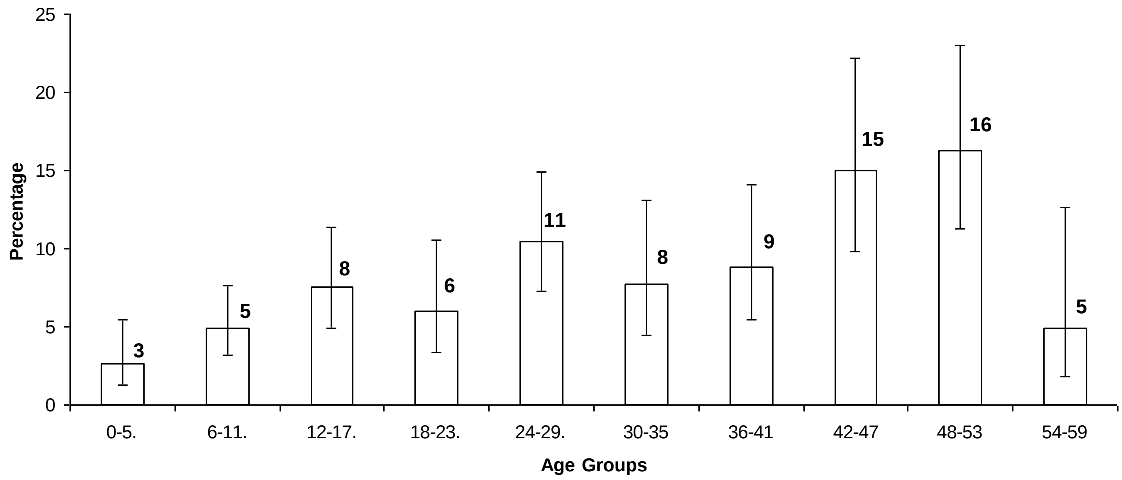


Figure 4.3: Prevalence of severely underweight children (height-for-age < -3.00 Z-score) with 95% confidence intervals by six month age group (n=2,168), North Maluku, Indonesia 2004

4.2.6.2 Prevalence of boys with underweight

The prevalence of boys who were underweight and severely underweight, aged 0 to 59 months by age group, was 28% (95%CI 25, 32) and 8.5% (95%CI 6.9,

11) respectively. The prevalence of underweight boys progressively increased through to age 23 months, with greater variation for older children. The highest prevalence of underweight in boys aged 48 to 53 months (49%, 95%CI 37, 61) and the lowest prevalence in those aged zero to five months (12%, 95%CI 7.3, 18).

The prevalence of severely underweight boys varied for all age groups from 3.5% (95%CI 1.3, 9.1) for those boys aged 18 to 23 months to 19% (95%CI 11, 30) for those boys aged 48 to 53 months. The mean weight-for-age Z-score for boys aged 0 to 59 months was -1.29 indicating that the distribution of this anthropometric indicator had shifted significantly below zero, the expected value of the reference distribution. Refer to Table 4.10.

Table 4.10: Prevalence of boys aged less than five years who were underweight and severely underweight (weight-for-age <-2.00 and <-3.00 Z-score) with 95% confidence intervals, mean Z-score and standard deviation by six month age groups, North Maluku, Indonesia 2004

Age Groups in months	Boys										
	Weight for Age										
	N	Underweight				Severely Underweight				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
0-5	146	17	12	7.3	18	6	4.1	1.8	8.9	-0.39	1.4
6-11	190	42	22	17	29	15	7.9	4.8	13	-1.01	1.41
12-17	159	45	28	21	37	16	10	5.9	17	-1.31	1.25
18-23	114	40	35	28	43	4	3.5	1.3	9.1	-1.31	1.34
24-29	126	33	26	20	34	13	10	6.0	17	-1.35	1.32
30-35	94	32	34	25	44	9	9.6	4.8	18	-1.53	1.27
36-41	107	35	33	24	43	8	7.5	3.5	15	-1.63	0.95
42-47	66	20	30	19	44	7	11	4.5	23	-1.7	0.98
48-53	75	37	49	37	61	14	19	11	30	-2.07	1.14
54-59	38	16	42	30	55	3	7.9	2.6	21	-2.05	0.82
Total	1115	317	28	25	32	95	8.5	6.8	11	-1.29	1.34

4.2.6.3 Prevalence of girls with underweight

The overall prevalence of girls who were underweight and severely underweight was 22% (95%CI 19, 25) and 6.9% (95%CI 5.7, 8.5) respectively. The prevalence of underweight girls varied significantly by age group with the highest prevalence in those aged 48 to 53 months (42%, 95%CI 29, 56) and the lowest prevalence in those aged zeron to five months (6.7%, 95%CI 3.1, 14). The highest prevalence of severely underweight girls was in the 42 to 47 month age group (19%, 95%CI 11, 30) and the lowest prevalence was in the zero to five month age group (0.8%, 95%CI 0.1, 6.0) (see Table 4.11)

Table 4.11 Prevalence of girls aged less than five years who were underweight and severely underweight (weight-for-age <-2.00 and <-3.00 Z-score) with 95% confidence intervals, mean Z-score and standard deviation by six month age groups, North Maluku, Indonesia 2004

Age Groups in months	Girls										
	Weight for Age										
	N	Underweight				Severely Underweight				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
0-5.	120	8	6.7	3.1	14	1	0.8	0.1	6.0	-0.08	1.28
6-11.	175	24	14	9.1	20	3	1.7	0.5	5.3	-0.7	1.26
12-17.	159	24	15	10	22	8	5.0	2.7	9.2	-0.96	1.16
18-23.	120	32	27	19	36	10	8.3	4.1	16	-1.22	1.29
24-29.	112	29	26	19	34	12	11	6.4	17	-1.24	1.25
30-35	75	18	24	16	35	4	5.3	2.1	13	-1.42	0.93
36-41	108	27	25	17	35	11	10	5.0	20	-1.44	1.04
42-47	81	27	33	24	45	15	19	11	30	-1.75	1.21
48-53	60	25	42	29	56	8	13	6.7	25	-1.97	1.15
54-59	43	17	40	26	55	1	2.3	0.3	16	-1.74	0.76
Total	1053	231	22	19	25	73	6.9	5.7	8.5	-1.11	1.28

The mean weight-for-age Z-score for girls aged 0 to 59 months was -1.11 indicating that the distribution of this anthropometric indicator had shifted significantly below zero, the expected value of the reference distribution.

4.2.6.4 Prevalence of children with underweight by district

The prevalence of underweight and severely underweight children varied significantly by district. The prevalence of underweight and severely underweight children was categorised as low and high level respectively, based on WHO criteria (WHO, 1995a). Low prevalence levels (less than 10%) of underweight children were found in six districts (Ternate, Tidore, Central Halmahera, West Halmahera, North Halmahera and South Halmahera). Sula Island and East Halmahera districts recorded a medium level prevalence of underweight (10 to 19%). The prevalence of severely underweight children varied significantly by district. High level prevalence of severely underweight children (20 to 29%) was found in the seven districts of Ternate, Central Halmahera, East Halmahera, West Halmahera, North Halmahera, South Halmahera and Sula Island. The Tidore district was found to have a medium level prevalence (10 to 19%) of severely underweight children based on 2006 WHO criteria (Table 4.12).

The prevalence of boys who were underweight and severely underweight aged 0 to 59 months in North Maluku was categorised as low level (less than 10%) and high (greater than or equal to 30%) based on WHO criteria (WHO, 1995a). Both the prevalence of underweight and severely underweight boys varied significantly by district. For six districts the prevalence of underweight was low (less than 10%) including Ternate, Tidore, Central Halmahera, East Halmahera, West Halmahera, and North Halmahera. For the two districts of South Halmahera and Sula Island the prevalence of underweight was categorised as medium (10 to 19%) (Refer to Table 4.12).

A high prevalence level (≥ 30%) of severely underweight boys aged group 0 to 59 months in North Maluku was found in the five districts of Ternate, East Halmahera, North Halmahera, South Halmahera and Sula Island. The districts of Central Halmahera and West Halmahera had a high level prevalence of severely underweight boys (20 to 29%) and Tidore district had a medium prevalence (10 to 19%) of severely underweight (see Table 4.12).

Table 4.12: Prevalence of boys aged less than five years who were underweight and severely underweight (weight-for-age <-2.00 and <-3.00 Z-score) with 95% confidence intervals, mean Z-score and standard deviation by districts, North Maluku, Indonesia 2004

Districts	Boys										
	Weight for Age										
	N	Underweight				Severely Underweight				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
Ternate	200	13	6.5	4.2	10	63	31	25	39	-1.46	1.13
Tidore	78	1	1.3	0.2	7.4	13	17	8.2	31	-0.86	1.21
Central Halmahera	147	12	8.2	4.2	15	42	29	20	39	-1.28	1.42
East Halmahera	139	12	8.6	4.7	15	49	35	26	45	-1.35	1.38
West Halmahera	91	4	4.4	1.6	12	25	27	23	33	-1.36	1.09
North Halmahera	148	10	6.8	4.2	11	47	32	24	41	-1.27	1.33
South Halmahera	222	26	12	7.9	17	69	31	25	38	-1.24	1.47
Sula Island	90	12	13	9.1	19	33	37	26	49	-1.63	1.37
Total	1115	90	8.1	6.5	10	341	31	27	34	-1.32	1.33

The prevalence of girls who were underweight and severely underweight aged 0 to 59 months in North Maluku was categorised as low (less than 10%) and high (20 to 29%) respectively based on WHO criteria (WHO, 1995a). Both the prevalence of underweight and severely underweight girls varied significantly by district.

The districts of Ternate, Tidore, Central Halmahera, West Halmahera, North and South Halmahera were categorised as low level prevalence (less than 5%)

of underweight for girls and East Halmahera and Sula Island districts were categorised as medium prevalence (10 to 19%) (see Table 4.12).

The two districts of South Halmahera and Sula Island were found with the highest prevalence (≥ 30%) of severely underweight girls. The districts of Ternate, Central Halmahera, East Halmahera, West and North Halmahera had a high prevalence of severely underweight girls. Tidore district had medium prevalence of severely underweight girls (see Table 4.13).

Table 4.13: Prevalence of girls aged less than five years who were underweight and severely underweight (weight-for-age <-2.00 and <-3.00 Z-score) with 95% confidence intervals, mean Z-score and standard deviation by district, North Maluku, Indonesia 2004

Districts	Girls										
	Weight for Age										
	N	Underweight				Severely Underweight				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
Ternate	187	15	8	5.4	12	55	29	23	36	-1.34	1.26
Tidore	71	5	7	3.5	14	14	20	14	26	-0.81	1.57
Central Halmahera	133	5	3.8	1.5	9.3	29	22	16	29	-1.11	1.32
East Halmahera	141	16	11	6.5	19	40	28	20	39	-1.29	1.42
West Halmahera	87	5	5.8	3.0	11	19	22	17	27	-1.22	1.11
North Halmahera	131	9	6.9	4.2	11	39	30	20	42	-1.17	1.49
South Halmahera	224	16	7.1	3.9	13	69	31	27	35	-1.2	1.43
Sula Island	79	8	10	8.3	12	29	36	28	47	-1.49	1.2
Total	1053	79	7.5	6.0	9.3	294	28	25	31	-1.22	1.37

The prevalence of underweight and severely underweight children, aged 0 to 59 months by district is illustrated in Figure 4.4 and Figure 4.5.

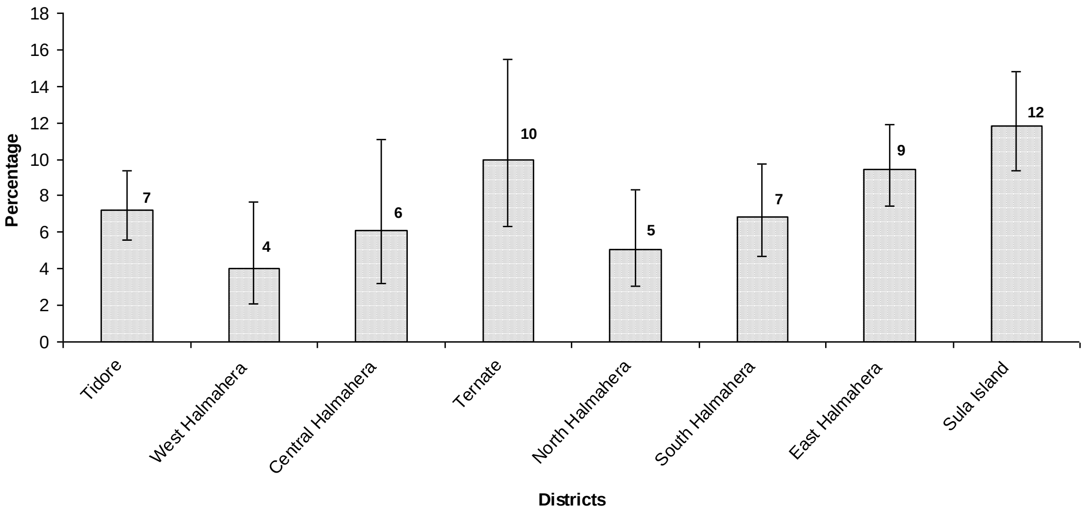


Figure 4.4: Prevalence of underweight children (weight-for-age < -2.00 Z-score) with 95% confidence intervals by district (n=2,168), North Maluku, Indonesia 2004

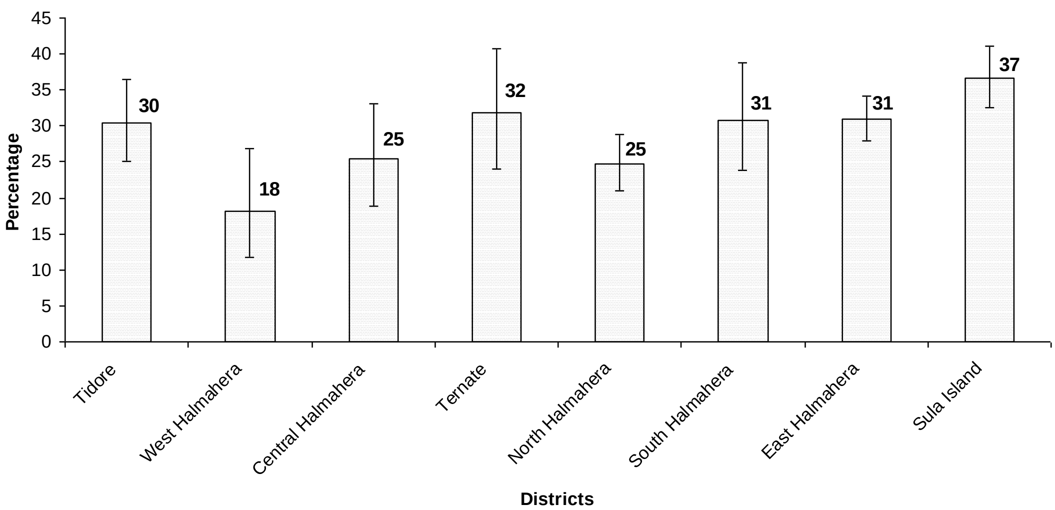


Figure 4.5: Prevalence of severely underweight children (weight-for-age < -3.00 Z-score) with 95% confidence intervals by districts (n=2,168), North Maluku, Indonesia 2004

Figure 4.6 reveals that the entire weight-for-age Z-score distribution for children aged 0 to 59 months in North Maluku, 2004, shifted to the left below the reference curve. The curve for boys was shifted further to the left than the curve for girls indicating that boys had slightly higher levels of under-nutrition than girls.

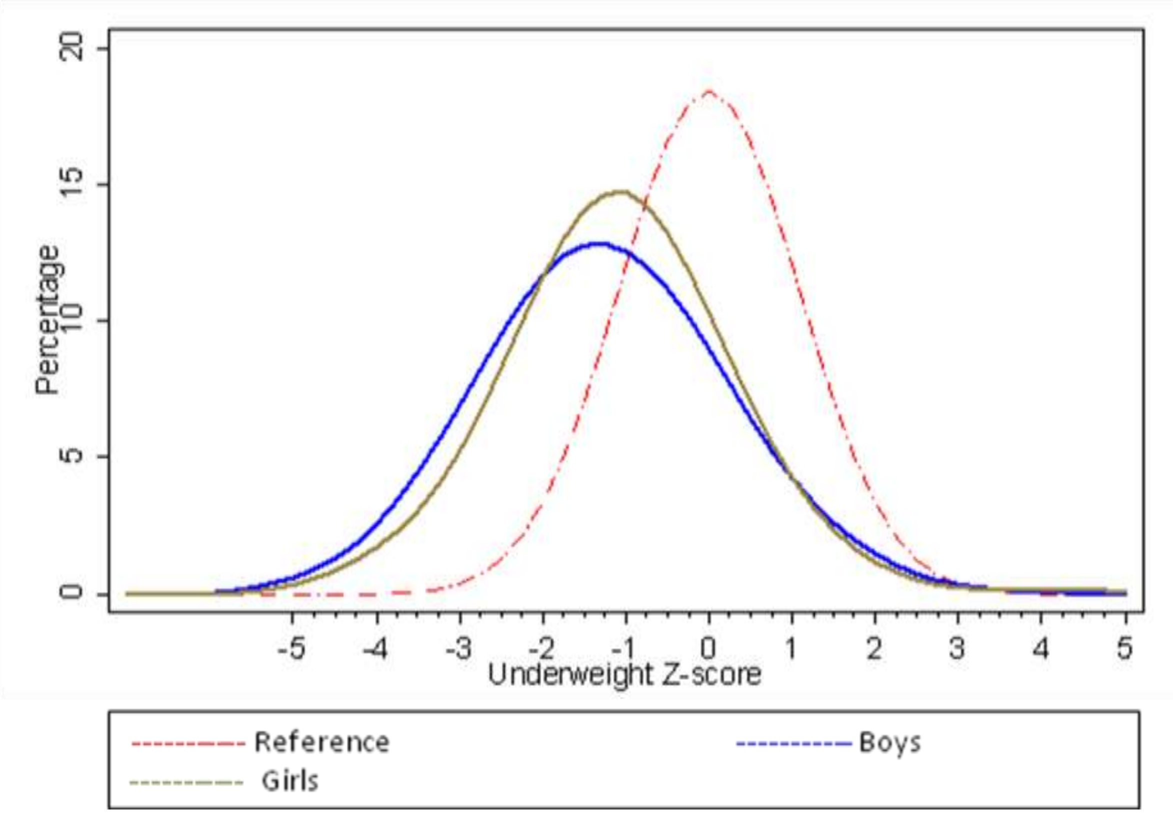


Figure 4.6: Weight-for-age Z-score distributions for boys and girls aged 0 to 59 months in North Maluku Province, Indonesia 2004

4.2.6.5 Prevalence of children aged 0 to 23 months with underweight and severe underweight according to family and child level characteristics

Table 4.14 illustrates the prevalence of children with underweight and severe underweight for a range of family and child level characteristics. For children aged 0 to 23 months there were no statistically significant differences in prevalence of underweight for any family level factors: Father’s education, Mother’s Education, Father occupation, Mother occupation, Parental Education, Parental employment, ousehold wealth index, Rural/urban region, geographical district and Number of household members. For child level factors there was a statistically significant difference between boys and girls with boys having a higher prevalence of underweight than boys: 24% (20, 28) versus 15% (95%CI 12, 19). For the remaining child level factors: immunisation status, sickness in the last two weeks and local health service vistis in the past three months.

For children aged 0 to 23 months there was a statistically significant difference in the prevalence of severely underweight children according to the father’s education. Children with fathers who completed senior high school had a lower prevalence of severe underweight (3.4%, 95%CI 2.2, 5.1) compared with children with fathers who completed elementary school only (7.3%, 95%CI 5.2, 10). For children aged 0 to 23 months there was a statistically significant difference in the prevalence of severely underweight children according to the parental education. Children with parents who both received high school education had a lower prevalence of severe underweight (3.2%, 95%CI 1.9, 5.3) compared with children where neither parent received high school education (8.3%, 95%CI 59, 12).

For the remaing family level characteristics: mother education, father occupation, mother occupation, parental occupation, household weath index, rural/urban region, geographical district and number of household members, there was no statistically significant differences in prevalence rates. For children aged 0 to 23 months there was no difference in the prevalence of severely underweight children according to any of the child level characteristics as demonstrated by overlapping confidence intervals shown in Table 4.14.

4.2.6.6 Prevalence of children aged 24 to 59 months with underweight and severe underweight according to family and child level characteristics

The prevalence of underweight for children aged 24 to 59 months was not statistically significantly different for categories within any of the family and child level characteristics tested. This is indicated by the overlapping of 95% confidence intervals for prevalence data shown in Table 4.14. Simarly, the prevalence of children with severe underweight was not statistically significantly different for categories within any of the family and child level characteristics tested, indicated by overalapping 95% condifence intervals.

4.2.6.7 Prevalence of children aged 0 to 59 months with underweight and severe underweight according to family and child level characteristics

For children aged 0 to 59 months there was a statistically significant difference in the prevalence of underweight children according to district with children living in Sula Island district having a higher prevalence compared to children living in the district of Tidore: 32% (95%CI 27, 37) versus 16%(95%CI 9.0, 26).For children aged 0 to 59 months there was no difference in the prevalence of underweight according to any of the remaining family level characteristics as demonstrated by overlapping confidence intervals shown in Table 4.14.

For children aged 0 to 59 months there was a statistically significant difference in the prevalence of severely underweight children according to the father's education. Children with fathers who completed senior high school had a lower prevalence of severe underweight (5.95, 95%CI 4.6, 7.6) compared to children with fathers who completed elementary school only (9.5%, 95% 7.7, 12). For children aged 0 to 59 months there was a statistically significant difference in the prevalence of severely underweight children according to district with children living in Sula Island district having a higher prevalence compared to children living in the district of Tidore: 13% (95%CI 9.9, 17) versus 4.7%(95%CI 2.8, 7.8).

For children aged 0 to 59 months there was no difference in the prevalence of underweight or severely underweight children according to any of the child level characteristics as demonstrated by overlapping confidence intervals shown in Table 4.14.

Table 4.14: Family and child level characteristics of underweight and severely underweight children aged 0 to 23, 24 to 59 and 0 to 59 months in North Maluku, Indonesia 2004

Characteristic	0 to 23 Months (n= 1183)							24 to 59 Months (n= 985)							0 to 59 Months (n= 2168)						
	Weight for Age							Weight for Age							Weight for Age						
		Underweight			Severely Underweight				Underweight			Severely Underweight				Underweight			Severely Underweight		
	N	n	%	95%CI	n	%	95%CI	N	n	%	95%CI	n	%	95%CI	N	n	%	95%CI	n	%	95%CI
Family level factors																					
Father education																					
Completed Elementary School	450	99	22	17, 27	33	7.3	5.2, 10	382	128	34	29, 38	46	12	9.1, 16	832	227	27	23, 31	79	9.5	7.7, 12
Completed Junior High School	289	59	20	16, 26	15	5.2	2.9, 9.0	268	79	29	23, 37	28	10	7.4, 15	557	138	25	21, 29	43	7.7	5.7, 10
Completed Senior High School	444	74	17	13, 21	15	3.4	2.2, 5.1	335	109	33	27, 38	31	9.3	6.5, 13	779	183	23	20, 27	46	5.9	4.6, 7.6
Mother Education																					
Completed Elementary School	611	133	22	18, 26	45	7.4	5.3, 10	552	181	33	29, 37	65	12	9.2, 15	1163	314	27	24, 30	110	9.5	7.7, 11.6
Completed Junior High School	286	51	18	14, 22	9	3.1	1.6, 6.2	228	66	29	24, 34	20	8.8	6.3, 12	514	117	23	19, 27	29	5.6	3.9, 8.1
Completed Senior High School	286	48	17	13, 22	9	3.1	1.6, 6.2	205	69	34	27, 41	20	9.8	6.2, 15	491	117	24	20, 28	29	5.9	4.0, 8.5
Father Occupation																					
Any Labour	741	144	19	16, 23	40	5.4	3.6, 7.9	655	202	31	27, 35	67	10	8.1, 13	1396	346	25	22, 27	107	7.7	6.2, 9.4
Fisher man	208	51	25	18, 32	13	6.3	3.6, 11	147	56	38	31, 46	20	14	8.7, 21	355	107	30	25, 36	33	9.3	6.5, 13
No work	39	8	21	11, 36	3	7.7	2.7, 20	21	7	33	15, 59	3	14	4.8, 36	60	15	25	14, 40	6	10	4.9, 19
Government /Private Officer	195	29	15	10, 21	7	3.6	1.5, 8.5	162	51	31	25, 39	15	9.3	5.4, 16	357	80	22	18, 27	22	6.2	4.1, 9.1
Mother Occupation																					
Any Labour	381	71	19	14, 24	20	5.2	3.1, 8.8	313	87	28	23, 33	33	11	7.5, 15	694	158	23	19, 27	53	7.6	5.6, 10
Fisher woman	49	16	33	20, 48	4	8.2	3.3, 19	47	18	38	24, 56	10	21	10, 39	96	34	35	25, 47	14	15	8.3, 24
No work	705	141	20	16, 24	38	5.4	3.8, 7.6	597	205	34	30, 39	60	10	7.8, 13	1302	346	27	24, 30	98	7.5	6.1, 9.3
Government /Private officer	48	4	8.3	3.2, 20	1	2.1	0.3, 14	28	6	21	11, 39	2	7.1	1.6, 26	76	10	13	7.2, 23	3	3.9	1.2, 12
Parental Education																					
Both with high education	497	84	17	14, 21	16	3.2	1.9, 5.3	374	118	32	27, 37	36	9.6	7.0, 13	871	202	23	20, 26	52	6.0	4.6, 7.8
Father with high education	75	15	20	13, 30	2	2.7	0.6, 11	59	17	29	18, 43	4	6.8	2.8, 15	134	32	24	17, 33	6	4.5	1.8, 10
Mother with high education	236	49	21	16, 27	14	5.9	3.4, 10	229	70	31	23, 39	23	10	6.5, 15	465	119	26	21, 31	37	8.0	5.5, 11
Neither with high education	375	84	22	18, 28	31	8.3	5.9, 12	323	111	34	29, 40	42	13	9.7, 17	698	195	28	24, 32	73	10	8.5, 13

	0-23 Months (n= 1183)							24-59 Months (n= 985)							0-59 Months (n= 2168)						
	Weight for Age							Weight for Age							Weight for Age						
Characteristic		Underweight			Severely Underweight				Underweight			Severely Underweight			N	Un			Sev		
	N	n	%	95%CI	n	%	95%CI	N	n	%	95%CI	n	%	95%CI		n	%	95%CI	n	%	95%CI
Parental Employment																					
Both working	463	89	19	15,24	25	5.4	3.4, 8.4	375	105	28	24, 33	42	11	8.1, 15	838	194	23	20, 27	67	8.0	6.1, 10
Father only working	681	135	20	16,24	35	5.1	3.6, 7.3	589	204	35	30, 39	60	10	7.9, 13	1270	339	27	24, 30	95	7.5	6.0, 9.3
Mother only working	15	2	13	2.8, 45	_	_		13	6	46	23, 71	3	23	8.7, 49	28	8	29	14, 50	3	11	3.9, 26
Neither working	24	6	25	12, 44	3	13	4.5, 30	8	1	13	1.5, 58	_	_		32	7	22	10, 41	3	9.4	3.3, 24
Household wealth Index																					
Poorest	459	103	22	18,28	30	6.5	4.4, 9.7	408	118	29	25, 34	42	10	7.7, 14	867	221	25	22, 30	72	8.3	6.6, 10
Middle	472	95	20	16,25	27	5.7	3.7, 8.7	395	132	33	29, 39	42	11	7.8, 14	867	227	26	23, 30	69	8.0	6.1, 10
Richest	252	34	13	9.4, 19	6	2.4	1.0, 5.4	182	66	36	29, 44	21	12	8.2, 16	434	100	23	19, 28	27	6.2	4.5, 8.6
Region																					
Rural	291	53	18	12, 26	10	3.4	1.8, 6.3	245	73	30	23, 38	25	10	7.2, 14	536	126	24	18, 30	35	6.5	4.8, 8.8
Urban	892	179	20	17, 24	53	5.9	4.3, 8.2	740	243	33	29, 37	80	11	8.8, 13	1632	422	26	23, 29	133	8.2	6.7, 10
District																					
Ternate	197	44	22	15, 32	7	3.6	1.7, 7.3	190	58	31	22, 40	21	11	7.6, 16	387	102	26	20, 34	28	7.2	5.2, 10
Tidore	94	9	10	3.1, 26	3	3.2	1, 9.9	55	15	27	17, 40	4	7.3	3.0, 17	149	24	16	9.0, 26	7	4.7	2.8, 7.8
Central Halmahera	161	33	21	14, 29	8	5.0	2.2, 11	119	38	32	26, 39	11	9.2	5.1, 16	280	71	25	19, 33	19	6.8	4.5, 10
East Halmahera	173	37	21	12, 36	14	8.1	4.5, 14	107	34	32	22, 44	15	14	8.3, 23	280	71	25	16, 38	29	10	6.2, 17
West Halmahera	80	13	16	14, 19	_	_		98	23	23	17, 31	8	8.2	4.5, 14	178	36	20	17, 24	8	4.5	2.5, 7.9
North Halmahera	135	22	16	9.9, 26	7	5.2	3.3, 8.0	144	43	30	23, 37	10	6.9	5.1, 9	279	65	23	18, 29	17	6.1	4.7, 7.8
South Halmahera	259	54	21	16, 27	16	6.2	2.9, 13	187	71	38	31, 45	22	12	8.9, 15	446	125	28	26, 30	38	8.5	6.1, 12
Sula Island	84	20	24	17, 33	8	9.5	5.0, 7.4	85	34	40	30, 51	14	16	10.8, 24	169	54	32	27, 37	22	13	9.9, 17
Household member																					
?5 members	750	155	21	17, 25	42	5.6	3.8, 8.1	609	182	30	26, 34	59	10	7.5, 12	1359	337	25	22, 28	101	7.4	6.0, 9.2
6-12 members	433	77	18	15.21	21	4.9	2.9, 7.9	376	134	36	31, 40	46	12	9.6, 15	809	211	26	23, 29	67	8.3	6.7, 10
Child level factors																					
Gender																					
Boy	609	144	24	[19.66,28.16]	41	6.7	4.7, 9.7	506	173	34	29, 39	54	11	8.0, 14	1115	317	28	25, 32	95	8.5	6.8, 11
Girl	574	88	15	[12.23,19.05]	22	3.8	2.5, 5.9	479	143	30	26, 34	51	11	8.3, 14	1053	231	22	19, 25	73	6.9	5.7, 8.5

Characteristic		Underweight			Severely Underweight				Underweight			Severely Underweight				Underweight			Severely Underweight		
	N	n	%	95%CI	n	%	95%CI	N	n	%	95%CI	n	%	95%CI	N	n	%	95%CI	n	%	95%CI
Immunisation Status																					
Never	177	36	20	15, 28	8	4.5	2.3, 8.7	82	23	28	20, 38	11	13	7.6, 23	259	59	23	18, 28	19	7.3	5.1, 10
Ever	1006	196	19	16, 23	55	5.5	4, 7.4	903	293	32	29, 36	94	10	8.6, 13	1909	489	26	23, 28	149	7.8	6.5, 9.3
Sick in the last 2 weeks																					
No	690	135	20	16, 23	39	5.7	3.9, 8.2	647	203	31	28, 35	65	10	7.9, 13	1337	338	25	23, 28	104	7.8	6.3, 10
Yes	493	97	20	16, 24	24	4.9	3.5, 6.8	338	113	33	29, 39	40	12	9.0, 15	831	210	25	22, 29	64	7.7	6.2, 9.5
Local health services visits in past 3 months																					,
0	196	40	20	14, 28	11	5.6	3.1, 9.9	344	108	31	27, 37	35	10	7.2, 14	540	148	27	24, 31	46	8.5	6.4, 11
Once	173	34	20	14, 27	10	5.8	3.2, 10	142	46	32	26, 40	16	11	6.6, 19	315	80	25	21, 31	26	8.3	5.7, 12
2 times	355	70	20	15, 26	25	7.0	4.4, 11	204	65	32	26, 38	24	12	7.9, 17	559	135	24	20, 29	49	8.8	6.3, 12
>=3 times	326	61	19	14, 24	11	3.4	2.0, 5.6	223	69	31	25, 38	18	8.1	5.1, 13	549	130	24	20, 28	29	5.3	3.7, 7.6

Refer also to Appendix 4.2 for age group distribution data by wealth index, Appendix 4.3 for wealth index distribution by district for children in North Maluku

4.2.7 Stunting

The prevalence of stunting in children (height-for-age < -2.00 Z-score) aged 0 to 59 months in North Maluku in 2004 was 38% (95%CI 36, 41). There was a high prevalence (30-39%) of low height-for-age in preschool aged children, based on WHO criteria (WHO, 1995a).

The prevalence of severe stunting in children (<-3.00 Z-score) aged 0 to 59 months was 18% (95%CI 16, 21), and was categorised as low (less than 20%), based on WHO criteria. The mean weight-for-age Z-score for children 0 to 59 months was -1.4 indicating that the distribution of this anthropometric indicator had shifted significantly below zero, the expected value of the reference distribution (see Table 4.32 in Appendix).

4.2.7.1 Prevalence of children with stunting by six month age group

As illustrated in Figure 4.7, there was an increase in the prevalence of children with stunting through to the 36 to 41 month age group, with a slight decline in the older age groups. The prevalence of children with severe stunting continued to increase in prevalence through to the 24 to 29 month age group and varied significantly in the older age groups (Figure 4.8).

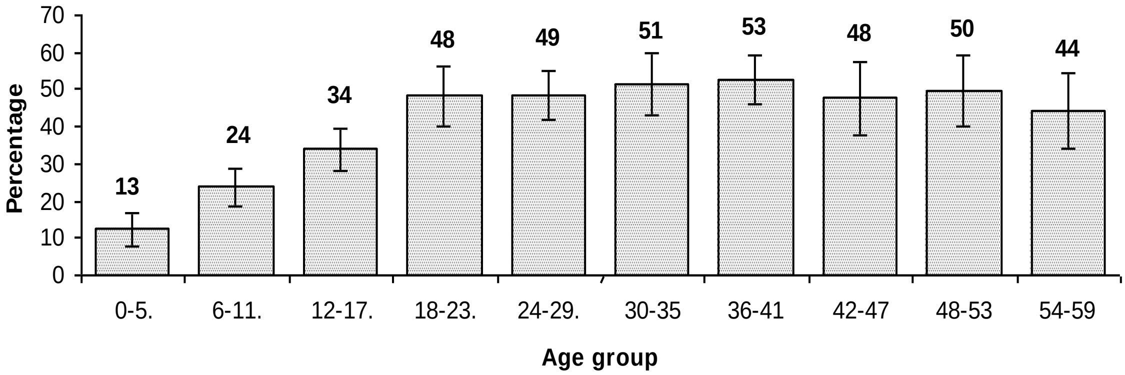


Figure 4.7: Prevalence of Children with stunting (height-for-age < -2.00 Z-score and 95% confidence intervals) by age groups (n=2,168), North Maluku, Indonesia 2004

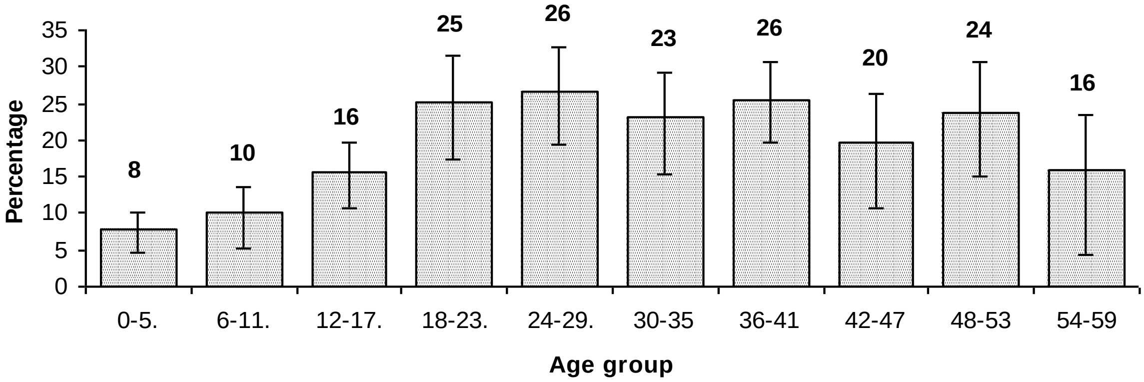


Figure 4.8 Prevalence of children with severe stunting (height-for-age < -3.00 Z-score and 95% confidence intervals) by six-month age groups (n=2,168), North Maluku, Indonesia 2004

4.2.7.2 Prevalence of boys with stunting

The prevalence of boys with stunting and severe stunting aged 0 to 59 months by age group was 41% (95%CI 38, 45) and 20% (95%CI 17, 24) respectively. The prevalence of boys with stunting and severe stunting increased with age through to 36 to 41 months, and then declined within the oldest age groups. See Table 4.15.

Table 4.15: Prevalence of boys less than five years with stunting and severe stunting (height-for-age <-2.00 and <-3.00 Z-score) with 95% confidence intervals, mean Z-score and standard deviation by age groups, North Maluku, Indonesia 2004

Age Groups in months	Boys										
	Height for Age										
	N	Stunting				Severe Stunting				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
0-5	146	19	13	9.0	18	12	8.2	5.1	13	0	2.78
6-11	190	54	28	22	36	24	13	7.7	20	-0.64	2.58
12-17	159	65	41	33	49	33	21	15	28	-1.55	2.21
18-23	114	58	51	41	61	33	29	20	40	-1.94	2.4
24-29	126	65	52	43	60	36	29	21	38	-1.93	1.99
30-35	94	52	55	44	66	22	23	15	34	-2.13	1.67
36-41	107	64	60	49	70	34	32	24	41	-2.4	1.73
42-47	66	34	51	39	64	11	17	8.9	29	-1.93	1.41
48-53	75	34	45	33	58	17	23	13	36	-2.26	1.97
54-59	38	16	42	30	55	7	18	8.3	36	-1.88	1.16
Total	1115	461	41	38	45	229	20	17	24	-1.49	2.33

4.2.7.3 Prevalence of girls with stunting

The prevalence of girls with stunting and severe stunting was 35% (95%CI 32, 39) and 16% (95%CI 14, 19 respectively). The prevalence of girls with stunting and severe stunting varied significantly by age group. The mean height-for-age Z-score for boys and girls aged 0 to 59 months were -1.49 and -1.28 respectively indicating that the distribution of this anthropometric indicator had shifted significantly below zero, the expected value of the reference distribution (see Table 4.16).

Table 4.16: Prevalence of girls aged less than five years with stunting and severe stunting (height-for-age <-2.00 and <-3.00 Z-score) & 95% confidence intervals, mean Z-score and standard deviation by age groups, North Maluku, Indonesia 2004

Age Groups in Months	Girls										
	Height for Age										
	N	Stunting				Severe Stunting				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
0-5.	120	15	12	6.9	22	9	7.5	3.9	14	0.24	2.6
6-11.	175	34	19	13	27	13	7.4	4.0	13	-0.41	2.11
12-17.	159	43	27	20	35	17	10	6.2	18	-0.9	2.11
18-23.	120	55	46	36	56	26	22	15	31	-1.7	1.95
24-29.	112	51	45	36	55	27	24	16	34	-1.79	1.71
30-35	75	35	47	36	58	17	23	15	33	-2.1	1.64
36-41	108	49	45	36	55	21	19	13	27	-1.97	1.96
42-47	81	36	44	31	58	18	22	14	34	-1.98	1.72
48-53	60	33	55	41	68	15	25	16	38	-2.5	1.95
54-59	43	20	46	32	61	6	14	6.7	27	-1.83	1.22
Total	1053	371	35	32	39	169	16	14	19	-1.28	2.16

4.2.7.4 Prevalence of children with stunting by district

The prevalence of children aged 0 to 59 months in North Maluku province with stunting and severe stunting varied significantly by district as illustrated in Figure 4.9 and Figure 4.10.

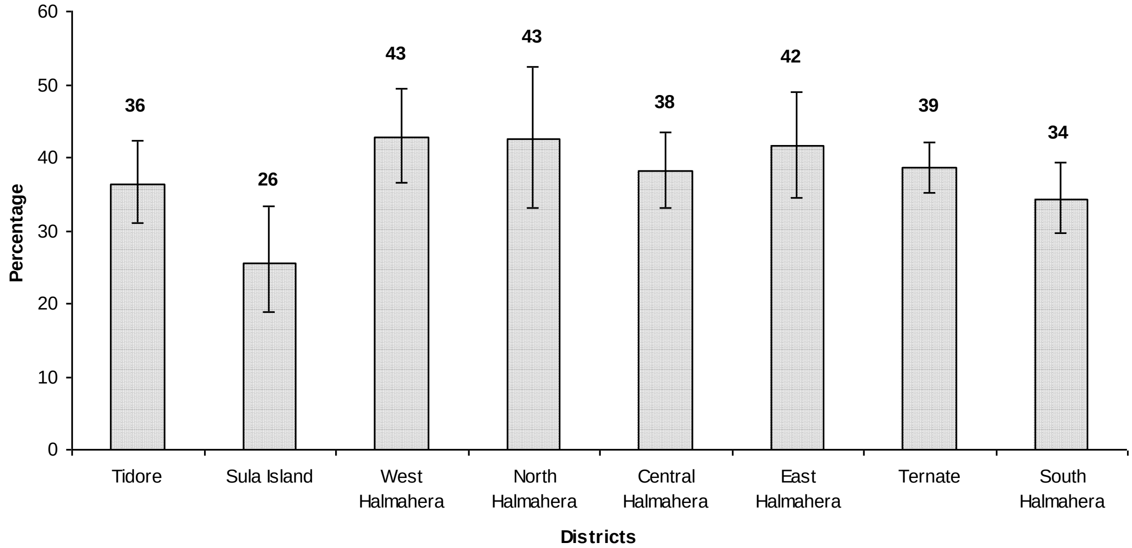


Figure 4.9: Prevalence of children with stunting (height-for-age < -2.00 Z-score) with 95%confidence intervals) by district (n=2,168), North Maluku, Indonesia 2004

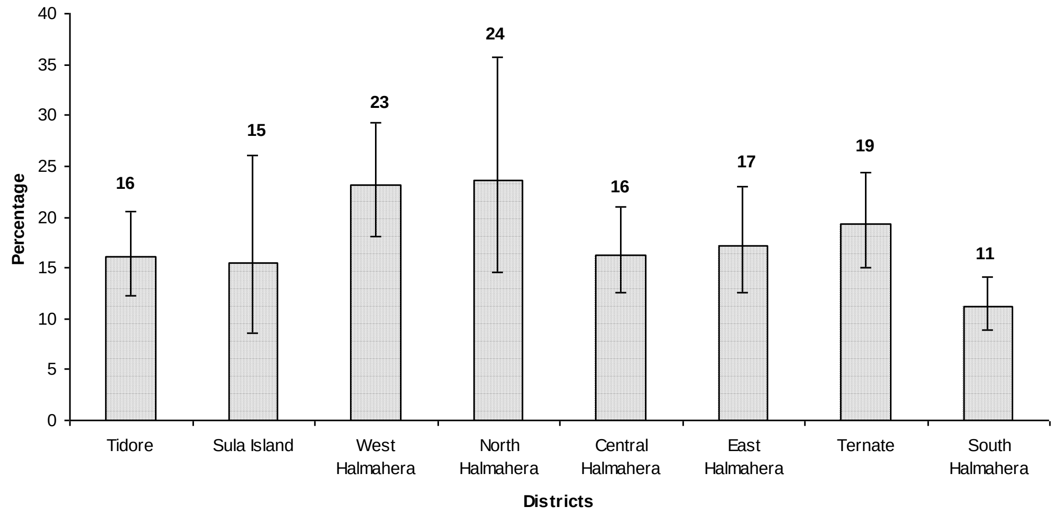


Figure 4.10: Prevalence of children with severe stunting (height-for-age < -2.00 Z-score & 95% confidence intervals) by district (n=2,168), North Maluku, Indonesia 2004

The prevalence of boys with stunting and severe stunting varied significantly by district as illustrated in Table 4.17. A very high prevalence (≥ 40%) of stunting and severe stunting was recorded in the districts of Central Halmahera, East Halmahera, West Halmahera and North Halmahera. The prevalence of stunting in Ternate, South Halmahera and Sula Island districts were high (30 to 39%), and Tidore district was categorised as medium. Three districts of Central Halmahera, East and North Halmahera were found to have a medium prevalence (20 to 29%) of children with severe stunting. Ternate, Tidore, West Halmahera, South Halmahera and Sula Island districts had a low prevalence (less than 20%) of severe stunting.

Table 4.17: Prevalence of boys aged less than five years with stunting and severe stunting (height-for-age <-2.00 and <-3.00 Z-score) & 95% confidence intervals, mean Z-score and standard deviation by districts, North Maluku, Indonesia 2004

Districts	Boys										
	Height for age										
	N	Stunting				Severe Stunting				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
Ternate	200	78	39	339	45	39	19	14	27	-1.66	1.92
Tidore	78	21	27	17	39	12	15	7.0	31	-0.97	1.86
Central Halmahera	147	71	48	38	59	39	26	18	37	-1.72	2.67
East Halmahera	139	65	47	36	57	39	28	19	40	-1.84	2.44
West Halmahera	91	41	45	41	49	15	16	11	24	-1.57	1.73
North Halmahera	148	67	45	37	54	32	22	14	32	-1.47	2.77
South Halmahera	222	87	39	32	47	42	19	13	27	-1.16	2.47
Sula Island	90	31	34	25	45	11	12	9.4	16	-1.37	2.01
Total	1115	461	41	38	45	229	20	17	24	-1.49	2.33

The prevalence of girls with stunting and severe stunting varied significantly by district (than 20%) in all districts of the No). A high prevalence (30 to39%) of girls with stunting was found in all districts except for Tidore which had medium prevalence (20 to 29%). The prevalence of girls with severe stunting was low (less than 20%) in all districts of the North Maluku province, see Table 4.18.

Table 4.18: Prevalence of girls less than five years with stunting and severe stunting (height-for-age <-2.00 and <-3.00 Z-score) with 95% confidence intervals, mean Z-score and standard deviation by district, North Maluku, Indonesia 2004

Districts	Girls										
	Height for age										
	N	Stunting				Severe Stunting				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
Ternate	187	63	34	26	43	23	12	8.8	17	-1.29	1.80
Tidore	71	17	24	17	32	11	15	7.6	29	-0.83	2.36
Central Halmahera	133	49	37	28	46	26	20	17	23	-1.40	2.17
East Halmahera	141	54	38	27	52	27	19	10	33	-1.38	2.11
West Halmahera	87	27	31	22	42	14	16	11	23	-1.53	2.15
North Halmahera	131	49	37	29	46	16	12	8.9	17	-1.25	2.27
South Halmahera	224	85	38	31	46	44	20	15	26	-1.27	2.43
Sula Island	79	27	34	26	44	8	10	7.2	14	-1.14	1.85
Total	1053	371	35	32	39	169	16	14	19	-1.28	2.16

Figure 4.11 reveals the entire height-for-age Z-score distribution for children 0 to 59 months in North Maluku was shifted to the left below the reference. The curve for the boys was shifted further to the left than the curve for the girls indicting that boys had slightly higher levels of under-nutrition than girls.

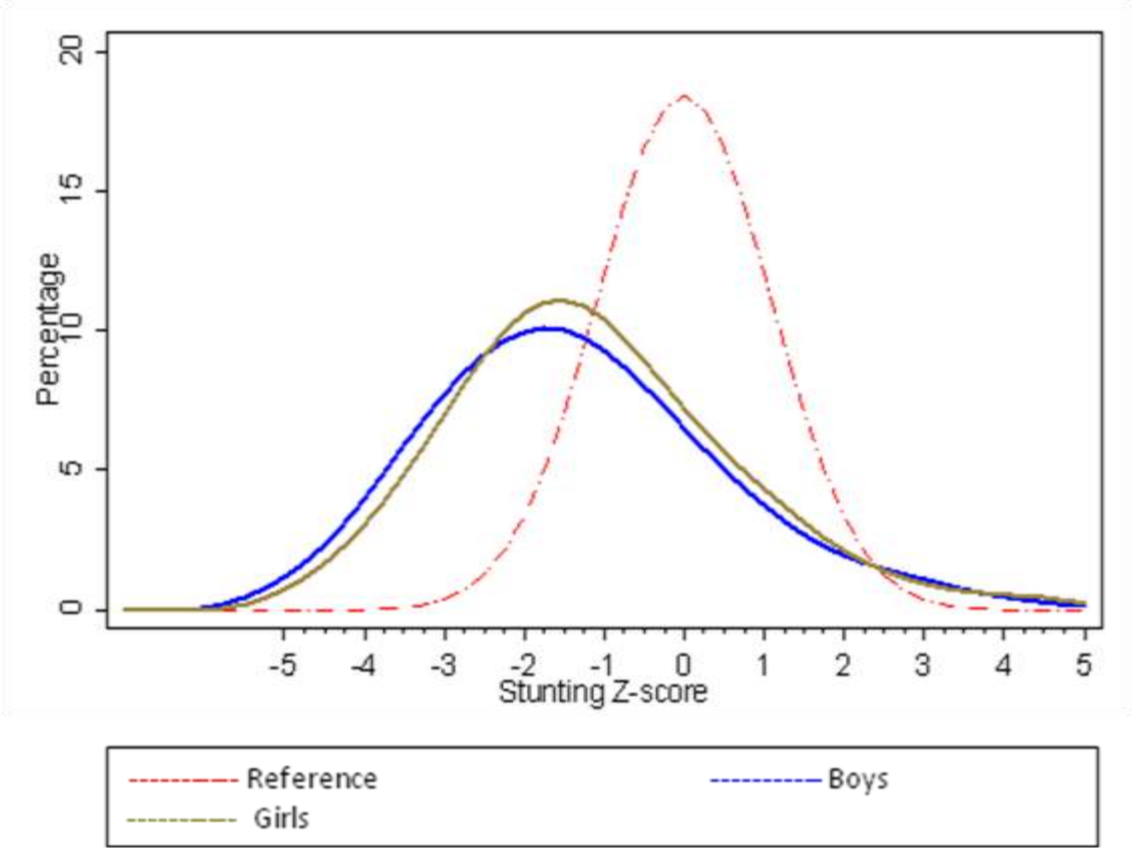


Figure 4.11: Height-for-age Z-score distribution for boys and girls aged 0 to 59 months with stunting in North Maluku, Indonesia in 2004.

4.2.7.5 Prevalence of children aged 0 to 23 months with stunting and severe stunting according to family and child level characteristics

The prevalence of children aged 0 to 23 months with stunting or severe stunting according to family and child level characteristics is summarised in Table 4.19. For children aged 0 to 23 months there were no statistically significant differences in stunting for any of the family level or child level characteristics.

For children aged 0 to 23 months there were statistically significant difference in severestunting for the family level characteristic of geographical district with children from East Halmahera having a statistically significantly higher prevalence of severe stunting compared to children from the district of West Halmahera (22%, 95%CI 13, 34 versus 6.3%, 95%CI 3.1, 12). Children aged 0 to 23 months from poorer households had a higher prevalence of severe stunting compared to wealthier households although this result was of borderline statistical significance (17%, 95%CI 13, 22 versus 8.3%, 95%CI 5.1, 13, respectively).

For the remaing family level characteristics: father education, mother education, father occupation, mother occupation, parental education, parental occupation, rural/urban region and number of household members, there were no statistically significant differences in prevalence rates of severe stunting. For children aged 0 to 23 months there were no statistically significant differences in severe stunting for any of the child level characteristics.

4.2.7.6 Prevalence of children aged 24 to 59 months with stunting and severe stunting according to family and child level characteristics

The prevalence of children aged 24 to 59 months with stunting or severe stunting according to family and child level characteristics is summarised in Table 4.19. For children aged 24 to 59 months there were no statistically significant differences in stunting or severe stunting for any of the child level characteristics.

For children aged 24 to 59 months there were statistically significant differences in the prevalence of stunting in the family level characteristics of household wealth index and rural/urban regions. Children aged 24 to 59 months from poorer households had a higher prevalence of stunting compared to wealthier households (55%, 95%CI 50, 60 versus 41%, 95%CI 35, 48, respectively), indicated by 95% confidence intervals that do not overlap. Children aged 24 to 59 months had a higher prevalence of stunting in urban compared to rural regions: 53% (95%CI49, 57) versus 41% (95%CI 34, 48) respectively.

For children aged 24 to 59 months there were statistically significant differences in the prevalence severe stunting for geographical district with children from the the districts of Central Halmahera (34% 95%CI 23, 46) and South Halmahera (29%, 95%CI 23, 36) having an increased prevalence of severe stunting compared to the district of Sula Island (12%, 95%CI 7,18).

4.2.7.7 Prevalence of children aged 0 to 59 months with stunting and severe stunting according to family and child level characteristics

The prevalence of children aged 0 to 59 months of age with stunting or severe stunting according to family and child level characteristics is summarised in Table 4.19.

For children aged 0 to 59 months there were statistically significant differences in prevalence for the family level characteristics of mother's education, parental education, household wealth index and geographical district. Children with mothers who completed senior high school had a lower prevalence of stunting compared to children with mothers who completed elementary school only (31%, 95%CI 27, 36 and 42%, 95%CI 38, 45, respectively). Children where both parents received high school education had a lower prevalence of stunting compared with children where neither parent received high school education although this difference was of borderline statistical significance (34%, 95%CI 30, 38 and 42%, 95%CI 38, 46, respectively). Children for poorer households had a higher prevalence of stunting compared with children from wealthier households (43%, 95%CI 39, 48 and 31%, 95%CI 26, 26, repsectively).

Compared to children aged to 59 months from the district of Tidore (26% 95%CI 19, 33), children aged 0 to 59 months from the districts of Central Halmahera (43%, 95%CI 36,50), North Halmahera (42%, 95%CI 34, 49) and South Halmahera (39%, 95%CI 35, 42) had higher prevalence rates of stunting. The districts of East Halamhera (43%, 95%CI 33, 52) and West Halmahera (38%, 95%CI 33, 44) had borderline statistically significant differeces in stunting compared to children from the district of Tidore (26% 95%CI 19, 33).

For children aged 0 to 59 months there were statistically significant differences in prevalence for the child level characteristic of immunisation status where children who were never immunised had a lower prevalence of stunting compared to children who had been immunised (30% 95%CI 25, 35 versus 40%, 95%CI 37, 42%, respectively).

For children aged 0 to 59 months there were no statistically significant differences in severe stunting for any of the famiy or child level characteristics.

Table 4.19: Family and child level characteristics of children aged 0 to 23, 24 to 59 and 0 to 59 months with stunting and severe stunting in North Maluku Province, Indonesia 2004

	0-23 Months (n= 1183)							24-59 Months (n= 985)							0-59 Months (n= 2168)						
	Height for Age							Height for Age							Height for Age						
Characteristic		Stunted			Severely Stunted				Stunted			Severely Stunted				Stunted			Severely Stunted		
	N	n	%	95%CI	n	%	95%CI	N	n	%	95%CI	n	%	95%CI	N	n	%	95%CI	n	%	95%CI
Family level factors																					
Father education																					
Completed Elementary School	**450**	**144**	**32**	**27, 37**	**73**	**16**	**13, 21**	**382**	**204**	**53**	**48, 58**	**101**	**26**	**21, 32**	**832**	**348**	**42**	**38, 46**	**174**	**21**	**18, 25**
Completed Junior High School	**289**	**28**	**28**	**23, 34**	**38**	**13**	**9.7, 18**	**268**	**137**	**51**	**45, 57**	**68**	**25**	**21, 31**	**557**	**219**	**39**	**35, 44**	**106**	**19**	**15, 23**
Completed Senior High School	**444**	**26**	**26**	**22, 31**	**56**	**13**	**9.2, 17**	**335**	**148**	**44**	**38, 51**	**62**	**19**	**14, 24**	**779**	**265**	**34**	**30, 38**	**118**	**15**	**12, 19**
Mother Education																					
Completed Elementary School	**611**	**188**	**31**	**27, 35**	**102**	**17**	**14, 20**	**552**	**296**	**54**	**49, 58**	**142**	**26**	**21, 31**	**1163**	**484**	**42**	**38, 45**	**244**	**21**	**18, 24**
Completed Junior High School	**286**	**85**	**30**	**25, 36**	**33**	**12**	**8, 16**	**228**	**109**	**48**	**40, 56**	**48**	**21**	**16, 27**	**514**	**194**	**38**	**33, 43**	**81**	**16**	**12, 20**
Completed Senior High School	**286**	**70**	**24**	**20, 30**	**32**	**11**	**7.7, 16**	**205**	**84**	**41**	**35, 48**	**41**	**20**	**15, 26**	**491**	**154**	**31**	**27, 36**	**73**	**15**	**12, 19**
Father Occupation																					
Any Labour	**741**	**217**	**29**	**26, 33**	**112**	**15**	**12, 19**	**655**	**341**	**52**	**48, 56**	**158**	**24**	**20, 29**	**1396**	**558**	**40**	**37, 43**	**270**	**19**	**17, 22**
Fisher man	**208**	**58**	**28**	**23, 34**	**26**	**13**	**8.5, 18**	**147**	**68**	**46**	**38, 55**	**38**	**26**	**20, 32**	**355**	**126**	**35**	**31, 40**	**64**	**18**	**15, 22**
No work	**39**	**14**	**36**	**22, 53**	**8**	**21**	**10, 37**	**21**	**13**	**62**	**40, 80**	**9**	**43**	**22, 67**	**60**	**27**	**45**	**34, 57**	**17**	**28**	**19, 41**
Government /Private officer	**195**	**54**	**28**	**21, 36**	**21**	**11**	**6.9, 17**	**162**	**67**	**41**	**34, 49**	**26**	**16**	**10, 24**	**357**	**121**	**34**	**29, 39**	**47**	**13**	**10, 18**
Mother Occupation																					
Any Labour	**381**	**114**	**30**	**25, 35**	**55**	**14**	**11, 18**	**313**	**160**	**51**	**46, 56**	**73**	**23**	**18, 30**	**694**	**274**	**39**	**35, 44**	**128**	**18**	**15, 22**
Fisher woman	**49**	**15**	**31**	**21, 43**	**9**	**18**	**9.8, 32**	**47**	**22**	**47**	**35, 59**	**13**	**28**	**17, 42**	**96**	**37**	**39**	**31, 47**	**22**	**23**	**16, 32**
No work	**705**	**200**	**28**	**24, 33**	**96**	**14**	**10, 18**	**597**	**293**	**49**	**44, 54**	**140**	**23**	**19, 28**	**1302**	**493**	**38**	**34, 41**	**236**	**18**	**15, 21**
Government /Private officer	**48**	**14**	**29**	**18, 44**	**7**	**15**	**8, 25**	**28**	**14**	**50**	**34, 66**	**5**	**18**	**8.3, 34**	**76**	**28**	**37**	**28, 47**	**12**	**16**	**10, 24**
Parental Education																					
Both with high education	**497**	**130**	**26**	**22, 31**	**56**	**11**	**8.4, 15**	**374**	**78**	**21**	**16, 26**	**7**	**0.8**	**0.4, 1.7**	**871**	**293**	**34**	**30, 38**	**134**	**15**	**13, 19**
Father with high education	**75**	**25**	**33**	**23, 46**	**9**	**12**	**5.6, 24**	**59**	**11**	**19**	**10, 33**	**2**	**0.2**	**0.4, 0.6**	**134**	**55**	**41**	**33, 50**	**20**	**15**	**9, 23**
Mother with high education	**236**	**69**	**29**	**24, 36**	**38**	**16**	**12, 22**	**229**	**52**	**23**	**17, 30**	**3**	**11**	**2.7, 34**	**465**	**191**	**41**	**37, 45**	**90**	**19**	**16, 24**
Neither with high education	**375**	**119**	**32**	**27, 37**	**64**	**17**	**13, 22**	**323**	**90**	**28**	**22, 34**	**0**	**0.0**	**0, 0**	**698**	**293**	**42**	**38, 46**	**154**	**22**	**18, 26**
Parental Employment																					
Both working	**463**	**138**	**30**	**26, 34**	**69**	**15**	**12, 19**	**375**	**186**	**50**	**45, 54**	**83**	**22**	**18, 28**	**838**	**324**	**39**	**35, 42**	**152**	**18**	**15, 21**
Father only working	**681**	**191**	**28**	**24, 32**	**90**	**13**	**10, 17**	**589**	**290**	**49**	**44, 55**	**139**	**24**	**19, 29**	**1270**	**481**	**38**	**35, 41**	**229**	**18**	**15, 21**
Mother only working	**15**	**5**	**33**	**14, 60**	**2**	**13**	**2.8, 45**	**13**	**10**	**77**	**45, 93**	**8**	**62**	**30, 85**	**28**	**15**	**54**	**38, 68**	**10**	**36**	**20, 56**
Neither working	**24**	**9**	**38**	**21, 57**	**6**	**25**	**12, 46**	**8**	**3**	**38**	**13, 71**	**1**	**13**	**2.8, 41**	**32**	**12**	**38**	**23, 55**	**7**	**22**	**11, 38**

Characteristic	0-23 Months (n= 1183)							24-59 Months (n= 985)							0-59 Months (n= 2168)						
	Height for Age							Height for Age							Height for Age						
		Stunted			Severely Stunted				Stunted			Severely Stunted				Stunted			Severely Stunted		
	N	n	%	95%CI	n	%	95%CI	N	n	%	95%CI	n	%	95%CI	N	n	%	95%CI	n	%	95%CI
Household wealth Index																					
Poorest	459	151	33	28, 39	80	17	13, 22	408	223	55	50, 60	103	25	20, 31	867	374	43	39, 48	183	21	17, 25
Middle	472	133	28	24, 32	66	14	11, 18	395	191	48	43, 54	98	25	21, 30	867	324	37	34, 41	164	19	16, 22
Richest	252	59	23	18, 30	21	8.3	5.1, 13	182	75	41	35, 48	30	16	12, 22	434	134	31	26, 36	51	12	9, 16
Region																					
Rural	291	79	27	21, 34	40	14	9.5, 20	245	100	41	34, 48	45	18	14, 24	536	179	33	29, 39	85	16	12, 20
Urban	892	264	30	26, 33	127	14	11, 18	740	389	53	49, 57	186	25	21, 30	1632	653	40	37, 43	313	19	16, 22
District																					
Ternate	197	61	31	24, 39	28	14	9.9, 20	190	80	42	34, 51	34	18	13, 24	387	141	36	31, 42	62	16	12, 21
Tidore	94	18	19	10, 32	12	13	4.9, 29	55	20	36	29, 44	11	20	11, 34	149	38	26	19, 33	23	15	8.6, 26
Central Halmahera	161	52	32	26, 40	25	16	11, 21	119	68	57	46, 67	40	34	23, 46	280	120	43	36, 50	65	23	18, 29
East Halmahera	173	64	37	28, 47	38	22	13, 34	107	55	51	41, 62	28	26	16, 40	280	119	43	33, 52	66	24	15, 36
West Halmahera	80	19	24	16, 34	5	6.3	3.1, 12	98	49	50	43, 57	24	24	18, 33	178	68	38	33, 54	29	16	13, 21
North Halmahera	135	42	31	24, 39	18	13	9.1, 19	144	74	51	42, 61	30	21	13, 32	279	116	42	34, 49	48	17	13, 23
South Halmahera	259	64	25	20, 30	32	12	8.2, 18	187	108	58	51, 64	54	29	23, 36	446	172	39	35, 42	86	19	15, 24
Sula Island	84	23	27	21, 35	9	11	6.7, 17	85	35	41	32, 51	10	12	7.4, 18	169	58	34	30, 39	19	11	8.9, 14
Household member																					
?5 members	750	235	31	28, 35	111	15	12, 19	609	299	49	45, 53	141	23	20, 27	1359	534	39	36, 42	252	19	16, 22
6-12 members	433	108	25	21, 29	56	13	10, 16	376	190	51	44, 57	90	24	19, 30	809	298	37	33, 41	146	18	15, 21
Child level factors																					
Children Age																					
Gender																					
Boy	609	196	32	28, 37	102	17	13, 21	506	265	52	48, 57	127	25	21, 30	1115	461	41	38, 45	229	21	17, 24
Girl	574	147	26	22, 30	65	11	8.9, 14	479	224	47	41, 52	104	22	18, 26	1053	371	35	32, 39	169	16	14, 19

	0-23 Months (n= 1183)							24-59 Months (n= 985)							0-59 Months (n= 2168)						
	Height for Age							Height for Age							Height for Age						
Characteristic		Stunted			Severely Stunted				Stunted			Severely Stunted				Stunted			Severely Stunted		
	N	n	%	95%CI	n	%	95%CI	N	n	%	95%CI	n	%	95%CI	N	n	%	95%CI	n	%	95%CI
Immunisation Status																					
Never	**177**	**38**	**21**	**16, 28**	**24**	**14**	**9.0, 20**	**82**	**39**	**48**	**38, 56**	**17**	**21**	**12, 33**	**259**	**77**	**30**	**25, 35**	**41**	**16**	**11, 22**
Ever	**1006**	**305**	**30**	**27, 34**	**143**	**14**	**12, 17**	**903**	**450**	**50**	**46, 54**	**214**	**24**	**20, 28**	**1909**	**755**	**40**	**37, 42**	**357**	**19**	**16, 21**
Sick in the last 2 weeks																					
No	**690**	**210**	**30**	**27, 35**	**115**	**17**	**13, 21**	**647**	**325**	**50**	**46, 54**	**155**	**24**	**20, 28**	**1337**	**535**	**40**	**37, 43**	**270**	**20**	**17, 23**
Yes	**493**	**133**	**27**	**23, 31**	**52**	**11**	**8.0, 14**	**338**	**164**	**49**	**42, 55**	**76**	**22**	**17, 29**	**831**	**297**	**36**	**32, 40**	**128**	**15**	**13, 19**
Local health services visit in past 3 months																					
0	**196**	**59**	**30**	**23, 38**	**30**	**15**	**10, 23**	**344**	**145**	**42**	**36, 48**	**55**	**16**	**12, 20**	**540**	**204**	**38**	**34, 42**	**85**	**16**	**13, 19**
1 time	**173**	**51**	**29**	**22, 39**	**30**	**17**	**11, 25**	**142**	**71**	**50**	**42, 58**	**38**	**27**	**19, 36**	**315**	**122**	**39**	**33, 45**	**68**	**22**	**17, 28**
2 times	**355**	**95**	**27**	**22, 32**	**41**	**12**	**8.5, 16**	**204**	**114**	**56**	**50, 62**	**54**	**26**	**21, 33**	**559**	**209**	**37**	**33, 42**	**95**	**17**	**14, 21**
>=3 times	**326**	**108**	**33**	**29, 38**	**44**	**14**	**9.6, 19**	**223**	**125**	**56**	**47, 65**	**64**	**29**	**21, 37**	**549**	**233**	**42**	**37, 48**	**108**	**20**	**15, 26**

Refer also to Appendix 4.2 for age group distribution data by wealth index, Appendix 4.3 for wealth index distribution by district for children in North Maluku

4.2.8 Wasting

The prevalence of wasting in children (weight for height < -2.00 Z-score) aged 0 to 59 months in North Maluku in 2004 was 13% (95%CI 11, 16). The prevalence was categorised as low (less than 20%) in preschool aged children. The prevalence of severe wasting in children (<-3.00 Z-score) aged 0 to 59 months was 5.4% (95%CI 4.4, 6.7), and was categorised as medium (5 to 9%). The mean weight-for-age Z-score for children 0 to 59 months was -0.58 indicating that the distribution of this anthropometric indicator had shifted significantly below zero, the expected value of the reference distribution (see Table 4. 33 in Appendix).

4.2.8.1 Prevalence of children with wasting by six month age group

As illustrated in Figure 4.14 and 4.15, the prevalence of children with wasting and severe wasting by six-month age group varied significantly.

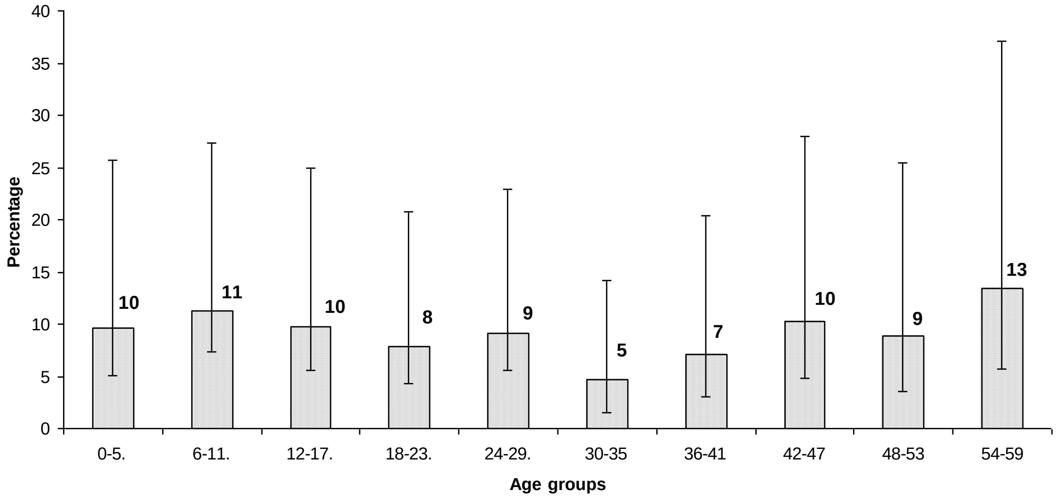


Figure 4.12: Prevalence of wasting children (height-for-age < -2.00 Z-score) & 95% confidence intervals by Age groups (n=2,168), North Maluku, Indonesia 2004. ** There were 12 missing value for children with wasting.

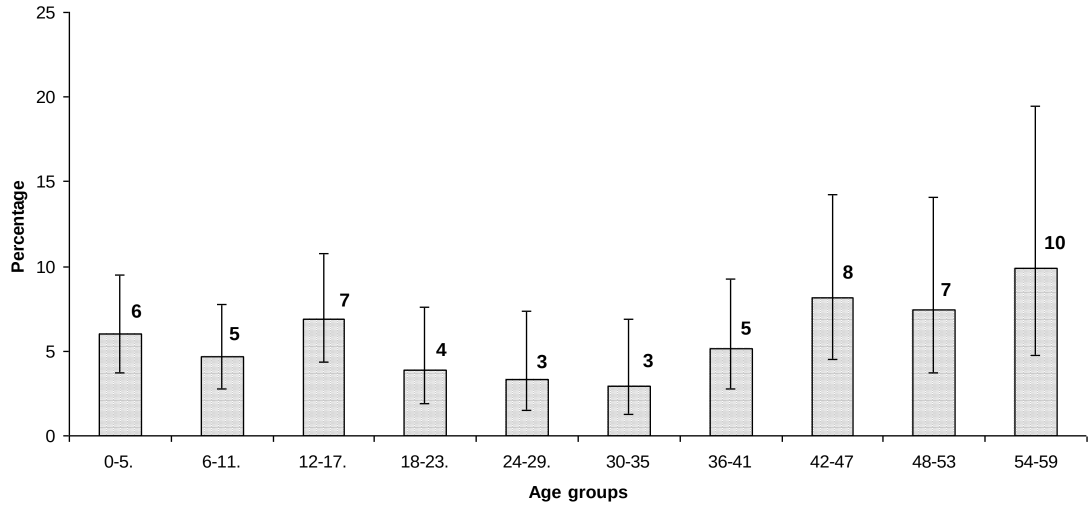


Figure 4.13: Prevalence of children with severe wasting (height-for-age < -3.00 Z-score) & 95% confidence intervals by six-month age groups (n=2,168), North Maluku, Indonesia 2004.

4.2.8.2 Prevalence of boys with wasting

Boys with severe wasting decreased in prevalence through to age group 36 to 41 months, and then increased with the older age groups, see Table 4.20.

Table 4.20: Prevalence of boys aged less than five years with wasting and severe wasting (weight-for-height <-2.00 and <-3.00 Z-score) & 95% confidence intervals, mean Z-score and standard deviation by six-month age groups, North Maluku, Indonesia 2004.

Age Groups in months	Boys										
	Weight for Height										
	N	Wasting				Severe Wasting				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
0-5.	146	22	15	10	23	11	7.5	4.4	13	-0.43	1.94
6-11.	190	35	18	13	25	14	7.4	4.3	12	-0.71	1.68
12-17.	159	22	14	8.8	21	11	6.9	3.7	12	-0.71	1.46
18-23.	114	15	13	7.7	21	7	6.1	2.7	13	-0.46	1.62
24-29.	126	19	15	9.7	23	7	5.6	2.2	13	-0.47	1.52
30-35	94	8	8.5	4.4	16	3	3.2	1.1	9.2	-0.52	1.27
36-41	107	11	10	5.3	19	5	4.7	2	11	-0.39	1.53
42-47	66	11	17	8.7	30	6	9.1	4.2	19	-0.87	1.39
48-53	75	12	16	8.9	28	8	10.7	5.2	21	-1.11	1.6
54-59	38	10	26	15	41	5	13	5.6	28	-1.42	1.47
Total	1115	165	15	13	18	77	6.9	5.3	8.9	-0.63	1.6

**** There were 12 missing value for children with wasting.**

4.2.8.3 Prevalence of girls with wasting

The prevalence of girls with wasting and severe wasting were 12% (95CI 9.6, 15) and 3.9% (95%CI 2.8, 5.5) respectively (See Table 4.21), and varied significantly by age group. The mean weight-for-height Z-score for boys and girls aged group 0 to 59 months were -0.63 and -0.51 respectively indicating that the distribution of this anthropometric indicator had shifted significantly below zero, the expected value of the reference distribution.

Table 4.21: Prevalence of girls aged less than five years with wasting and severe wasting (weight-for-height <-2.00 and <-3.00 Z-score) & 95% confidence intervals, mean Z-score and standard deviation by six-month age groups, North Maluku, Indonesia 2004.

Age Groups in months	Girls										
	Weight for Height										
	N	Wasting				Severe wasting				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
0-5	120	15	13	6.5	24	5	4.2	1.5	11	-0.24	1.85
6-11	175	20	11	7.3	17	3	1.7	0.5	5.4	-0.46	1.4
12-17	159	22	14	8.2	22	11	6.9	3.9	12	-0.65	1.47
18-23	120	12	10	5.7	17	2	1.7	0.4	6.6	-0.48	1.27
24-29	112	11	9.8	5.6	17	1	0.9	0.1	5.9	-0.37	1.15
30-35	75	5	6.8	2.7	16	2	2.7	0.6	10	-0.36	1.26
36-41	108	13	12	6.3	22	6	5.6	2.7	11	-0.55	1.44
42-47	81	12	15	8.4	25	6	7.4	3.5	15	-0.8	1.47
48-53	60	7	12	5.7	22	2	3.3	0.8	13	-0.64	1.31
54-59	43	7	16	7.7	31	3	7.0	2.2	20	-0.91	1.33
Total	1053	124	12	9.6	15	41	3.9	2.8	5.5	-0.51	1.43

**** There were 12 missing value for children with wasting.**

4.2.8.4 Prevalence of children with wasting by District

Table 4.22 shows that the prevalence of children with wasting and severe wasting varied significantly by district. Overall the prevalence of children with wasting and severe wasting were categorised as high and low respectively, based on WHO criteria (WHO, 1995a). The very high prevalence (≥15%) of wasted children was in the districts of Ternate, Tidore, North Halmahera, and South Halmahera. High prevalence level (10 to 14%) of children with wasting was found in Sula Island and Central Halmahera districts. East and West Halmahera districts were medium level (5 to 9%).

The prevalence of children with severe wasting also varied significantly by district. A high prevalence of children with severe wasting was found in South Halmahera districts. Tidore, Ternate and North Halmahera districts had medium level (5 to 9%) of children with severe wasting and Sula Island, East and West Halmahera districts were low (less than 20%). The prevalence of boys with wasting and severe wasting aged 0 to 59 months in North Maluku were categorised as high (10 to14%) and medium (5 to 9%) respectively base on WHO criteria. Both the prevalence of boys with wasting and severe wasting varied significantly by district (Tidore, Central Halmahera and West see Table 4.22).

Table 4.22: Prevalence of wasting in boys and girls aged less than five years by district Prevalence of both sexes children aged less than five years with wasting and severe wasting (weight-for-height <-2.00 and <-3.00 Z-score) & 95% confidence intervals, mean Z-score and standard deviation by districts, North Maluku, Indonesia 2004

Districts	Boys and Girls										
	Weight for Height										
	N	Wasting				Severe wasting				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
Tidore	387	65	17	12	22	25	6.5	4.1	9.9	-0.67	1.66
Sula Island	149	15	10	6.0	17	4	2.7	0.9	8.1	-0.46	1.4
West Halmahera	280	20	7.2	4.7	11	4	1.4	0.5	4.1	-0.34	1.18
North Halmahera	280	42	15	9.2	24	18	6.4	4.1	9.9	-0.45	1.68
Central Halmahera	178	18	10	7.9	13	3	1.7	0.7	4.0	-0.53	1.19
East Halmahera	279	22	7.9	5.5	11	12	4.3	2.4	7.5	-0.47	1.42
Ternate	446	73	16	13	21	33	7.4	5.4	10	-0.65	1.65
South Halmahera	169	34	20	17	24	19	11	7.9	15.68	-1.09	1.49
Total	2168	289	13	11	16	118	5.4	4.4	6.73	-0.58	1.52

**** There were 12 missing value for children with wasting**

The very high prevalence (≥15%) of boys with wasting was in the Central Ternate, East Halmahera, South Halmahera and Sula Island districts. The prevalence of boys with wasting in West Halmahera and North Halmahera districts was high (10 to 14%). The prevalence of boys with wasting in Tidore and Central Halmahera districts were categorised as medium (5 to 9%). The highest prevalence of boys with severe wasting was found in Sula Island and South Halmahera districts. Ternate, West Halmahera and North Halmahera districts were categorised as medium prevalence of boys with severe wasting (5 to 9%) and the lowest prevalence(less than 5%) was found in Tidore, Central Halmahera and West Halmahera districts (See Table 4.23).

Table 4.23: Prevalence of boys aged less than five years with wasting and severe wasting (weight-for-height <-2.00 and <-3.00 Z-score) & 95% confidence intervals, mean Z-score and standard deviation by district, North Maluku, Indonesia 2004.

Districts	Boys										
	Weigh for Height										
	N	Wasting				Severe wasting				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
Ternate	200	31	15	10	23	11	5.5	2.9	10	-0.63	1.64
Tidore	78	6	7.7	3.7	15	2	2.6	0.4	14	-0.53	1.1
Central Halmahera	147	13	8.9	5.2	15	4	2.7	1.0	7.1	-0.4	1.32
East Halmahera	139	23	17	11	24	9	6.5	3.3	12	-0.45	1.79
West Halmahera	91	11	12	9.2	16	2	2.2	0.7	6.8	-0.59	1.28
North Halmahera	148	16	11	8	15	10	6.8	3.5	13	-0.48	1.67
South Halmahera	222	45	20	15	27	25	11	7.8	16	-0.85	1.72
Sula Island	90	20	22	15	32	14	16	10	23	-1.16	1.71
Total	1115	165	15	13	18	77	6.9	5.3	8.9	-0.63	1.6

**** There were 12 missing value for children with wasting.**

The prevalence of girls with wasting and severe wasting aged 0 to 59 months were categorised as high prevalence (10 to14%) and low prevalence (less than 5%) respectively. The prevalence of girls with wasting and severe wasting varied significantly by district (Table 4.24).

Table 4.24: Prevalence of girls aged less than five years with wasting and severe wasting (weight-for-height <-2.00 and <-3.00 Z-score) & 95% confidence intervals, mean Z-score and standard deviation by district, North Maluku, Indonesia, 2004.

Districts	Girls										
	Weight for Height										
	N	Wasting				Severe Wasting				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
Ternate	187	34	18	14	23	14	7.5	4.9	11	-0.71	1.69
Tidore	71	9	13	7.4	22	2	2.8	0.5	15	-0.39	1.68
Central Halmahera	133	7	5.3	3.0	9.2					-0.26	1
East Halmahera	141	19	13	6.5	26	9	6.4	2.7	14	-0.45	1.57
West Halmahera	87	7	8.3	4.0	17	1	1.1	0.7	7.8	-0.47	1.09
North Halmahera	131	6	4.6	2.0	10	2	1.5	0.4	5.3	-0.45	1.06
South Halmahera	224	28	13	8.7	18	8	3.6	2.0	6.2	-0.45	1.55
Sula Island	79	14	18	13	23	5	6.3	2.9	13	-1.01	1.2
Total	1053	124	12	9.6	15	41	3.9	2.8	5.5	-0.51	1.43

**** There were 12 missing value for children with wasting.**

Ternate and Sula Island districts were categorised as very high prevalence and Tidore, East Halmahera and South Halmahera were categorised as high prevalence (10 to 14%) of girls with wasting. Central Halmahera and West Halmahera were categorised as medium prevalence, and low prevalence (less than 5%) was found in North Halmahera only. There were no girls with severe wasting found in the Central Halmahera district.

Figure 4.16 reveals that the entire weight-for-height Z-score distribution for children 0 to 59 months shifted to the left below the reference. This was indicated by more children with wasting in the study than the reference population. The curve is spread out to the left indicating the presence of acute malnutrition in the population. The curve for the boys had shifted further to the left than the curve for the girls indicting that boys had slightly higher levels of malnutrition than girls.

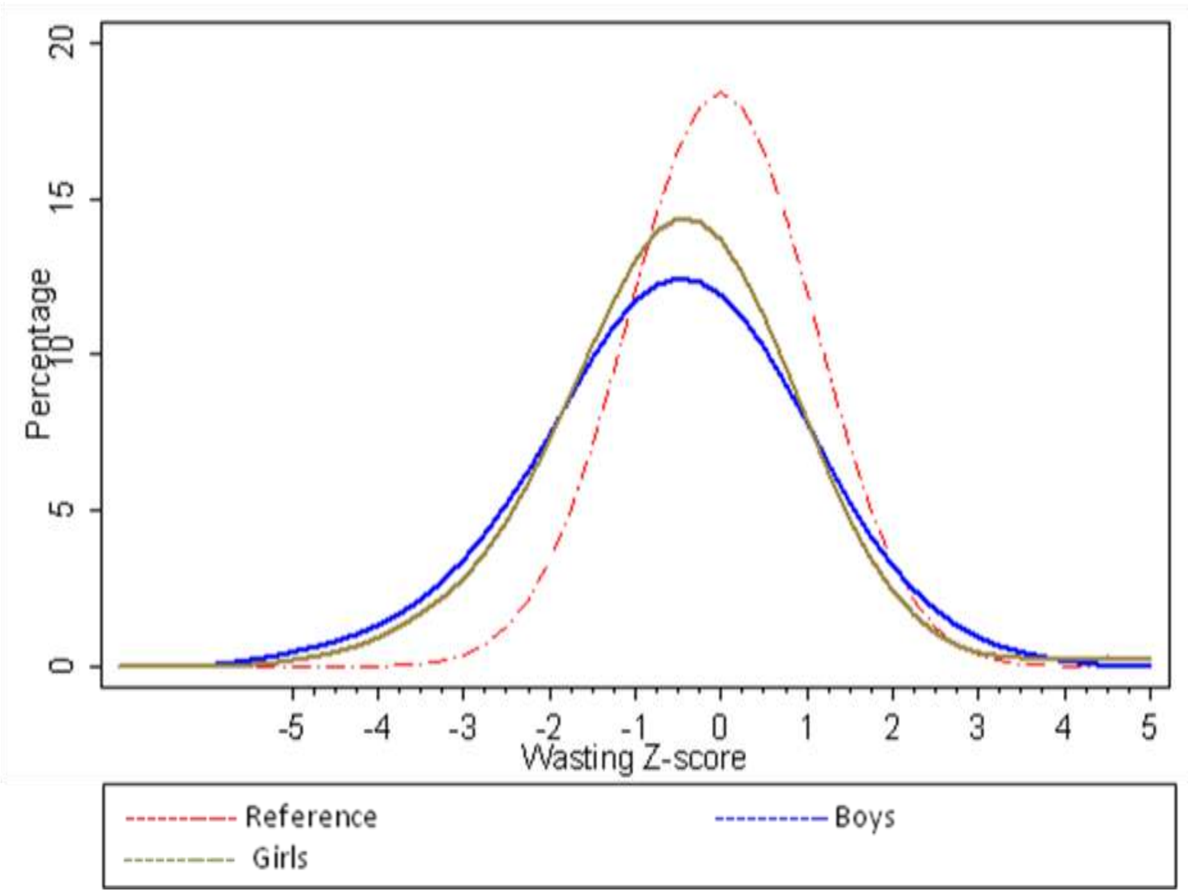


Figure 4.14: Weight-for-height Z-score distributions for boys and girls aged 0 to 59 months in North Maluku

4.2.8.5 Prevalence of children aged 0 to 23 months with wasting and severe wasting according to family and child level characteristics

The prevalence of children aged 0 to 23 months with wasting or severe wasting according to family and child level characteristics is summarised in Table 4.25. There are no statistaclly significant differences in the prevalence of wasting for children aged 0 to 23 months for any family or child level characteristics, as indicated by overlapping 95% confidence intervals.

For children aged 0 to 23 months a statistically significant difference was found for the prevalence of wasting according to geographical district with children from the district of West Halmahera having a lower prevalence compared to children from the district of Sula Isalnd (1.3%, 95%CI 0.2, 7.3 and 11%, 95%CI 8.6, 13, respectively).

For the remaining family and child level characteristics there were no statistically significant differences in the prevalence of severe wasting for children aged 0 to 23 months.

4.2.8.6 Prevalence children aged 24 to 59 months with wasting and severe wasting according to family and child level characteristics

The prevalence of children aged 24to 59 months with wasting or severe wasting according to family and child level characteristics is summarised in Table 4.25.

For children aged 24 to 59 months statistically significant differences in wasting were found for the family level characteristics of father occupation, household wealth and geographical district. Children aged 24 to 59 months whose father was employed as a fisherman had a higher prevalence of wasting compared to children aged 24 to 59 whose father was employed doing any labour (18%, 95%CI 15, 26 and 11%, 95%CI 7.5, 14, respectively). Children aged 24 to 59 months from poorer households have a lower prevalence of wasting compared with children from wealthier households (8.8%, 95%CI 6.0, 13 and 20%, 95%CI 15, 26, respectively). Children aged 24 to 59 months from the districts of Ternate (19%, 95%CI 13, 27) and Sula Island (22%, 95%CI 16, 30) had a higher prevalence of wasting compared with children aged 24 to 59 months from Central Halmahera (3.4%, 95%CI 1.1, 9.8). For all remaining family level characteristics no statistically significant differences were found for the prevalence of wasting in children aged 24 to 59 months.

For children aged 24 to 59 months statistically significant differences in the prevalence of severe wasting were found for the family level characteristic of geographical district. Children from the district of Sula Island had a higher prevalence of severe wasting (12%, 95%CI 6.8, 20) compared with children from the district of Central Halmahera (1.7%, 95%CI 0.4, 6.3). For all remaining family level characteristics no statistically significant differences were found for the prevalence of severe wasting in children aged 24 to 59 months.

For children aged 24 to 59 months a statistically significant difference in the prevalence of wasting and severe wasting was found for the child level characteristic of visits to the local health services in the past three months. Compared with children aged 24 to 59 months who did not visit the local health service in the previous three months (18%, 95%CI 14, 23) children who visited twice (7.8%, 95%CI 4.6, 13) or three or more times (9.0%, 95%CI 6.3, 13) had a lower prevalence of wasting. Compared with children aged 24 to 59 months who did not visit the local health service in the previous three months (9.0%, 95%CI 6.3, 13) children who visited twice (3.9%, 95%CI 2.0, 7.4) or three or more times (2.2%, 95%CI 0.9, 5.2) had a lower prevalence of severe wasting.

For the remaining child level characteristics of gender, immunisation status and sickness in the past two weeks, no statistically significant differences were found for the prevalence of wasting and severe wasting in children aged 24 to 59 months.

4.2.8.7 Prevalence children aged 0 to 59 months with wasting and severe wasting according to family and child level characteristics

The prevalence of children aged 0 to 59 months with wasting or severe wasting according to family and child level characteristics is summarised in Table 4.25.

For children aged 0 to 59 months statistically significant differences were found in the prevalence of wasting and severe wasting for the family level characteristic of geographical district. Compared with children aged 0 to 59 months from the district of Central Halmahera (7.0% 95%CI 4.6, 11), children from the districts of Ternate (17%, 95%CI 12, 22), South Halmahera (16% 95%CI 13, 21and Sula Isalnd 20%, 95%CI 17, 24) had statistically significant increased prevalence rates of wasting. Compared to children aged 0 to 59 months from the district of West Halmahera (1.7%, 95%CI 0.7, 4.0), children aged 0 to 59 months from the districts of Ternate (6.5%, 95%CI 4.1, 9.9), East Halmahera (6.4%, 95%CI 4.1, 9.9), South Halmahera (7.4%, 95%CI 5.4, 10) and Sula Island (11%, 95%CI 7.9, 16) had statistically significant increased prevalence rates of severe wasting.

For all remaining family level characteristics no statistically significant differences were found for the prevalence of wasting or severe wasting in children aged 0 to 59 months.

For children aged 0 to 59 months a statistically significant difference in the prevalence of wasting and severe wasting was found for the child level characteristic of visits to the local health services in the past three months. Compared with children aged 0 to 59 months who did not visit the local health service in the previous three months (18%, 95%CI 15, 21) children who visited three or more times (10%, 95%CI 7.4, 14) had a lower prevalence of wasting. Compared with children aged 0 to 59 months who did not visit the local health service in the previous three months (8.1%, 95%CI 5.9, 11) children who visited once (4.8%, 95%CI 2.9, 7.5), twice (4.8%, 95%CI 3.2, 7.2) or three or more times (3.5%, 95%CI 2.1, 5.7) had a lower prevalence of severe wasting

For all remaining child level characteristics no statistically significant differences were found for the prevalence of wasting or severe wasting in children aged 0 to 59 months

Table 4.25 Family and child level characteristics of children aged 0 to 23, 24 to 59 and 0 to 59 months with wasting and severe wasting in North Maluku Province, Indonesia 2004

	0-23 Months (n= 1183)							24-59 Months (n= 985)							0-59 Months (n= 2168)						
	Weight for Height							Weight for Height							Weight for Height						
Characteristic		Wasted			Severely wasted				Wasted			Severely wasted				Wasted			Severely wasted		
	N	n	%	95%CI	n	%	95%CI	N	n	%	95%CI	n	%	95%CI	N	n	%	95%CI	n	%	95%CI
Family level factors																					
Father education																					
Completed Elementary School	450	69	15	12, 20	28	6.2	4.3, 9.0	382	42	11	7.7, 15	18	4.7	2.9, 7.6	832	111	13	11, 17	46	5.5	4.1, 7.5
Completed Junior High School	289	40	14	10, 19	21	7.3	4.5, 12	268	30	11	15, 17	15	5.6	3.2, 10	557	70	13	10, 16	36	6.5	4.6, 9.1
Completed Senior High School	444	54	12	9.0, 16	15	3.4	2.0, 5.8	335	54	16	12, 21	21	6.3	4.0, 10	779	108	14	11, 17	36	4.6	3.4, 6.3
Mother Education																					
Completed Elementry School	611	100	16	13, 20	41	6.7	4.7, 9.4	552	62	11	28, 15	28	5.1	3.6, 7.2	1163	162	14	11, 17	69	5.9	4.5, 7.7
Completed Junior High School	286	30	10	7.0, 16	12	4.2	2.4, 7.1	228	30	13	12, 18	12	5.3	3.2, 8.6	514	60	12	8.9, 15	24	4.7	3.3, 6.5
Completed Senior High School	286	33	12	8.0, 16	11	3.8	2.0, 7.1	205	34	17	14, 22	14	6.8	4.1, 11	491	67	14	11, 17	25	5.1	3.4, 7.5
Father Occupation																					
Any Labor	741	107	14	12, 18	44	5.9	4.4, 8.0	655	69	11	7.9, 14	28	4.3	3.0, 6.1	1396	176	13	10, 15	72	5.2	4.0, 6.6
Fisher man	208	37	18	12, 25	17	8.2	5.3, 13	147	27	18	15, 26	15	10.2	6.7, 15	355	64	18	14, 24	32	9.0	6.4, 13
No work	39	4	10	4.1, 23	1	2.6	0.3, 17	21	0	0		0	0.0		60	4	6.7	2.6, 16	1	1.7	0.2, 12
Government /Private officer	195	15	8	4.2, 14	2	1.0	0.1, 6.9	162	30	19	11, 27	11	6.8	3.4, 13	357	45	13	9.2, 17	13	3.6	1.9, 6.9
Mother Occupation																					
Any Labor	381	54	14	9.7, 20	20	5.2	3.1, 8.8	313	30	10	12, 15	12	3.8	2.2, 6.7	694	84	12	9.1, 16	32	4.6	3.0, 6.9
Fisher man	49	8	16	7.7, 31	4	8.2	3.3, 19	47	8	17	4.0, 34	4	8.5	2.8, 23	96	16	17	9.4, 28	8	8.3	4.3, 16
No work	705	96	14	11, 17	39	5.5	3.9, 7.8	597	84	14	11, 18	35	5.9	4.1, 8.3	1302	180	14	12, 16	74	5.7	4.4, 7.3
Government /Private officer	48	5	10	4.3, 23	1	2.1	0.3, 14	28	4	14	3.0, 32	3	10.7	3.6, 28	76	9	12	6.5, 21	4	5.3	2.0, 13
Parental Education																					
Both with high education	497	56	11	8.0, 16	23	4.6	2.8, 7.4	374	57	15	12, 20	25	6.7	4.6, 10	838	107	13	10, 16	44	5.3	3.6, 7.5
Father with high education	75	7	9	3.9, 21	0	0.0		59	7	12	1.0, 23	1	1.7	0.2, 11	1270	178	14	12, 17	73	5.7	4.4, 7.5
Mother with high education	236	38	16	11, 23	13	5.5	3.0, 9.8	229	27	12	11, 17	11	4.8	2.6, 8.6	28	2	7.1	1.7, 25	0	0.0	
Neither with high education	375	62	17	13, 21	28	7.5	5.2, 11	323	35	11	7.3, 16	17	5.3	3.1, 8.7	32	2	6.3	1.7, 21	1	3.1	0.4, 21
Parental Employment																					
Both working	463	65	14	10, 19	25	5.4	3.3, 8.8	375	42	11	7.9, 16	19	5.1	3.2, 7.9	838	107	13	10, 16	44	5.3	3.6, 7.5
Father only working	681	94	14	11, 17	38	5.6	3.9, 7.9	589	84	14	11, 18	35	5.9	4.2, 8.4	1270	178	14	12, 17	73	5.7	4.4, 7.5
Mother only working	15	2	13	2.8, 45	0	0.0		13	0	0		0	0.0		28	2	7	1.7, 25	0	0.0	
Neither working	24	2	8.3	2.4, 25	1	4.2	0.5, 26	8	0	0		0	0.0		32	2	6.3	1.7, 21	1	3.1	0.4, 21

	0-23 Months (n= 1183)							24-59 Months (n= 985)							0-59 Months (n= 2168)						
	Weight for Height							Weight for Height							Weight for Height						
Characteristic		**Wasted**			**Severely wasted**				**Wasted**			**Severely wasted**				**Wasted**			**Severely wasted**		
	N	**n**	**%**	**95%CI**	**n**	**%**	**95%CI**	**N**	**n**	**%**	**95%CI**	**n**	**%**	**95%CI**	**N**	**n**	**%**	**95%CI**	**n**	**%**	**95%CI**
Household wealth Index																					
Poorest	459	64	14	10, 19	23	5.0	3.3, 7.5	408	36	8.8	6.0, 13	16	3.9	2.3, 6.7	867	100	12	9.0, 15	39	4.5	3.2, 6.4
Middle	472	69	15	11, 18	29	6.1	4.1, 9.0	395	54	14	10, 18	21	5.3	3.4, 8.1	867	123	14	12, 17	50	5.8	4.2, 7.8
Richest	252	30	12	7.4, 19	12	4.8	2.6, 8.7	182	36	20	15, 26	17	9.3	5.6, 15.	434	66	15	12, 19	29	6.7	4.5, 9.7
Region																					
Rural	291	37	13	8.3, 19	16	5.5	2.9, 10.3	245	43	18	12, 25	13	5.3	2.5, 10.7	536	80	15	11, 19	29	5.4	3.5, 8.3
Urban	892	126	14	11, 18	48	5.4	4.0, 7.3	740	83	11	8.8, 14	41	5.5	4.0, 7.5	1632	209	13	11, 15	89	5.5	4.3, 7.0
District																					
Ternate	197	29	15	8.8, 24	14	7.1	3.6, 13.5	190	36	19	13, 27	11	5.8	2.6, 12.4	387	65	17	12, 22	25	6.5	4.1, 9.9
Tidore	94	8	9	4.7, 15	2	2.1	0.4, 11.6	55	7	13	4.4, 31	2	3.6	0.6, 19.9	149	15	10	6.0, 17	4	2.7	0.9, 8.1
Central Halmahera	161	16	10	5.8, 16	2	1.2	0.4, 4.2	119	4	3.4	1.1, 9.8	2	1.7	0.4, 6.3	280	20	7	4.6, 11	4	1.4	0.5, 4.1
East Halmahera	173	30	17	8.8, 31	13	7.5	3.9, 13.9	107	12	11	6.2, 20	5	4.7	2.6, 8.1	280	42	15	9.2, 24	18	6.4	4.1, 9.9
West Halmahera	80	9	11	8.2, 15	1	1.3	0.2, 7.3	98	9	9.2	5.9, 14	2	2.0	0.6, 7.2	178	18	10	7.7, 13	3	1.7	0.7, 4.0
North Halmahera	135	10	7	3.7, 14	4	3.0	1.2, 7.1	144	12	8.3	5.0, 14	8	5.6	2.7, 11.3	279	22	8	5.5, 11	12	4.3	2.4, 7.5
South Halmahera	259	46	18	13, 24	19	7.3	4.7, 11.4	187	27	14	9.7, 21	14	7.5	5.1, 10.8	446	73	16	13, 21	33	7.4	5.4, 10
Sula Island	84	15	18	14, 23	9	11	8.6, 13	85	19	22	16, 30	10	12	6.8, 20	169	34	20	17, 24	19	11	7.9, 15.7
Household member														,							
?5 members	750	116	15	12, 20	43	5.7	4.1, 7.9	609	76	12	9.7, 16	31	5.1	3.5, 7.4	1359	192	14	12, 17	74	5.4	4.2, 7.0
6-12 members	433	47	11	7.9, 15	21	4.9	2.9, 7.9	376	50	13	9.7, 18	23	6.1	3.9, 9.4	809	97	12	10, 15	44	5.4	3.9, 7.6
Child level factors																					
Gender																					
Boy	609	94	15	12, 19	43	7.1	5.1, 9.7	506	71	14	11, 18	34	6.7	4.7, 9.6	1115	165	15	12, 17	77	6.9	5.3, 8.9
Girl	574	69	12	8.9, 16	21	3.7	2.2, 6.0	479	55	11	8.5, 15	20	4.2	2.7, 6.4	1053	124	12	10, 14	41	3.9	2.8, 5.5

Characteristic	0-23 Months (n= 1183) Weight for Height							24-59 Months (n= 985) Weight for Height							0-59 Months (n= 2168) Weight for Height						
		Wasted			Severely wasted				Wasted			Severely wasted				Wasted			Severely wasted		
	N	n	%	95%CI	n	%	95%CI	N	n	%	95%CI	n	%	95%CI	N	n	%	95%CI	n	%	95%CI
Immunisation Status																					
Never	177	33	19	12, 27	13	7.3	4.5, 12	82	7	8.5	4.6, 16	4	4.9	1.9, 12	259	40	15	11, 22	17	6.6	4.2, 10
Ever	1006	130	13	10, 16	51	5.1	3.7, 6.9	903	119	13	11, 16	50	5.5	4.1, 7.5	1909	249	13	11, 15	101	5.3	4.2, 6.6
Sick in the last 2 weeks																					
No	690	93	13	10, 17	31	4.5	3, 6.8	647	69	11	37, 14	37	5.7	3.9, 8.4	1337	162	12	10, 15	68	5.1	3.8, 6.7
Yes	493	70	14	11, 18	33	6.7	4.7, 9.5	338	57	17	17, 22	17	5.0	3.1, 8.2	831	127	15	13, 18	50	6.0	4.5, 8
Local health services visits in past 3 months																					
0	196	33	17	12, 23	13	6.6	4.1, 11	344	62	18	14, 23	31	9.0	6.3, 13	540	95	18	15, 21	44	8.1	5.9, 11
Once	173	24	14	9.3, 20	11	6.4	3.5, 11	142	17	12	6.9, 20	4	2.8	1.1, 7.2	315	41	13	8.9, 19	15	4.8	2.9, 7.5
2 times	355	51	14	11, 19	19	5.4	3.4, 8.4	204	16	7.8	4.6, 13	8	3.9	2.0, 7.4	559	67	12	9.1, 16	27	4.8	3.2, 7.2
>=3 times	326	37	11	7.2, 17	14	4.3	2.4, 7.5	223	20	9.0	6.3, 13	5	2.2	0.9, 5.2	549	57	10	7.4, 14	19	3.5	2.1, 5.7

Refer also to Appendix 4.2 for age group distribution data by wealth index, Appendix 4.3 for wealth index distribution by district for children in North Maluku

4.2.9 Composite Index of Anthropometric Failure

The prevalence of children with underweight (weight-for-age <-2.00 Z-score), stunting (height-for-age <-2.00 Z-score), wasting (weight-for-height <-2.00 Z-score), and the prevalence of under nutrition as measured by the Composite Index of Anthropometric Failure (CIAF) is shown in Table 4.26 by gender. Children with stunting only were the largest percentage in the sample. The lowest percentage of under nutrition by CIAF was those children who simultaneously had wasting, stunting and underweight.

Table 4.26: Composite Index of Anthropometric Failure among children aged 0 to 59 months in North Maluku Province, Indonesia 2004

CIAF	Both Sexes		Boys		Girls	
	n	%	n	%	n	%
Adequate	1,141	53	563	50	578	55
Underweight only	90	4.2	41	3.7	49	4.7
Stunting only	300	14	163	15	137	13
Stunting and underweight	362	17	197	18	165	16
Wasting only	92	4.2	48	4.3	44	4.2
Wasting and underweight	126	5.8	71	6.4	55	5.2
Underweight, stunting and wasting	57	2.6	32	2.9	25	2.4
Total	2,168	100	1115	100	1053	100

The prevalence of children with underweight, stunting, wasting and the prevalence of under nutrition as measured by the Composite Index of Anthropometric Failure (CIAF) is shown in Table 4.27 by district. According to this data, approximately half the children in the eight districts had adequate nutrition, with the distrcict of Tidore reporting the highest prevalence of adequate nutrition (67%). The prevalence of children with underweight, wasting and stunting ranged from 1.1% in Central Halmahera to 7.0% in West Halmera with the average prevalence across all eight districts of 4.1%.

Table 4.27: Composite Index of Anthropometric Failure among children aged 0 to 59 months by District in North Maluku Province, Indonesia 2004

	Ternate		Tidore		Central Hamahera		East Halmahera		West halmahera		North Hamahera		South Halmahera		Sula Island		North Maluku	
CIAF	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Adequate	197	51	100	67	155	55	138	49	102	57	143	49	219	49	87	52	1141	53
Underweight only	20	5.2	5	3.4	10	3.6	16	6	3	2	9	5	24	5	5	3	92	4.2
Stunting only	29	7.5	6	4	3	1.1	16	6	8	5	12	7	31	7	21	12	126	5.8
Stunting and underweight	11	2.8	2	1.3	3	1.07	6	2	2	1	6	3	14	3	13	8	57	2.6
Wasting only	56	15	13	8.7	62	22	55	20	21	12	53	18	79	18	23	14	362	17
Wasting and underweight	52	13	17	11	44	16	37	13	29	16	41	15	65	15	15	9	300	14
Wasting, stunting and underweight	22	5.7	6	4	3	1.1	12	4	13	7	15	3	14	3	5	3	90	4.1
Total	387	100	149	100	280	100	280	100	178	100	279	100	446	100	169	100	2168	100

The proportion of children who were underweight was 25%, the proportion of children with stunting was 38% and the proportion of children with wasting was 13% . The proportion of under nutrition in children aged 0 to 59 months in North Maluku in 2004 using the CIAF was 46% (see Table 4.28).

Table 4.28: Prevalence of under nutrition among children aged 0 to 59 months in North Maluku Province, Indonesia 2004

Under nutrition	N	%
Stunted	832	38
Wasted	289	13
Underweight	548	25
CIAF	1027	46

4.3 Discussion

This is the first study to document the nutritional status, using anthropometric measurements, (of children aged 0 to 59 months in North Malukuusing the 2006 WHO growth standards. Data on young children in this region who are underweight and severely underweight, stunted and severely stunted, wasted and severely wasted are described by age-group, gender and district to help inform nutritional policy. Data for this analysis, including the age of the children, were collected in 2004 during which the local situation in North Maluku province remained unstable following a period of civil unrest.

The findings from this research supported our hypothesis that the prevalence of underweight children aged 24-59 months would be higher than children aged 0-23 months (33% versus 20%, $p = 0.01$). The food intake of the younger children would usually be provided by their parents, while the older children may be left to fend for themselves or may decline to eat what is provided.
Our hypothesis that the prevalence of stunting children aged 24-59 months would be higher than aged 0-23 months (50% versus 30%, $p =0.01$) was also supported. The high prevalence of children with stunting aged 24-49 months may be a consequence of long term inadequate food intake during the period of civil unrest in North Maluku which resulted in insufficient nutrient requirements for growth when they lived in refugee camps. This indicates that the current nutritional status of the children was impacted by the long period of civil unrest in North Maluku.

Our hypothesis that the prevalence of wasting in children aged 24-59 months would be higher than aged 0-23 months (13% versus 14%, p = 0.45) was not supported. Younger children (0-23 months) usually have their food intake intensively provided by their mother by having only exclusive breast feeding, milk formula or combination between both sources which will meet their nutrient requirements to grow compare with the older children (24-59 months) who have a variety of food sources with food not provided as intensively as to the younger children. In developing countries family size is one of the main barriers in regard to household food intake. The more family members in the household, the higher the risk of older children having undernutrition.

Our hypothesis that the prevalence of underweight and stunting in boys would be higher than in girls (28% versus 22%, p = 0.01 for underweight and 41% versus 35%, p = 0.01 for stunting) respectively were supported. This may be because boys are more likely to be recognized to suffer from under nutrition than girls due to increased additional nutritional requirements in boys than in girls and the influences of early childhood diseases in boys (Sharma et al, 2006)

Our hypothesis that the prevalence of wasting in girls would be higher than in boys (12% versus 15%, p =0.03) was not supprted. This study found that the prevalence of wasting children was higher in boys than in girls. Boys are more vulnerable to undernutrition than girls, because boys have more nutritional needs to grow than girls (Sharma et al, 2006).

The customs in North Maluku which still exist now are that during meal times the parents have to be served first followed by the rest of family members. This contributes to why under nutrition is still high in North Maluku. Poor hygiene before meals also contributes to older children having a higher risk of under nutrition. After playing outside the house older children rarely wash their hands before having their meals. Even when they wash their hands they do so inadequately due to Insufficient fresh water. Fresh water is used mostly reserved for drinking water supply in the household. The family who live in the islands sometimesneed to buy fresh water from another island because of insufficient fresh water resources

We hypothesised that children living in urban geographical locations will have better nutritional status compared with children living in rural geographical regions, however this was not supported for the indicators of underweight or wasting. The prevalence of underweight children living in urban districts was similar to the prevalence of underweight children living in rural districts (26 versus 24%, p= 0.49) as was the prevalence of children with wasting living in urban districts compared to children living in rural districts (13% versus 15% p= 0.37). However, the prevalence of children with stunting living in urban districts was higher than children living in rural districts (40% versus 33%, p = 0.03).

Geographically, North Maluku is made up of many islands and the main form of transportation between islands is by boat. Children who live in urban areas generally have better access to health services, better food availability; and moreintensively receive health promotion programs from the local government compared with children who live in rural or remote areas. Because of the transportation barrier, the nutritional and immunization programs may be delayed or postponed due to the conditions at sea hampering transport. Many other factors are associated with the high prevalence of under nutrition children in North Maluku including family income and parental educational levels. Many people in rural and remote areas are fishermen who sell the better quality fish in their catch to provide an income for their family and purchase food staples such as rice. As a new province in Indonesia, the North Maluku government needs to undertake more research to prevent and manage under-nutrition in North Maluku.

Children with wasting only who live in urban areas have better nutritional status than children who live in rural areas. Lack of food resources, inadequate food intake and poor of adequate food, poor physical stamina and a weak immune system, leave the children open to infection during civil unrest. The nutritional status of children after the riot was strongly influenced by the condition of the refugee camps. Unfortunately however, there is no data available about nutritional status of young children before (or during) the riot for comparison.

Ternate and Tidore districts (categorised as urban) are the main base camps for the refugee during civil unrest, For children who live in the refugee camps, their nutritional status will be dramatically plunged, because of inadequate of food consumption, lack of fresh water, poor hygiene and mentally sick because the insecure environments are surrounded them (Beatrice et al, 2011).

It took almost two years in North Maluku to solve the riot between Muslims and Christians; solved by Indonesian government. This civil unrest resulted in the nutritional status of young children declining. Without aid from other countries or from Non Government Organizations (NGO), the refugee camps will not be appropriate places for the refugees to stay, especially for children. An urgent need for nutritional intervention for the children is required to allow them to thrive and grow.

Stunting is caused by insufficient food intake over a long duration of time and frequent infections and it is a primary manifestation of malnutrition in early childhood (Olaf et al, 2005). Based on the high prevalence of stunting in children in North Maluku (58%) reported in this study, using the 2006 child growth standards, children in Ternate and Tidore suffered from inadequate food intake during the riot when living in refugee camps. Stunting can result in delayed motor development, impaired cognitive function and poor school performance for young children.

The age distribution of nutritional status indicators in this study revealed no extreme pattern related to age at six-month intervals. If there was no selection bias or age reporting bias each column for each month of age would be approximately equal. There are some higher values at six, 12, 24, 36 and 48-months, although not sufficient to greatly distort the anthropometric indices. A greater proportion of children are aged in the youngest age groups. There may have been a tendency to underestimate children aged over 36 months as older children are more mobile and independent of their mothers or care givers. They may have run away when the survey team arrived and were therefore not available for anthropometric measurements to be taken. Therefore the representativeness of the older age group is less certain.

The standard deviation of an anthropometric index reflects the intrinsic variability of this index in this population and variability due to anthropometric measurement error. The WHO has reported usual ranges for the standard deviation of anthropometric indices observed in a large number of surveys, which serve as a guide to access the quality of anthropometric data (WHO, 1995b). Survey data with standard deviation values higher than the WHO value implies there may be error with the age anthropometric data. Values less than these imply a population with intrinsic variation and no problem with age or anthropometric data (CBS, 2005).

The standard deviation Z-score for underweight, stunting, and wasting in children aged 0 to 59 months in North Maluku was 2.25 (WHO 1995 range standard is 1.10 to 1.30), 1.52 (WHO 1995 range standard is 1.10 to 1.30) and 1.31 (WHO 1995 range standard is 1.00 to 1.20), respectively. All of the nutritional status indicators in this study were higher than the WHO 1995 range standard. The absence of an accurate estimation of the child's age may have influenced the standard deviation Z-score in this study.

The standard deviations for this study were wider than the WHO standards for all anthropemtric indices, indicating that the data was of less than optimal quality. However, undertaking this study and reporting this data is important to provide indepth baseline nutritional data from which to develop relevant health policy and to undertake further research including the evaluation of intervention programs in North Maluku, despite its level of potential inaccuracy.

Verification of the child's age particularly during a period of unrest was not complete. The parent or other family member may have lost the child's birth certificate or a birth certificate may not have been available as most of the children born in rural areas have a traditional midwife as the only paramedic to help them. The enumerator could make an inadvertent error in calculating the child's age as the parents may estimate the age of their children.

The prevalence of the nutritional status indicators of stunting (38%), wasting (13%) and underweight (25%) for children aged 0 to 59 months in North Maluku, less than two standard deviations from the mean, were high. The prevalence of children with severe underweight and severe stunting were low and the prevalence of severely wasted children indicated medium prevalence.

For the three nutritional status indicators the prevalence of under nutrition of boys was higher than girls, using the WHO classification for assessing severity of undernutrition by prevalence ranges among children aged less than five years (WHO, 1995b). Undernutrition remains a substantial public health problem in disadvantaged households and districts in North Maluku.

In 2001 the Centre for Food, Nutrition, and Health (CFNH), Hasanuddin University, collected the nutritional status of the children aged 0 to 59 months in the Ternate district (the capital city of North Maluku) by using the 1978 NCHS/WHO 1978 growth references (WHO, 1978), and found that the prevalence of underweight and severely underweight children in the Ternate district was 26% and 7.2% respectively; the prevalence of children with stunting and severe stunting was 36% and 16% respectively; and the prevalence of children with wasting and severe wasting was 17% and 6.5% respectively. In this study we found the prevalence of underweight and severely underweight children to be similar (29% and 7.8%, respectively); the prevalence of stunting and severe stunting to be similar (38% and 18%, respectively); and the prevalence of wasting and severe wasting was lower (13% and 5.4%, respectively). Based on the WHO classification (WHO, 1995a) the prevalence of underweight children aged less than five years in North Maluku was categorised as low (less than 10%) but the prevalence of severely underweight children, children with stunting and children with wasting were categorised as high.

In 2004 another study was conducted in North Maluku to determine the nutritional status of the children in all eight districts within the province using the 1978 NCHS/WHO growth reference (Razak, 2004). From this study, the prevalence of underweight children and children with stunting and wasting was 33%, 33% and 13% respectively, however there was no underweight, stunting and wasting prevalence for less than three standard deviations available (Razak, 2004; Sánchez-Pérez et al.). The prevalence of underweight (29%) and wasting (13%) were similar in this study compared with the study by Razak while the prevalence of stunting (38%) was slightly higher in this study. The comparion of our data to this earlier study gives external validity to our results suggesting they are reasonable estimates of nutritional status.

This study is the first to analyse the nutritional status of the children aged 0 to 59 months in Indonesia by using the 2006 WHO growth reference. There are few data available for North Maluku as this is a new province in Indonesia. The local government is still developing policy and programs for all departments, including nutrition, since the period of civil unrest. The current findings of the prevalence of underweight, stunting and wasting in North Maluku children are reasonably similar to those reported in pre-school aged children from Egypt (35%, 51% and 19%, respectively), Kenya (22%, 35% and 6% respectively), Mexico (23%, 16% and 2% respectively) and Korea 20%, 39% and 8% respectively) (Calloway, 1989; Chang SM et al., 2002; Franz and FitzRoy; Gross and Webb; Pelletier et al., 1995; Purnima Menon, 2000; Smith, 2000; Walker et al., Wang, 2001).

The nutritional status indicators commonly recommended to be used are underweight (low weight-for- age), stunting (low height-for-age), and wasting (low weight-for-height). Because some of the indicators overlap, no indicator on its own is able to provide a comprehensive estimate of the number of children undernourished. For example, a proportion of children in a population who are categorized as stunted may also have wasting and/or be underweight; and some children categorized as underweight may also have wasting and/or be stunted; and some children who have wasting may also be stunted and/or underweight . The Composite Index of Anthropometric Failure (CIAF) is usually used to identify the true nutritional failure in the community, and has been shown to have a strong association with infection and poverty in communities (Berger et al., 2006).

Using the 2006 WHO international growth reference (2006) the data from this study suggests that 38% of children were stunted, 13% wasted and 25% were underweight. However, by using the CIAF method we were able to distinguish children with multiple failures. For example, of the 38% stunted, CIAF identified 14% as stunted only, 17% were both stunted and underweight and 2.6% were stunted, underweight and wasted. The ability to identify children with multiple nutritional failures may have profound implications for nutritional intervention and treatment. This study data suggests that the complexity as well as the prevalence of under nutrition will be different using WHO 2006 growth standards categories for children who experience multiple anthropometric failures.

The Composite Index of Anthropometric Failure (CIAF) among children aged 0-59 months by districts in North Maluku shows that the prevalence of underweight only and wasting only in children from the urban districts of Ternate and Tidore are lower when compared with the result from the recent current 2006 WHO international child growth standards. The prevalence of stunting only in children from Ternate and Tidore is higher than the recent current 2006 WHO international growth standards. For the rural districts, it shown from using CIAF the prevalence of underweight only, stunting only and wasting only are lower compared to the current 2006 WHO international growth standards. The results suggest urgent implementation of nutritional intervention programs using CIAF indicators, especially in some key districts of North Maluku.

Based on CIAF data, Ternate district will be the main priority district to implement nutritional programs for children because of its large population size and high prevalence of stunting only, follow by Sula Island which has a higher prevalence but a much smaller population, and then other districts to follow. Also in the Ternate district the prevalence of children who suffer from wasting only or from wasting and underweight is 15% and 13%, respectively. While other districts have a similar of higher prevalence, Ternate has a large population and so this impacts on a large number of children.

Thus, CIAF may better predict the risk associated with anthropometric failure in children aged less than five years of age and allow for prioritisation of nutritional intervention strategies. CIAF also provides a single number for the overall estimate of undernourished children in a population. Additionally, using the CIAF, anthropometric data can be disaggregated for further analysis, for example to analyze the specific risk factors and correlates or the mortality and morbidity patterns for the different types of anthropometric failure. Such disaggregation enables the identification of groups of children missed by conventional indices. (Berger et al., 2006).

Generally, South Halmahera is the main priority district for a nutritional intervention program in North Maluku based on CIAF, followed by Ternate, East Halmahera, North Halmahera, Sula Island and Tidore Districts, respectively.

Wasting is referred to as acute malnutrition because it is believed that episodes of wasting have a short duration, in contrast to stunting, which is regarded as chronic malnutrition. Wasting can be caused by an extremely low energy intake, nutrient losses due to infection, or a combination of low intake and high loss.

Specifically, wasting as an acute malnutrition was highly prevalent in all districts in North Maluku. A nutritional intervention program would ideally be established immediately by policy makers in all districts of North Maluku to prevent the children suffering from acute malnutrition (wasting) from developing chronic malnutrition (stunting). Given these associations, it may be expected that children who are simultaneously wasted, stunted and underweight are at greatest risk of illness (Wagstaff and Watanabe, 2000).

In summary, the findings reveal that public health nutrition intervention programs for pre-school children will need to be provided to improve the nutritional status of children with under nutrition in North Maluku, Indonesia.

4.4 References

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4.5 Appendices

Appendix 4 1Single-month age distribution for pre-school aged children in North Maluku province, Indonesia 2004

Table 4.29: Percentage of children less than five years in each single-month age intervals, North Maluku Province , Indonesia 2004

Age in Months	N	Percent	Cummulative	Age in Months	N	Percent	Cummulative
0	7	0.3	0.3	31	36	1.7	68.7
1	45	2.1	2.4	32	20	0.9	69.7
2	47	2.2	4.6	33	25	1.2	70.8
3	48	2.2	6.8	34	26	1.2	72.0
4	63	2.9	9.7	35	29	1.3	73.3
5	56	2.6	12.3	36	61	2.8	76.2
6	80	3.7	16.0	37	37	1.7	77.9
7	57	2.6	18.6	38	30	1.4	79.2
8	47	2.2	20.8	39	19	0.9	80.1
9	54	2.5	23.3	40	34	1.6	81.7
10	63	2.9	26.2	41	34	1.6	83.3
11	64	3.0	29.1	42	29	1.3	84.6
12	73	3.4	32.5	43	26	1.2	85.8
13	64	3.0	35.4	44	25	1.2	87.0
14	47	2.2	37.6	45	13	0.6	87.6
15	54	2.5	40.1	46	29	1.3	88.9
16	43	2.0	42.1	47	25	1.2	90.0
17	37	1.7	43.8	48	44	2.0	92.1
18	42	1.9	45.7	49	21	1.0	93.0
19	39	1.8	47.5	50	22	1.0	94.1
20	48	2.2	49.7	51	21	1.0	95.0
21	36	1.7	51.4	52	14	0.7	95.7
22	36	1.7	53.0	53	13	0.6	96.3
23	33	1.5	54.6	54	16	0.7	97.0
24	78	3.6	58.2	55	19	0.9	97.9
25	43	2.0	60.2	56	16	0.7	98.6
26	29	1.3	61.5	57	14	0.7	99.3
27	33	1.5	63.0	58	9	0.4	99.7
28	27	1.3	64.3	59	7	0.3	100.0
29	28	1.3	65.5	60	0	0.0	
30	33	1.5	67.1	**Total**	2168	100.0	

Appendix 4 2 Six-month age group distribution by wealth index for children aged 0 to 59 months in North Maluku province, Indonesia 2004

Table 4.30: Six-month age group distribution by wealth index of children aged less than five years in North Maluku Province, Indonesia 2004

Age groups in months		Poorest		Middle		Richest	
	N	n	%	n	%	n	%
0-5.	266	94	35	113	42	59	22
6-11.	365	143	39	149	41	73	20
12-17.	318	117	37	127	40	74	23
18-23.	234	105	45	83	35	46	20
24-29.	238	101	42	98	41	39	16
30-35	169	78	46	66	39	25	15
36-41	215	89	41	81	38	45	21
42-47	147	57	39	63	43	27	18
48-53	135	59	44	50	37	26	19
54-59	81	24	30	37	46	20	25
Total	**2168**	**867**	**40**	**867**	**40**	**434**	**20**

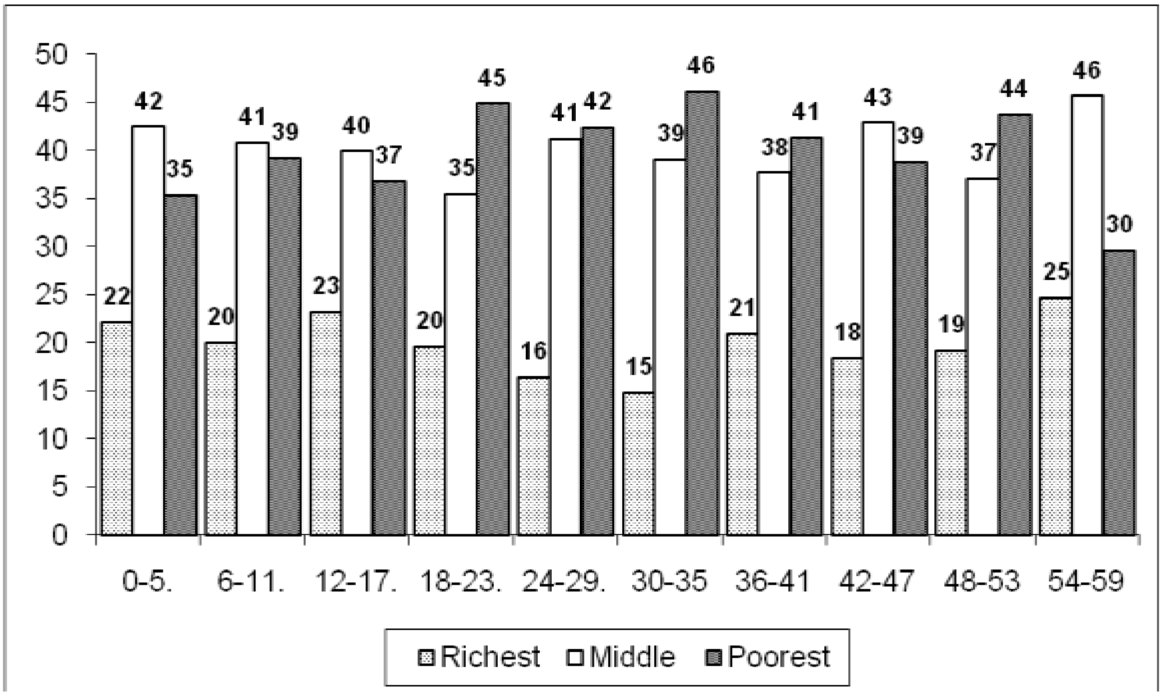

Figure 4.15: Six-month age group distribution by wealth index of children aged less than five years in North Maluku Province, Indonesia 2004

Table 4.31: Prevalence for children aged less than five years who were underweight and severely underweight (weight-for-age <-2.00 and <-3.00 Z-score) with 95% confidence intervals, mean Z-score and standard deviation by six month age groups, North Maluku, Indonesia 2004

Age Groups in months	Boys and Girls										
	Weight for Age										
	N	Underweight				Severely Underweight				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
0-5	266	25	9.4	6.4	14	7	2.6	1.3	5.5	-0.25	1.35
6-11	365	66	18	14	23	18	4.9	3.1	7.7	-0.86	1.35
12-17	318	69	22	17	27	24	7.5	4.9	12	-1.14	1.22
18-23	234	72	31	25	37	14	6.0	3.3	11	-1.26	1.31
24-29	238	62	26	21	31	25	11	7.3	15	-1.3	1.29
30-35	169	50	30	23	38	13	7.7	4.4	13	-1.48	1.13
36-41	215	62	29	23	36	19	8.8	5.4	14	-1.54	1
42-47	147	47	32	24	41	22	15	9.8	22	-1.73	1.11
48-53	135	62	46	38	54	22	16	11	23	-2.03	1.14
54-59	81	33	41	31	51	4	4.9	1.8	13	-1.88	0.8
Total	2168	548	25	23	28	168	7.7	6.6	9.1	-1.2	1.31

Table 4.32: Prevalence of boys and girls aged less than five years with stunting and severe stunting (height-for-age <-2.00 and <-3.00 Z-score) with 95% confidence intervals, mean Z-score and standard deviation by age groups, North Maluku, Indonesia 2004

Age Groups in months	Boys and Girls										
	Height for Age										
	N	Stunting				Severe Stunting				Mean Z-scr	SD Z-scr
		n	%	CI		n	%	CI			
0-5.	266	34	13	9	18	21	7.9	5.6	11	0.11	2.70
6-11.	365	88	24	19	30	37	10	6.6	15	-0.53	2.37
12-17.	318	108	34	29	40	50	16	12	21	-1.23	2.18
18-23.	234	113	48	40	56	59	25	19	33	-1.82	2.18
24-29.	238	116	49	42	55	63	26	20	34	-1.86	1.86
30-35	169	87	51	43	60	39	23	17	31	-2.11	1.65
36-41	215	113	53	46	59	55	26	20	31	-2.18	1.86
42-47	147	70	48	38	58	29	20	13	29	-1.96	1.59
48-53	135	67	50	40	59	32	24	17	32	-2.37	1.95
54-59	81	36	44	35	55	13	16	8.7	28	-1.85	1.18
Total	2168	832	38	36	41	398	18	16	21	-1.39	2.25

Table 4.33: Prevalence of children aged less than five years with wasting and severe wasting (weight-for-height <-2.00 and <-3.00 Z-score) & 95% confidence intervals, mean Z-score and standard deviation by six-month age groups, North Maluku, Indonesia 2004.

Age Groups in months	Boys and girls										
	Weight for Height										
	N	Wasting				Severe wasting				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
0-5	266	37	14	9.7	21	16	6	3.8	9.5	-0.35	1.9
6-11	365	55	15	112	20	17	4.7	2.8	7.7	-0.59	1.55
12-17	318	44	14	9.7	19	22	6.9	4.4	11	-0.68	1.46
18-23	234	27	11	7.9	17	9	3.8	1.9	7.6	-0.47	1.45
24-29	238	30	13	9.1	17	8	3.4	1.5	7.4	-0.42	1.36
30-35	169	13	7.7	4.6	13	5	3	1.2	6.8	-0.45	1.26
36-41	215	24	11	7.1	17	11	5.1	2.8	9.2	-0.47	1.48
42-47	147	23	16	10	23	12	8.2	4.5	14	-0.83	1.43
48-53	135	19	14	8.9	22	10	7.4	3.7	14	-0.9	1.49
54-59	81	17	21	13	31	8	9.9	4.7	19	-1.15	1.41
Total	2168	289	13	11	16	118	5.4	4.4	6.7	-0.58	1.52

**** There were 12 missing value for children with wasting.**

Appendix 4 3 Wealth index distribution by district and age for children aged 0 to 59 months in North Maluku province, Indonesia 2004

Table 4.34 Wealth index distribution by district for children aged less than five years in North Maluku Province, Indonesia 2004

Districts	Poorest				Middle				Richest				Wealth Index			
	n	%	CI		n	%	CI		n	%	CI		Mean	SD	Median	Iqr
Ternate	81	21	11.12	35.90	137	35	30.54	40.04	169	44	33.01	55.47	1.29	2.25	1.14	3.65
Tidore	13	8.7	3.91	18.33	71	48	34.67	60.95	65	44	27.54	61.17	1.53	2.11	1.04	3.29
Central Halmahera	164	59	38.60	76.07	90	32	17.72	51.03	26	9.3	4.77	17.32	-0.68	1.57	-1.05	1.24
East Halmahera	200	71	62.19	79.17	67	24	17.81	31.35	13	4.6	2.37	8.91	-1.14	1.17	-1.30	1.06
West Halmahera	70	39	26.02	54.43	102	57	43.73	69.86	6	3.4	2.12	5.33	-0.64	1.08	-0.84	1.05
North Halmahera	121	43	36.95	50.02	129	46	37.19	55.54	29	10	5.00	20.36	-0.49	1.34	-0.84	0.74
South Halmahera	164	37	22.15	54.30	201	45	34.72	56.31	81	18	8.42	34.19	-0.05	1.69	-0.44	2.67
Sula Island	54	32	14.95	55.63	70	41	29.95	53.90	45	27	10.27	53.51	0.34	1.99	-0.43	2.92
Total	867	40	33.14	47.26	867	40	35.40	44.76	434	20	15.01	26.18	0.00	1.92	-0.68	2.39

Table 4.35 Wealth index distribution by six-month age group for children aged 0 to 59 months in in North Maluku Province, Indonesia 2004

Age groups in months	Poorest				Middle				Richest				Wealth Index			
	n	%	CI		n	%	CI		n	%	CI		Mean	SD	Median	Iqr
0-5.	94	35	27.20	44.42	113	42	35.22	50.08	59	22	15.78	30.24	0.15	1.91	-0.59	2.53
6-11.	143	39	30.69	48.37	149	41	33.75	48.30	73	20	13.84	28.01	0.05	1.92	-0.61	2.53
12-17.	117	37	28.60	45.82	127	40	33.63	46.60	74	23	16.70	31.45	0.27	2.08	-0.56	2.51
18-23.	105	45	34.91	55.26	83	35	27.90	43.85	46	20	13.12	28.38	-0.10	1.95	-0.84	2.51
24-29.	101	42	33.98	51.36	98	41	34.82	48.70	39	16	10.47	23.59	-0.26	1.81	-0.83	1.93
30-35	78	46	35.90	56.75	66	39	30.16	48.73	25	15	9.05	23.26	-0.28	1.68	-0.84	1.81
36-41	89	41	33.07	50.24	81	38	29.15	46.05	45	21	13.86	31.52	-0.03	1.89	-0.81	2.44
42-47	57	39	28.03	50.74	63	43	33.50	52.75	27	18	10.90	29.27	-0.06	1.91	-0.62	2.19
48-53	59	44	32.76	55.30	50	37	28.47	46.51	26	19	11.39	30.69	-0.06	1.96	-0.84	2.67
54-59	24	30	20.81	40.28	37	46	36.01	55.68	20	25	15.53	36.90	0.19	1.83	-0.60	2.27
Total	867	40	33.14	47.26	867	40	35.40	44.76	434	20	15.01	26.18	0.00	1.92	-0.68	2.39

CHAPTER 5

SOCIO-ECONOMIC FACTORS ASSOCIATED WITH CHILDREN WITH STUNTING IN NORTH MALUKU INDONESIA

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5.1 Introduction

The period of civil unrest in the new province of North Maluku highlighted the importance of investigating under nutrition in children aged 0 to 59 months. This chapter describes the demographic and socio-economic factors associated with children aged 0 to 59 months who have stunting in North Maluku, Indonesia in 2004. Socio-economic status was measured using the mother's and father's level of education, their occupation, household wealth index, number of household members, household location (rural or urban), and geographical district. The child's age and gender, immunisation status and recent health of the child were also measured. The Chapter concludes with recommended interventions that may prevent stunting and improve the nutritional status of young children in North Maluku Indonesia.

Details of the study methodology have been presented in Chapter 3. Nutritional status of the children was defined as stunted for a Z-score range of -2.00 to 2.99 and severely stunted for a Z-score greater than or equal to -3.00 of an international reference population recognised by the World Health Organization (WHO, 1995). The results obtained from the backward stepwise multiple binary regression applied in this study were used to determine these risk factors.

5.2 Results

The following tables compiled from the secondary data analysis of the North Maluku Health Survey summarise the number and percentage of children presenting with stunting and severe stunting for each of the three age groups studied: 0 to 23 months, 24 to 59 months and 0 to 59 months.

Table 5.1 Number and percentage of children aged 0-23 months and 24-59-months with stunting and severe stunting, North Maluku, Indonesia 2004

	0-23 months			**0-23 months**	
Height for Age	**n**	**%**	**Height for Age**	n	%
Not Stunted	840	71	Not Severely Stunted	1016	86
Stunted	343	29	Severely Stunted	167	14
Total	1183	100	Total	1183	100
Height for Age	**24-59 months**		**Height for Age**	**24-59 months**	
	n	%		n	%
Not Stunted	496	50	Not Severely Stunted	931	94
Stunted	489	50	Severely Stunted	54	5.5
Total	985	100	Total	985	100

It can be seen from Table 5.1 that 29% of children aged from 0 to 23 months were stunted and 14% were severely stunted. Of children aged from 24 to 59 months, 50% were stunted and 5.5% were severely stunted.

Unadjusted and adjusted odds ratios were calculated to estimate the risk of independent variables associated with stunting and severe stunting in the study population of children aged 0 to 59 months. Table 5.2 shows the unadjusted and adjusted ORs for the association between socioeconomic characteristics and stunting in children aged 0 to 23 months, 24 to 59 months and overall for children aged 0 to 59 months. Table 5.3 shows the unadjusted and adjusted ORs for the association between socioeconomic characteristics and severe stunting of children aged 0 to 23 months, 24 to 59 months and overall for children aged 0 to 59 months.

5.2.1 Univariate analysis for stunting in children

The interpretation of the results of the univariate analyses (unadjusted OR) for stunting is provided below, according to two age groups 0 to 23 and 24 to 59 months and for the overall 0 to 59 month study population.

5.2.1.1 Risk factors for stunting in children aged 0 to 23 months

Results of significance from the univariate analysis indicated an association with stunting in children in the 0 to 23 months age group, as follows:

Children aged 0 to 23 months with fathers who completed senior high school had lowered odds of being stunted compared to children aged 0 to 23 months with fathers who completed elementary school only (OR 0.76, 95%CI 0.55, 1.05), however this result did not meet statistical significance. Children aged 0 to 23 months with mothers who completed senior high school had statistically significant lowered odds of being stunted compared to children aged 0 to 23 months with mothers who completed elementary school only (OR 0.73, 95%CI 0.55, 0.97). Children aged 0 to 23 months where neither parent completed senior high school had increased odds of being stunted compared to children aged 0 to 23 months where both parents completed senior high school (OR 1.31, 95%CI 0.96, 1.80), however this result did not meet statistical significance.

Children aged 0 to 23 months from the more wealthy households had lowered odds of being stunted when compared with children aged 0 to 23 months from the least wealthy households (OR 0.62, 95%CI 0.41, 0.94). Children aged 0 to 23 months with six to 12 household members had reduced odds of being stunted compared with children aged 0 to 23 months with five or less household members (OR 0.73, 95%CI 0.56, 0.95). Children aged 0 to 23 months from the districts of Tidore and South Halmahera had reduced odds of being stunted compared with children aged 0 to 23 months from Ternate, however the results were not statistically significantly different (OR 0.53, 95%CI 0.24, 1.17 and OR 0.73, 95%CI 0.46, 1.16, respectively).

A child's age in months had a statistically significant association with stunting (OR 0.10, 95%CI 1.07, 1.14) where every increase in age by one month increased the odds of stunting by 10%. Girls aged 0 to 23 months had statistically significantly lowered odds of being stunted compared with boys aged 0 to 23 months (OR 0.73, 95%CI 0.54, 0.97). Immunised children aged 0 to 23 months had statistically significantly increased odds of being stunted compared with children aged 0 to 23 months who were not immunised (OR 1.59 95%CI 1.15, 2.21). Children aged 0 to 23 months who were sick in the past two weeks had reduced odds of being stunted (OR 0.84, 95%CI 0.66, 1.08) however this result did not reach statistical significance.

There was no association found between stunting in children aged 0 to 23 months and the family level characteristics of father occupation, mother occupation, parental employment, number of family meals and geographical region, or the child level characteristic of number of local health service visits in the past three months as illustrated in Table 5.2.

5.2.1.2 Risk factors for stunting in children aged 24 to 59 months

Results of significance from the univariate analysis indicated an association with stunting in children in the 24 to 59 months age group, as follows:

Children aged 24 to 59 months with fathers who completed senior high school had statistically significant lowered odds of being stunted compared to children aged 24 to 59 months with fathers who completed elementary school only (OR 0.69, 95%CI 0.50, 0.96). Children aged 24 to 59 months with mothers who completed senior high school had statistically significant lowered odds of being stunted compared to children aged 24 to 59 months with mothers who completed elementary school only (OR 0.60, 95%CI 0.42, 0.85). Children aged 24 to 59 months where neither parent completed senior high school had statistically significant increased odds of being stunted compared to children aged 24 to 59 months where both parents completed senior high school (OR 1.51, 95%CI 1.05, 2.18).

Children aged 24 to 59 months whose father worked as a government or private officer had statistically significantly lowered odds of being stunted compared with children aged 24 to 59 months whose father worked as a labourer (OR 0.65, 95%CI 0.45, 0.94). There was no significant difference between children aged 24 to 59 months who had a father who worked as a fisherman or who did not work compared with those who worked as a labourer. Children aged 24 to 59 months where the mother only was working was associated with increased odds of stunting compared to children aged 24 to 59 months where both parents were working however this result did not reached statistical significance (OR 3.39, 95%CI 0.79, 14.53).

Children aged 24 to 59 months from the wealthy households had statistically significant lowered odds of being stunted than children aged 24 to 59 months from the poorest households (OR 0.58, 95%CI 0.41, 0.83). Children aged 24 to 59 months who lived in urban areas had statistically significant increased odds of being stunted compared with children aged 24 to 59 months in rural areas (OR 1.61, 95%CI: 1.15, 2.24). Children aged 24 to 59 months who lived in the district of South Halmahera had statistically significant increased odds of being stunted compared to children aged 24 to 59 months who lived in Ternate District (OR 1.88 95%CI 1.21, 2.92).

Girls aged 24 to 59 months had lowered odds of being stunted compared with boys aged 24 to 59 months (OR 0.80, 95%CI 0.61, 1.05) however this result did not reach statistical significance. Children aged 24 to 59 months who visited local health services at least three times in the preceding three months had statistically significant increased odds of being stunted compared with children aged 24 to 59 months who did not visit the local health services during the same period (OR 1.75 95%CI 1.15, 2.67).

There was no statistically significant association between stunting in children aged 24 to 59 months and the family level characteristics of mother occupation, number of family meals per day and number of household members, and the child level characteristics of child age, immunisation status, and sickness in the past two weeks as illustrated in Table 5.2.

5.2.1.3 Risk factors for stunting in children aged 0 to 59 months

Results of significance from the univariate analysis indicated an association with stunting in children in the 0 to 59 months age group, as follows:

Children aged 0 to 59 months with fathers who completed senior high school had statistically significant lowered odds of being stunted compared to children aged 24 to 59 months with fathers who completed elementary school only (OR 0.72, 95%CI 0.57, 0.91). Children aged 0 to 59 months with mothers who completed senior high school had statistically significant lowered odds of being stunted compared to children aged 0 to 59 months with mothers who completed elementary school only (OR 0.64, 95%CI 0.50, 0.83). Children aged 0 to 59 months where neither father nor mother completed education to senior high school level had statistically significant increased odds of being stunted (OR 1.43, 95%CI 1.11, 1.84) compared to children aged 0 to 59 months where both parents completed school. Children aged 0 to 59 months where only the mother completed education to senior high school level had statistically significant increased odds of being stunted (OR 1.38, 95%CI 1.09, 1.73) compared to children aged 0 to 59 months where both parents completed high school.

Children aged 0 to 59 months whose father worked as a government or private officer had statistically significantly lowered odds of being stunted than children aged 0 to 59 months whose father worked as a labourer (OR 0.77, 95%CI 0.60, 0.99). Children aged 0 to 59 months where the mother only was working had increased odds of stunting compared to children aged 0 to 59 months where both parents were working (OR 1.83, 95%CI 0.97, 3.47) however this result did not reach statistical significance.

Children aged 0 to 59 months from the more wealthy households had statistically significantly reduced odds of stunting (OR 0.50, 95%CI 0.33, 0.75) than children aged 0 to 59 months from the least wealthy households. Children aged 0 to 59 months who lived in urban areas had statistically significantly increased odds of being stunted compared with children aged 0 to 59 months from rural areas (OR 1.33, 95%CI: 1.03, 1.71). Children aged 0 to 59 months who lived in Tidore had statistically significantly lowered odds of being stunted than children aged 0 to 59 months who lived in Ternate district (OR 0.60, 95% CI: 0.38, 0.94).

The child's age in months was significantly associated with stunting (OR 1.02, 95%CI 1.02, 1.04) where every one month increase in age increased the odds of stunting by three percent for children aged 0 to 59 months. Girls aged 0 to 59 months had statistically significantly lowered odds of being stunted compared with boys aged 0 to 59 months (OR 0.74, 95%CI 0.59, 0.93). Children aged 0 to 59 months who were immunised had statistically significantly increased odds of being stunted compared with children not immunised (OR 1.55, 95%CI 1.19, 2.00). Children aged 0 to 59 months who were sick in the past two weeks had reduced odds of being stunted however this result did not reach statistical significance (OR 0.83, 95%CI 0.68, 1.02).

There was no association between stunting in children aged 0 to 59 months and the family level characteristics of mother occupation, number of family meals per day and number of household members as illustrated in Table 5.2.

5.2.1.4 Risk factors for severe stunting in children aged 0 to 23 months

Results of significance from the univariate analysis indicated an association with severe stunting in children in the 0 to 23 months age group, as follows:

Children aged 0 to 23 months with whose father completed senior high school had lowered odds of being severely stunted (OR 0.75, 95%CI 0.51, 1.10) compared with children aged 0 to 23 months whose father completed elementary school, however this result did not reach statistical significance. Children aged 0 to 23 months whose mother completed senior high school had statistically significantly lowered odds of being severely stunted (OR 0.63, 95%CI 0.43, 0.92) compared with children aged 0 to 23 months whose mother completed elementary school. Children aged 0 to 23 months where neither parent completed high school had statistically significantly increased odds of being severely stunted compared with children aged 0 to 23 months where both parents completed high school (OR 1.62, 95%CI 1.09, 2.41).

Children aged 0 to 23 months whose father worked as a government or private officer had reduced odds of being severely stunted compared to children aged 0 to 23 months whose father worked in any labour occupation (OR 0.68, 95%CI 0.42, 1.10) although this result did not reach statistical significance. Children aged 0 to 23 months where neither parent was working had increased odds of severe stunting compared to children aged 0 to 23 months where both parents were working (OR 1.90, 95%CI 0.72, 5.01), however this result did not reach statistical significance.

Children aged 0 to 23 months from wealthy households had statistically significantly reduced odds of being severely stunted (OR 0.43, 95%CI 0.24, 0.79) compared with children from the poorest households. Compared to children aged 0 to 23 months living in the district of Ternate, children aged 0 to 23 months living in the district of West Halmahera had statistically significantly reduced odds of severe stunting (OR 0.40, 95%CI 0.18, 0.92).

For children aged 0 to 23 months the child's age in months was statistically significantly associated with severe stunting (OR 1.08, 95%CI 1.05, 1.12) where every one month increase in age was associated with an eight percent increase in severe stunting. Girls aged 0 to 23 months had statistically significantly reduced odds of being severely stunted than boys aged 0 to 23 months (OR 0.63, 95%CI 0.45, 0.89). Children aged 0 to 23 months who experienced sickness in the two weeks preceding the study had statistically significantly reduced odds of being severely stunted (OR 0.59, 95%CI 0.41, 0.85) compared to children aged 0 to 23 months who were not sick during the same period. Children aged 0 to 23 months who visited local health services twice in the previous three months had reduced odds of severe stunting compared with children aged 0 to 23 months who did not visit local health services in the past three months (OR 0.72, 95%CI 0.42, 1.25) however this result did not reach statistical significance.

There was no association between severe stunting in children aged 0 to 23 months and the family level characteristics of mother occupation, geographical region, number of household meals per day and number of household members. The child level characteristic of immunisation status was not associated with severe stunting in children aged 0 to 23 months, as illustrated in Table 5.3.

5.2.1.5 Risk factors for severe stunting in children aged 24 to 59 months

Results of significance from the univariate analysis indicated an association with severe stunting in children in the 24 to 59 months age group, as follows:

Children aged 24 to 59 months with fathers who completed high school had statistically significantly lowered odds of being severely stunted (OR 0.63, 95%CI 0.41, 0.96) when compared with children aged 24 to 59 months with fathers who completed elementary school only. Children aged 24 to 59 months with mothers who completed high school had lowered odds of being severely stunted (OR 0.72, 95%CI 0.48, 1.08) when compared with children aged 24 to 59 months with mothers who completed elementary school only, although this result did not reach statistical significance. Children aged 24 to 59 months where neither parent completed high school had statistically significantly increased odds of being severely stunted compared with children aged 24 to 59 months where both parents completed high school (OR 1.62, 95%CI 1.09, 2.41). There was no significant difference between children aged 24 to 59 months where the father completed high school only or where the mother completed high school only compared with children aged 24 to 59 months where both parents completed high school education.

Children aged 24 to 59 months whose father worked as a government or private officer had reduced odds of being severely stunted compared to children aged 0 to 23 months whose father worked in any labour occupation (OR 0.60, 95%CI 0.35, 1.04) although this result did not reach statistical significance. Children aged 0 to 23 months whose father was not working had increased odds of being severely stunted compared to children aged 24 to 59 months whose father worked in any labour occupation (OR 2.36, 95%CI 0.87, 6.42) although this result also did not reach statistical significance. Children aged 24 to 59 months where the mother only was working had statistically significantly increased odds of severe stunting compared to children aged 24 to 59 months where both parents were working (OR 5.63, 95%CI 1.51, 21).

Children aged 24 to 59 months from wealthy households had statistically significantly lowered odds of being severely stunted (OR 0.58, 95%CI 0.37, 0.92) compared with children aged 24 to 59 months from the poorest households. Children aged 24 to 59 months living in urban regions had increased odds of being severely stunted compared with children aged 24 to 59 months from rural regions (OR 1.49, 95%CI 1.00, 2.22) with borderline statistical significance. Compared to children aged 24 to 59 months living in the district of Ternate, children aged 24 to 59 months living in the districts of Central Halmahera and South Halmahera had statistically significantly increased odds of severe stunting (OR 2.32, 95% CI 1.24, 4.34 and OR 1.86, 95%CI 1.14, 3.05, respectively).

For children aged 24 to 59 months the child's age in months was associated with severely stunted children (OR 0.99, 95%CI 0.97, 1.00) where every one month increase in age was associated with a one percent decrease in severe stunting, however this result was of borderline statistical significance. Girls aged 24 to 59 months had reduced odds of being severely stunted compared to boys aged 24 to 59 months (OR 0.83, 95%CI 0.61, 1.12), although this result did not reach statistical significance. Compared to children aged 24 to 59 months who did not visit local health services in the previous three months, children aged 24 to 59 months who visited local health services once, twice or three times or more within the preceding three months of the study survey had approximately double the odds of being severely stunted (OR 1.92, 95%CI 1.15, 3.32, OR 1.89, 95%CI 1.21, 2.95 and OR 2.12 95%CI 1.30, 3.44, respectively).

There was no association found between severe stunting in children aged 24 to 59 months and the family level characteristics of mother occupation, number of family meals per day and number of household members. There was no association between severe stunting in children aged 24 to 59 months and the child level characteristics of immunisation status and child sickness in the past two weeks as illustrated in Table 5.3.

5.2.1.6 Risk factors for severe stunting in children aged 0 to 59 months

Results of significance from the univariate analysis indicated an association with severe stunting in children in the 0 to 59 months age group, as follows:

Children aged 0 to 59 months whose father completed senior high school had statistically significantly reduced odds of being severely stunted compared with children age 0 to 59 months whose father completed elementary school (OR 0.68, 95%CI 0.50, 0.91). Children aged 0 to 59 months whose mother completed junior high school or senior high school had statistically significantly reduced odds of being severely stunted compared with children age 0 to 59 months whose mother completed elementary school (OR 0.70, 95%CI 0.51, 0.98 and OR 0.66, 95%CI 0.49, 0.88 respectively). Children aged 0 to 59 months where neither parent completed high school had statistically significantly increased odds of being severely stunted (OR 1.43 95%CI 1.11, 1.84) compared to children aged 0 to 59 months where both parents completed high school. In addition, children aged 0 to 59 months where the mother completed high school had increased odds of being severely stunted compared to children aged 0 to 59 months where both parents completed high school (OR 1.38, 95%CI 1.09, 1.73).

Children aged 0 to 59 months whose father worked as a government or private officer had statistically significantly reduced odds of being severely stunted compared with children aged 0 to 59 months whose father worked as a labourer (OR 0.63, 95%CI 0.45, 0.89). There was no statistical difference for children aged 0 to 59 months with fathers who were not working or who were working as a fisherman. Children aged 0 to 59 months with a mother only who worked had increased odds of being severely stunted compared with children aged 0 to 59 months where both parents were working (OR 1.83, 95%CI 0.97, 3.47); however these results did not reach statistical significance.

Children aged 0 to 59 months from wealthy households had statistically significant reduced odds of being severely stunted compared with children aged 0 to 59 months from the poorest households (OR 0.50, 95%CI 0.33, 0.75). Children aged 0 to 59 months who lived in urban areas had statistically significant increased odds of being severely stunted compared with children aged 0 to 59 months who lived in rural areas (OR 1.33 95%CI 1.03, 1.71). Compared to children aged 0 to 59 months living in the district of Ternate, children aged 0 to 59 months living in the district of Tidore had statistically significant reduced odds of severe stunting (OR 0.60, 95% CI 0.38, 0.94).

For children aged 0 to 59 months there was a statistically significant association between a child’s age in months and being severely stunted (OR 1.03, 95%CI

1.02, 1.04) where each one month increase in age was associated with a three percent increase in severe stunting. Girls aged 0 to 59 months had statistically significantly reduced odds of being severely stunted compared with boys aged 0 to 59 months (OR 0.77, 95%CI 0.63, 0.95). Children aged 0 to 59 months who experienced sickness in the preceding two weeks of the study survey had statistically significantly lowered odds of being severely stunted compared with children aged 0 to 59 months who were not sick during the same period (OR 0.72, 95%CI 0.54, 0.95).

There was no association between severe stunting in children aged 0 to 59 months for the family level characteristics of mother occupation, number of family meals per day and number of household members, or for the child level characteristic of immunisation status as illustrated in Table 5.3.

5.2.2 Multivariate analysis for stunting in children

The interpretation of the results for the multivariate analysis (adjusted OR) is provided below under the two age groups 0 to 23 and 24 to 59 months and for the overall 0 to 59 month study population.

5.2.2.1 Risk factors for stunting in children aged 0 to 23 months

Results of significance from the multivariate analysis indicated an association with stunting in children in the 0 to 23 months age group for age and gender, as follows:

Child age in months was statistically significantly associated with stunting in children aged 0 to 23 months (OR 1.11, 95%CI 1.08, 1.14) where very one month increase in age was associated with an 11 percent increase in stunting. Girls aged 0 to 23 months had statistically significantly lowered odds of being stunted compared to boys aged 0 to 23 months (OR 0.67, 95%CI 0.5, 0.89).

This analysis was adjusted for the family level characteristics of father education, mother education, parental education, household wealth index, district and the number of household members, plus the child level characteristics of immunisation status and sickness in the last two weeks.

5.2.2.2 Risk factors for stunting in children aged 24 to 59 months

Results of significance from the multivariate analysis indicated an association with stunting in children in the 24 to 59 months age group and mother's education and recent visits to the local health service, as follows:

Children aged 24 to 59 months whose mother completed senior high school had statistically significantly reduced odds of being stunted when compared to children aged 24 to 59 months whose mother completed elementary school level education only (OR 0.60, 95%CI 0.42, 0.85).

Children aged 24 to 59 months who visited the local health services at least three times in the preceding three months of the study survey had statistically significantly increased odds of being stunted (OR 1.66, 95%CI 1.09, 2.55) compared with children aged 24 to 59 months who did not visit the local health services during this same period.

This analysis was adjusted for the family level characteristics of father education, parental education, father occupation, parental employment, household wealth index, region and district plus the child level characteristics of child age in months, gender and visits to local health services.

5.2.2.3 Risk factors for stunting in children aged 0 to 59 months

Results of significance from the multivariate analysis indicated an association with stunting in children in the 0 to 59 months age group with household wealth, child age and gender and recent visits to the local health service, as follows:

Children aged 0 to 59 months from wealthy households had statistically significantly reduced odds of being stunted than children from the poorest households (OR 0.62, 95%CI 0.45, 0.85). A child's age was statistically significantly associated with stunting for those aged 0 to 59 months (OR 1.03, 95%CI 1.02, 1.04) where every one month increase in age was associated with a statistically significant three percent increase in stunting.

Girls aged 0 to 59 months had statistically significantly reduced odds of being stunted compared to boys aged 0 to 59 months (OR 0.74, 95%CI 0.59, 0.93). Children aged 0 to 59 months who visited local health services three or more times in the preceding three months of the study survey had statistically significantly increased odds of being stunted compared to children who did not visit the local health services during this same period (OR 1.54, 95%CI 1.1, 2.06).

This analysis was adjusted for the family level characteristics of father education, mother education, father occupation, parental education, parental employment, region and district, plus the child level characteristics of immunisation status and sickness in the last two weeks.

5.2.3 Multivariate analysis for severe stunting in children

5.2.3.1 Risk factors for severe stunting in children aged 0 to 23 months

Results of significance from the multivariate analysis indicated an association with severe stunting in children aged 0 to 23 months and household wealth and child age and gender, as follows:

Children aged 0 to 23 months from the wealthy households had statistically significantly lowered odds of being severely stunted compared with children aged 0 to 23 months from the poorest households (OR 0.42, 95%CI 0.23, 0.77).

Child age in months was statistically significantly associated with severe stunting in children aged 0 to 23 months (OR 1.08, 95%CI 1.05, 1.12) where every one month increase in age was associated with an eight percent increase in severe stunting. Girls aged 0 to 23 months had statistically significantly reduced odds of being severely stunted than boys aged 0 to 23 months (OR 0.58, 95%CI 0.42, 0.81). Children aged 0 o 23 months who reported being sick in the previous two weeks had statistically significantly reduced odds of being severely stunted compared to children aged 0 to 23 months who had not been sick in the previous two weeks (OR 0.56, 95%CI 0.41, 0.85).

This analysis was adjusted for the family level characteristics of father education, mother education, father occupation, parental education, parental employment and district, plus the child level characteristics of immunisation status and number of local health service visits in the previous three months.

5.2.3.2 Risk factors for severe stunting in children aged 24 to 59 months

Results of significance from the multivariate analysis indicated an association with severe stunting in children aged 24 to 59 months and parental occupation and district as follows:

Children aged 24 to 59 months whose parents were not working had statistically significantly reduced odds of being severely stunted compared with children aged 24 to 59 months where both parents were working (OR 0.67, 95%CI 0.12, 3.85). Compared to children aged 24 to 59 months living in the district of Ternate, children aged 24 to 59 months living in the districts of Central Halmahera and South Halmahera had statistically significantly increased odds of severe stunting (OR 2.34, 95% CI 1.20, 4.55 and OR 1.90, 95%CI 1.14, 3.14, respectively).

This analysis was adjusted for the family level characteristics of father education, mother education, father occupation, parental education, household wealth index, region and district, and the child level characteristics of child age, gender and visits to local health services.

5.2.3.3 Risk factors for severe stunting in children aged 0 to 59 months

Results of significance from the multivariate analysis indicated an association with severe stunting in children aged 0 to 59 months and the father's occupation, household wealth and the child's age and gender, as follows:

A child aged 0 to 59 months whose father worked in the government or private sector had reduced odds of being severely stunted compared with children aged 0 to 59 months whose father worked in any labour (OR 0.79, 95%CI 0.55, 1.14) however the OR was not statistically significant. Children aged 0 to 59 months from the wealthy households had half the odds of being severely stunted (OR 0.52, 95%CI 0.33, 0.82) when compared with children aged 0 to 59 months from the poorest households. This result was statistically significant.

Child age in months was statistically significantly associated with being severely stunted in children aged 0 to 59 months (OR 1.02, 95%CI 1.01, 1.03) indicating that every one month increase in age was associated with a two percent increase in severe stunting. Girls aged 0 to 59 months had statistically significantly reduced odds of being severely stunted compared with boys aged 0 to 59 months (OR 0.72, 95%CI 0.58, 0.90).

This analysis was adjusted for the family level characteristics of father education, mother education, father occupation, parental education, parental employment, region, and district, plus the child level characteristics of sickness in the last two weeks and visits to local health services in the past three months.

Refer to Table 5.2 for univariate and multivariate analyses of stunted children, and Table 5.3 for univariate and multivariate analyses of severely stunted children (both samples n=2,168).

Table 5.2: Univariate and multivariate analyses of the association between stunting in children aged 0 to 23, 24 to 59 months and 0 to-59 months, North Maluku, Indonesia 2004

Characteristic	Stunted Children 0 to 23 Months (n=1183)							
	Unadjusted				Adjusted			
	OR	95% CI		*p*	OR	95% CI		*p*
Family level factors								
Father education								
Completed Elementary school	1.00							
Completed Junior High School	0.84	0.59	1.21	0.342				
Completed Senior High school	0.76	0.55	1.05	0.090				
Mother Education								
Completed Elementary school	1.00							
Completed Junior High School	0.95	0.69	1.31	0.757				
Completed Senior High school	0.73	0.55	0.97	0.032				
Father Occupation								
Any Labour	1.00							
Fisher man	0.93	0.66	1.32	0.696				
No work	1.35	0.65	2.80	0.411				
Government /Private officer	0.92	0.62	1.38	0.698				
Mother Occupation								
Any Labour	1.00							
Fisher woman	1.03	0.58	1.83	0.909				
No work	0.93	0.69	1.25	0.617				
Government /Private officer	0.96	0.49	1.92	0.916				
Parental Education								
Both with high education	1.00							
Father with high education	1.41	0.78	2.54	0.246				
Mother with high education	1.17	0.83	1.64	0.369				
Neither with high education	1.31	0.96	1.80	0.089				

Characteristic	Stunted Children 24 to 59 Months (n=985)							
	Unadjusted				Adjusted			
	OR	95% CI		*p*	OR	95% CI		*p*
Family level factors								
Father education								
Completed Elementary school	1.00							
Completed Junior High School	0.91	0.66	1.27	0.581				
Completed Senior High school	0.69	0.50	0.96	0.03				
Mother Education								
Completed Elementary school	1.00				1.00			
Completed Junior High School	0.79	0.55	1.13	0.196	0.80	0.56	1.15	0.227
Completed Senior High school	0.60	0.42	0.85	0.005	0.60	0.43	0.85	0.004
Father Occupation								
Any Labour	1.00							
Fisher man	0.79	0.54	1.16	0.222				
No work	1.50	0.59	3.80	0.39				
Government /Private officer	0.65	0.45	0.94	0.022				
Mother Occupation								
Any Labour	1.00							
Fisher woman	0.84	0.49	1.45	0.527				
No work	0.92	0.70	1.22	0.564				
Government /Private officer	0.96	0.45	2.05	0.907				
Parental Education								
Both with high education	1.00							
Father with high education	1.34	0.74	2.41	0.325				
Mother with high education	1.48	1.04	2.09	0.029				
Neither with high education	1.51	1.05	2.18	0.028				

Characteristic	Stunted Children 0 to 59 Months (n=2168)							
	Unadjusted				Adjusted			
	OR	[95% CI]		*p*	OR	95% CI		*p*
Family level factors								
Father education								
Completed Elementary school	1.00							
Completed Junior High School	0.90	0.71	1.14	0.383				
Completed Senior High school	0.72	0.57	0.91	0.007				
Mother Education								
Completed Elementary school	1.00							
Completed Junior High School	0.85	0.66	1.09	0.193				
Completed Senior High school	0.64	0.50	0.83	0.001				
Father Occupation								
Any Labour	1.00							
Fisher man	0.83	0.65	1.06	0.127				
No work	1.23	0.77	1.96	0.382				
Government /Private officer	0.77	0.60	0.99	0.046				
Mother Occupation								
Any Labour	1.00							
Fisher woman	0.96	0.65	1.42	0.84				
No work	0.93	0.75	1.17	0.542				
Government /Private officer	0.89	0.55	1.46	0.648				
Parental Education								
Both with high education	1.00							
Father with high education	1.37	0.92	2.04	0.114				
Mother with high education	1.38	1.09	1.73	0.007				
Neither with high education	1.43	1.11	1.84	0.007				

Table 5.2 continued

Characteristic	Stunted Children 0 to 23 Months (n=1183)							
	Unadjusted				Adjusted			
	OR	[95% CI]		*p*	OR	[95% CI]		*p*
Parental Employment								
Both working	1.00							
Father only working	0.92	0.70	1.21	0.541				
Mother only working	1.18	0.39	3.59	0.77				
Neither working	1.41	0.62	3.20	0.4				
Household wealth Index								
Poorest	1.00							
Middle	0.80	0.58	1.10	0.167				
Richest	0.62	0.41	0.94	0.025				
Region								
Rural	1.00							
Urban	1.13	0.77	1.65	0.526				
District								
Ternate	1.00							
Tidore	0.53	0.24	1.17	0.113				
Central Halmahera	1.06	0.66	1.72	0.799				
East Halmahera	1.31	0.76	2.24	0.32				
West Halmahera	0.69	0.38	1.28	0.238				
North Halmahera	1.01	0.62	1.64	0.978				
South Halmahera	0.73	0.46	1.16	0.182				
Sula Island	0.84	0.50	1.41	0.503				
Household member								
≤5 members	1.00							
6-12 members	0.73	0.56	0.95	0.022				

Characteristic	Stunted Children 24 to 59 Months (n=985)							
	Unadjusted				Adjusted			
	OR	[95% CI]		*p*	OR	[95% CI]		*p*
Parental Employment								
Both working	1.00							
Father only working	0.99	0.75	1.29	0.915				
Mother only working	3.39	0.79	14.53	0.099				
Neither working	0.61	0.15	2.54	0.491				
Household wealth Index								
Poorest	1.00							
Middle	0.78	0.58	1.04	0.089				
Richest	0.58	0.41	0.83	0.003				
Region								
Rural	1.00							
Urban	1.61	1.15	2.24	0.006				
District								
Ternate	1.00							
Tidore	0.79	0.49	1.26	0.312				
Central Halmahera	1.83	1.05	3.21	0.034				
East Halmahera	1.45	0.85	2.50	0.172				
West Halmahera	1.38	0.87	2.18	0.173				
North Halmahera	1.45	0.87	2.44	0.153				
South Halmahera	1.88	1.21	2.92	0.006				
Sula Island	0.96	0.57	1.64	0.886				
Household member								
≤5 members	1.00							
6-12 members	1.06	0.80	1.41	0.69				

Characteristic	Stunted Children 0 to 59 Months (n=2168)							
	Unadjusted				Adjusted			
	OR	[95% CI]		*p*	OR	[95% CI]		*p*
Parental Employment								
Both working	1.00							
Father only working	0.97	0.79	1.18	0.741				
Mother only working	1.83	0.97	3.47	0.063				
Neither working	0.95	0.47	1.92	0.888				
Household wealth Index								
Poorest	1.00				1.00			
Middle	0.87	0.65	1.16	0.344	0.78	0.63	0.98	0.034
Richest	0.50	0.33	0.75	0.001	0.62	0.45	0.85	0.004
Region								
Rural	1.00							
Urban	1.33	1.03	1.71	0.028				
District								
Ternate	1.00							
Tidore	0.60	0.38	0.94	0.026				
Central Halmahera	1.31	0.91	1.88	0.142				
East Halmahera	1.29	0.81	2.06	0.281				
West Halmahera	1.08	0.78	1.50	0.646				
North Halmahera	1.24	0.84	1.83	0.268				
South Halmahera	1.10	0.82	1.45	0.523				
Sula Island	0.91	0.66	1.26	0.574				
Household member								
≤5 members	1.00							
6-12 members	0.90	0.73	1.11	0.318				

Table 5.2 continued

Characteristic	Stunted Children 0 to 23 Months (n=1183)								Stunted Children 24 to 59 Months (n=985)								Stunted Children 0 to 59 Months (n=2168)							
	Unadjusted				Adjusted				Unadjusted				Adjusted				Unadjusted				Adjusted			
	OR	**[95% CI]**		***p***	**OR**	**[95% CI]**		***p***	**OR**	**[95% CI]**		***p***	**OR**	**[95% CI]**		***p***	**OR**	**[95% CI]**		***p***	**OR**	**[95% CI]**		***p***
Child level factors																								
Children Age	1.10	1.07	1.14	0	1.11	1.08	1.14	<0.001	1.00	0.98	1.01	0.671					1.02	1.02	1.04	<0.001	1.03	1.01	1.03	<0.001
Gender																								
Boy	1.00				1.00				1.00								1.00				1.00			
Girl	0.73	0.54	0.97	0.032	0.67	0.50	0.89	0.006	0.80	0.61	1.05	0.108					0.74	0.59	0.93	0.010	0.74	0.59	0.93	<0.001
Immunisation Status																								
Never	1.00								1.00								1.00							
Ever	1.59	1.15	2.21	0.006					1.10	0.76	1.58	0.62					1.55	1.19	2.00	0.001				
Sick in the last 2 weeks																								
No	1.00								1.00								1.00							
Yes	0.84	0.66	1.08	0.17					0.93	0.70	1.25	0.638					0.83	0.68	1.02	0.072				
Visits to Local health Services																								
0	1.00								1.00				1.00				1.00				1.00			
once	0.97	0.60	1.56	0.901					1.37	0.92	2.05	0.12	1.35	0.90	2.04	0.143	1.04	0.75	1.44	0.804	1.24	0.89	1.73	0.191
2 times	0.85	0.55	1.30	0.443					1.74	1.28	2.35	0.001	1.67	1.23	2.27	0.002	0.98	0.76	1.27	0.898	1.28	1.01	1.62	0.044
>=3 times	1.15	0.74	1.78	0.524					1.75	1.15	2.67	0.01	1.66	1.09	2.55	0.020	1.21	0.91	1.62	0.178	1.54	1.15	2.06	0.005

OR – odds ratio; CI – confidence interval. Multiple logistic regression analysis was used to adjust the ORs for the characteristics listed in the table where the p-value on univariate analysis was <0.250.

Table 5.3: Univariate and multivariate analyses for the association between severe stunting and children aged 0 to 23 months, 24 to 59 months and 0 to 59 months, North Maluku, Indonesia 2004

Characteristic	Severely Stunted Children 0 to 23 Months (n=1183)								Severely Stunted Children 24 to 59 Months (n=985)								Severely Stunted Children 0 to 59 Months (n=2168)							
	Unadjusted				Adjusted				Unadjusted				Adjusted				Unadjusted				Adjusted			
	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*	OR	[95% CI]		*p*	OR	95% CI		*p*
Family level factors																								
Father education																								
Completed Elementary school	1.00								1.00								1.00							
Completed Junior High School	0.78	0.48	1.26	0.309					0.95	0.64	1.40	0.778					0.89	0.64	1.24	0.479				
Completed Senior High school	0.75	0.51	1.10	0.132					0.63	0.41	0.96	0.033					0.68	0.50	0.91	0.010				
Mother Education																								
Completed Elementary school	1.00								1.00								1.00							
Completed Junior High School	0.65	0.41	1.05	0.075					0.77	0.52	1.13	0.179					0.70	0.51	0.98	0.037				
Completed Senior High school	0.63	0.43	0.92	0.019					0.72	0.48	1.08	0.110					0.66	0.49	0.88	0.005				
Father Occupation																								
Any Labour	1.00								1.00								1.00				1.00			
Fisher man	0.80	0.49	1.32	0.381					1.10	0.78	1.53	0.584					0.92	0.70	1.19	0.515	1.13	0.85	1.52	0.399
No work	1.45	0.63	3.34	0.378					2.36	0.87	6.42	0.092					1.65	0.92	2.94	0.089	2.04	1.17	3.53	0.012
Government /Private officer	0.68	0.42	1.10	0.113					0.60	0.35	1.04	0.066					0.63	0.45	0.89	0.010	0.79	0.55	1.14	0.211
Mother Occupation																								
Any Labour	1.00								1.00								1.00							
Fisher woman	1.33	0.62	2.88	0.457					1.26	0.56	2.81	0.571					1.31	0.78	2.22	0.300				
No work	0.93	0.63	1.39	0.733					1.01	0.67	1.51	0.972					0.98	0.75	1.28	0.876				
Government /Private officer	1.01	0.51	2.01	0.972					0.71	0.27	1.89	0.492					0.83	0.49	1.40	0.478				
Parental Education																								
Both with high education	1.00								1.00								1.00							
Father with high education	1.07	0.44	2.63	0.874					0.87	0.38	1.97	0.733					1.37	0.92	2.04	0.114				
Mother with high education	1.51	0.97	2.35	0.067					1.11	0.74	1.68	0.600					1.38	1.09	1.73	0.007				
Neither with high education	1.62	1.09	2.41	0.018					1.47	0.96	2.23	0.075					1.43	1.11	1.84	0.007				

Table 5.3 continued

Characteristic	Severely Stunted Children 0 to 23 Months (n=1183)								Severely Stunted Children 24 to 59 Months (n=985)								Severely Stunted Children 0 to 59 Months (n=2168)							
	Unadjusted				Adjusted				Unadjusted				Adjusted				Unadjusted				Adjusted			
	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*	OR	95% CI		*p*	OR	[95% CI]		*p*	OR	95% CI		*p*
Parental Employment																								
Both working	1.00								1.00				1.00				1.00							
Father only working	0.87	0.60	1.26	0.457					1.09	0.75	1.58	0.657	1.19	0.77	1.85	0.420	0.97	0.79	1.18	0.741				
Mother only working	0.88	0.16	4.74	0.878					5.63	1.51	20.98	0.011	5.18	1.44	18.60	0.013	1.83	0.97	3.47	0.063				
Neither working	1.90	0.72	5.01	0.189					0.50	0.10	2.59	0.404	0.67	0.12	3.85	0.650	0.95	0.47	1.92	0.888				
Family Meals per day																								
2 Times	1.00								1.00															
>2 Times	0.89	0.60	1.32	0.549					0.94	0.65	1.35	0.739												
Household wealth Index																								
Poorest	1.00				1.00				1.00								1.00				1.00			
Middle	0.77	0.51	1.15	0.199	0.82	0.55	1.22	0.319	0.98	0.69	1.39	0.896					0.87	0.65	1.16	0.344	0.89	0.66	1.20	0.438
Richest	0.43	0.24	0.79	0.007	0.42	0.23	0.77	0.006	0.58	0.37	0.92	0.021					0.50	0.33	0.75	0.001	0.52	0.33	0.82	0.005
Region																								
Rural	1.00								1.00								1.00							
Urban	1.04	0.64	1.70	0.869					1.49	1.00	2.22	0.048					1.33	1.03	1.71	0.028				
District																								
Ternate	1.00								1.00				1.00				1.00							
Tidore	0.88	0.29	2.68	0.824					1.15	0.51	2.56	0.733	1.17	0.51	2.65	0.707	0.60	0.38	0.94	0.026				
Central Halmahera	1.11	0.64	1.92	0.706					2.32	1.24	4.34	0.009	2.34	1.20	4.55	0.013	1.31	0.91	1.88	0.142				
East Halmahera	1.70	0.81	3.56	0.157					1.63	0.78	3.40	0.192	1.75	0.83	3.68	0.136	1.29	0.81	2.06	0.281				
West Halmahera	0.40	0.18	0.92	0.031					1.49	0.87	2.56	0.147	1.49	0.83	2.65	0.176	1.08	0.78	1.50	0.646				
North Halmahera	0.93	0.51	1.68	0.803					1.21	0.60	2.41	0.588	1.19	0.57	2.47	0.637	1.24	0.84	1.83	0.268				
South Halmahera	0.85	0.46	1.57	0.600					1.86	1.14	3.05	0.014	1.90	1.14	3.14	0.014	1.10	0.82	1.45	0.523				
Sula Island	0.72	0.37	1.40	0.332					0.61	0.33	1.14	0.120	0.66	0.34	1.27	0.207	0.91	0.66	1.26	0.574				
Household member																								
≤5 members	1.00								1.00								1.00							
6-12 members	0.86	0.59	1.24	0.407					1.04	0.77	1.42	0.780					0.90	0.73	1.11	0.318				

Table 5.3 continued

Characteristic	Severely Stunted Children 0 to 23 Months (n=1183)								Severely Stunted Children 24 to 59 Months (n=985)								Severely Stunted Children 0 to 59 Months (n=2168)							
	Unadjusted				Adjusted				Unadjusted				Adjusted				Unadjusted				Adjusted			
	OR	95% CI		p	OR	95% CI		p	OR	95% CI		p	OR	95% CI		p	OR	[95% CI]		p	OR	95% CI		p
Child level factors																					1.00			
Children Age	1.08	1.05	1.12	0.000	1.08	1.05	1.12	<0.001	0.99	0.97	1.00	0.084					1.03	1.02	1.04	0.000	1.02	1.01	1.03	<0.001
Gender																								
Boy	1.00				1.00				1.00								1.00				1.00			
Girl	0.63	0.45	0.89	0.010	0.58	0.42	0.81	0.002	0.83	0.61	1.12	0.216					0.77	0.63	0.95	0.014	0.72	0.58	0.90	0.005
Immunisation Status																								
Never									1.00								1.00							
Ever	1.06	0.66	1.70	0.818					1.19	0.63	2.24	0.590					1.22	0.80	1.87	0.348				
Sick in the last 2 weeks																								
No	1.00				1.00				1.00								1.00							
Yes	0.59	0.41	0.85	0.005	0.56	0.39	0.80	0.002	0.92	0.65	1.31	0.641					0.72	0.54	0.95	0.023				
Visit Local Health Services																								
0	1.00								1.00								1.00							
Once	1.16	0.64	2.11	0.620					1.92	1.15	3.20	0.013					1.47	0.98	2.22	0.063				
2 times	0.72	0.42	1.25	0.240					1.89	1.21	2.95	0.006					1.10	0.77	1.55	0.601				
>=3 times	0.86	0.45	1.65	0.651					2.12	1.30	3.44	0.003					1.31	0.86	2.01	0.209				

OR – odd ratio; CI – confidence interval. Multiple logistic regression analysis was used to adjust the ORs for the characteristics listed in the table where the p-value on univariate analysis was <0.250.

5.3 Discussion

In this chapter, socio-economic factors were assessed to determine if any association existed with stunting and severe stunting in children aged less than 59 months in North Maluku Province Indonesia, in 2004. The analysis for stunting and severe stunting in children was categorised into three age groups: (1) 0 to 23 months; (2) 24 to 59 months; and (3) overall 0 to 59 months; to determine if differences existed between younger and older children.

North Maluku is a new province in Indonesia and this is the first study to determine factors related to stunting and severe stunting in pre-school aged children in this region. This is also the first study in Indonesia to assess the association between severe stunting and socio-economic background in young children.

The prevalence of stunting was higher in the older children compared with the younger group (50% versus 29% respectively) with one in two children aged 24 to 59 months with stunting. For severe stunting the prevalence was higher in the younger age group compared with the older age group (14% versus 5.5%).

The data from this study supported the hypothesis that children from wealthier families will have lower odds of stunting compared to children from poorer households with the odds being reduced significantly by 22% in middle income families and 38% in richest families, adjusted for other family level and child level characteristics (OR 0.78, 95%CI 0.63, 0.98 and 0.62, 95%CI 0.45, 0.85).

Based upon multivariate analyses for children aged 0 to 23 months, modelling results established that the age of the child in months and gender were strongly associated with stunting and severe stunting. Increasing age in months increased the odds of stunting and severe stunting and girls had 33% and 42% lowered odds of stunting and severe stunting, respectively, compared to boys. Household wealth was also strongly associated with children being severely stunted where being from a wealthier household reduced the odds of severe stunting by 28% to 58% compared with middle and poorer households, respectively.

For children aged 24 to 59 months, the mother's education and the number of child visits to local health services were independently associated with stunting, and parental employment and district were independently associated with severe stunting. As might be expected better educated mothers reduced the odds of stunting and severe stunting in their children by between 20 and 40%. Other research has shown that a mother's education is likely to influence the frequency of children with stunting (Addison, 2006; Harpham et al., 2006; Moestue and Huttly, 2008).

Children aged 0 to 59 months who visited local health services three or more times in the preceding three months of the study survey had statistically significantly increased odds of being stunted compared to children who did not visit the local health services during this same. There are two main reasons why the family might bring a child to the health services. The first is when their child is sick and the second is to attend a regular health programs for children and their mothers, held monthly in health services in North Maluku Province. Perhaps the mothers of children with stunting visit the health service more often due to illness.

Children aged 24 to 59 months where the mother only was working and not the father had statistically significantly increased odds of severe stunting compared to children aged 24 to 59 months where both parents were working. The reasons for this may be related to accessibility of food while the mother is at work where the mother assumes that the father will take on this responsibility. Where both parents are working the mother may organise for another family member to provide food for the child. We were not able to explore these reasons further from this study.

Children aged 24 to 59 months from the districts of Central Halmahera and South Halmahera had approximately double the odds of severe stunting compared to children from the district of Ternate. Given that the refugee camps were established in Ternate it may have been anticipated that Ternate would have higher rates of stunting. However, Ternate is the capital city of North Maluku where health facilities can be accessed relatively easily by families compared to families who live in Central Halmahera and South Halmahera districts. North Maluku is made up of many islands and the most common mode of transportation to travel from one district to another district is by boat. Transportation between districts is a major barrier for families from more remote areas accessing food and health information and limiting access to local health services, which are available only twice a week.

The children living in Tidore were more likely to be protected from stunting and severe stunting than those living in other districts because Tidore District is the old capital city of North Maluku where all the main transportation can easily be accessed compared with the other districts. Like Ternate, Tidore is also an area where the refugee camps were established and possibly reflects the level of food aid provided post conflict. In terms of future program delivery to improve nutritional status this means that availability of transportation needs to be factored in to the design of any intervention.

Overall, for children aged 0 to 59 months, household wealth index, child age in months, gender of the child and visits to local health services were independently associated with stunting; and household wealth, age in months, gender of the child and father occupation were associated with severe stunting.

If the father of the children was unable to work the odds of the child having severe stunting were doubled. As the father is usually responsible for providing all the family needs including food, availability and consumption may be limited, directly influencing the health and nutritional status of their children. In Indonesia it is common for more than one family to live in one household; even after marriage a couple may remain living with their parents and the parents will look after their extended family.

Household socio-economic factors are a strong influence on the household member's health in terms of their financial ability to secure goods and services. Children from wealthier households had reduced odds of stunting and severe stunting by 22% and 38% respectively, compared to children from the poorest households. The results from this research are consistent with findings from other studies where communities with a ’poor’ household wealth index had a higher probability of raising under-nourished children in the age group of 0 to 59 months (1977; Arnold et al., 1981; Berg and Muscat, 1972; Cordaro and Levinson, 1971; Creed and Graham, 1980; Desai et al., 1980; Dewey, 1998; Gordon, 1982; Kaplay, 1978; Levy et al., 1975).

Compared with the children aged 24 to 59 months children aged less than 24 months are more dependent on their mother for adequate food intake. Younger children’s primary nutritional intake may be from breast milk. Mother’s may believe that breast feeding provides sufficient nutrition for their children and unfortunately there was no breast feeding data available for this study to explore this further. Children aged 24 to 59 frequently have more food choices and may have additional food available for them compared to younger children. These findings are similar to that reported by others (Adair and Guilkey, 1997; Chen et al., 1980; Mendez and Adair, 1999; Semba et al., 2008), which reported that children in the younger age group of 0 to 23 months were at a higher risk of becoming stunted or severely stunted.

Gender had a strong association with stunting and severe stunting for the 0 to 23 months age group and for children aged 0 to 59 months, where girls had reduced odds of being stunted and severely stunted. This result is interesting because usually girls had increased odds of being stunted and severely stunted compared with boys. It may because of traditional food habits and beliefs.

Previous studies in the shantytowns of Sao Paulo of Brazil support this finding (Hoffman et al., 2000; Moestue and Huttly, 2008; Prista et al., 2003).

Interestingly, children who frequently visited local health service (Posyandu) in the previous three months had increased the odds of stunting, especially for children aged 24 to 59 months and overall for children aged 0 to 59 months. An explanation for this may be that mothers commonly bring their children to Posyandu because the children were sick.

For severely stunted children aged 0 to 23 months, the children who were sick in the two weeks preceding the study survey were less likely to be severely stunted when compared to children who were not sick. They may have been sick in the last two weeks but not with a condition which would affect their nutritional status. For example, following immunisation a child may experience a high fever, or food allergies such as itchy skin. Previous studies have reported that sickness in the last two weeks can affect the nutritional status of children (Harpham et al., 2006; Manger et al., 2008; Smith et al., 1991).

Previous research on nutritional status in Indonesia has reported on stunting in children with few studies exploring severe stunting. Observations from the literature are that children with severe stunting need to be treated with immediate action and intensive intervention, perhaps with a different approach to children with stunting.

The prevalence of stunting among pre-school children in Indonesia showed no changes from 1991 to 2001 (44.5% in 1991 and 46% in 2001).The prevalence of stunting has been increasing to more than 40% since the 1990s (Atmarita, 2008) with the results lower than from this study.

Similar study results were found in another study in Indonesia in which children whose mother had higher education led to a reduction of between 4.4% and 5.0% in the odds of child stunting (OR 0.95, 95% CI 0.946, 0.954 in rural area; OR 0.96, 0.95, 0.96 in urban area). Fathers with a higher education led to a decrease of 3% in the odds of child stunting (OR 0.97, 95% CI 0.967, 0.974) (Richard D Semba, 2008).

There are two immediate causes of chronic child under-nutrition which leads to stunting: insufficient access to nutrients and high disease exposure. However, each ethnic group has its own customs and lifestyle factors, therefore socio-economic, regional, and ethnic factors frequently play a significant role in nutritional outcomes (Carlos Larrea and Freire, 2002). In developing countries, under-nutrition is one of the leading causes of morbidity and mortality in children less than five years old (Ayaya, 2004; Hautvast et al., 2000). Risk factors of under-nutrition including being stunted or severely stunted can include ignorance, family size, parental education, poverty, residence, and possessions such as radios, bicycles, livestock, water sources and agricultural land (Ayaya, 2004; Hautvast et al., 2000). Each country has different characteristics of morbidity, child care behaviour (including feeding practices), cultural beliefs, access to health care and environmental ecosystems, security and population specific approaches when studying risk factors for under-nutrition (Ricci and Becker, 1996).

This survey was a cross sectional analysis and therefore no association with causality can be determined. A major limitation of this study as a secondary data analysis is that there were no dietary intake data or breast feeding data to support the stunted and severely stunted status of the children. This study used two main characteristics: family and child level factors; however the results would have been enhanced with the addition of further dietary information. In addition data provided for this survey is subject to recall bias and therefore provides an estimate only of the nutritional status. In addition response bias may have resulted in an under estimate of stunting and of the true nutritional status of young children in North Maluku at this time. The precision and accuracy of data collection in terms of anthropometric measurement could be questioned. Even though training was provided, the type of equipment used and the variability among field workers may account for the wide Standard Deviations (SDs) of the anthropometric indices. While the wide standard deviations for this study indicate that the data was not of optimal quality, this data is important to provide indepth baseline nutritional data from which to develop relevant health policy and to undertake further research including the evaluation of intervention programs in North Maluku.

The findings in this study may help inform the North Maluku local government to establish programs of appropriate interventions for children less than five years old and also may assist the Indonesian government's public health planner to establish national nutrition and intervention programs for children of this age group to preventing stunting in young children. The data suggest that nutritional programs may be needed for older children and specifically boys, however preventing stunting in the earlier age of life may be more effective to reduce prevalence of stunting in older age by optimising access with interventions available via local health services.

However, overall, the findings from this study contribute to the wider understanding of factors associated with stunting and severe stunting in children aged 0 to 59 months in North Maluku, Indonesia. This study can provide a basis for planning interventions to prevent stunting in children less than five years of age. Based on this study providing base line data of nutrition status of children in North Maluku, further longitudinal studies of the risk factors for stunting in young children are required and recommended to determine any changes over time and to monitor the effectiveness of available nutritional support programs.

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CHAPTER 6

SOCIO-ECONOMIC FACTORS ASSOCIATED WITH CHILDREN WITH WASTING IN NORTH MALUKU INDONESIA

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6.1 Introduction

The period of civil unrest in the new province of North Maluku highlighted the importance of investigating under nutrition in children aged 0 to 59 months. This chapter describes the demographic and socio-economic factors associated with children aged 0 to 59 months with wasting in North Maluku, Indonesia in 2004. Moderate and severe wasting in children aged less than five years can be an indicator of child under-nutrition. As for Chapter 5, socio-economic status was measured using the mother's and father's level of education, their occupation, household wealth index, number of household members, household location (rural or urban), and geographical district. The child's age and gender, immunisation status and recent health of the child were also measured. The Chapter concludes with recommended interventions that may prevent wasting and improve the nutritional status of young children in North Maluku Indonesia.

Details of the study methodology have been presented in Chapter 3. This analysis refers to the proportion of children aged less than five years whose weight-for-height is below minus two standard deviations (-2 SD) for moderate wasting or below minus three standard deviations (-3 SD) for severe wasting from the median weight-for-height of the 2006 WHO International Child Growth Standards (WHO, 1995). The results obtained from the backward stepwise multiple binary regression applied in this study were used to determine these risk factors.

6.2 Results

The following tables compiled from the secondary data analysis of the North Maluku Health Survey summarise the number and percentage of children presenting with wasting and severe wasting for each of the three age groups studied: 0 to 23 months, 24 to 59 months and 0 to 59 months.

Table 6.1shows that 14% of children aged from 0 to 23 months were wasted and 5.4% were severely wasted. For children aged 24 to 59 months 13% of were wasted and 5.5% of children in this age group were severely wasted.

Table 6.1: Number and percentage of children with wasting aged 0 to 23 months and 24-59 months in North Maluku Province, Indonesia 2004

Weight-for-Height	0-23 months		Weight-for-Height	0-23 months	
	n	**%**		n	%
Not Wasted	1013	86	Not Severely Wasted	1119	95
Wasted	163	14	Severely Wasted	64	5.4
Total	1183	100	Total	1183	100
Weight-for-Height	**24-59 months**		**Weight-for-Height**	**24-59 months**	
	n	%		n	%
Not Wasted	854	87.1	Not Severely Wasted	931	94.5
Wasted	126	12.9	Severely Wasted	54	5.5
Total	985	100	Total	985	100

Unadjusted and adjusted odds ratios (OR) were calculated to estimate the risk of independent variables associated with wasting and severe wasting in the study population aged 0 to 59 months. Tables 6.2 and 6.3 report the unadjusted and adjusted ORs for the association between wasted and severely wasted children and the socio-economic characteristics of children aged 0 to 23 months, 24 to 59 months and the overall range of 0 to 59 months, with a sample of 2,168 children.

6.2.1 Univariate analysis for the outcome of wasting in children

The interpretation of results of the univariate analyses (unadjusted OR) is provided below, according to two age groups 0 to 23 and 24 to 59 months and for the overall 0 to 59 month study population.

6.2.2 Risk factors for wasting in children aged 0 to 23 months

Results of significance from the univariate analysis indicated an association with wasting in children in the 0 to 23 months age group, as follows:

Children aged 0 to 23 months with fathers who completed senior high school had reduced odds of wasting compared with children aged 0 to 23 months with fathers who completed elementary school (OR 0.67, 95%CI 0.42, 1.05), however this result did not reach statistical significance. Children aged 0 to 23 months with mothers who completed junior high school were statistically significantly associated with reduced odds of wasting compared with children aged 0 to 23 months with mothers who completed elementary school (OR 0.60, 95%CI 0.37, 0.95). Children aged 0 to 23 months with mothers who completed high school also had reduced odds of wasting compared with children aged 0 to 23 months with mothers who completed elementary school (0.67, 95% CI 0. 42, 1.05), however this result did not reach statistical significance.

A child's age in months was associated with wasting where for every increase in age by one month the odds of wasting was reduced by 1% however this result did not reach statistical significance (OR 0.99, 95%CI 0.96, 1.01). Girls aged 0 to 23 months had lowered odds of being wasted compared with boys aged 0 to 23 months (OR 0.75, 95%CI 0.52, 1.08), however this result was not statistically significant. Immunised children aged 0 to 23 months had reduced odds of being wasted compared with children aged 0 to 23 months who were not immunised (OR 0.63 95%CI 0.37, 1.05) however this result did also not reach statistical significance. Children aged 0 to 23 months who visited local health services three or more times in past three months had reduced odds of wasting (OR 0.63, 95%CI 0.35, 1.13) however this result did not reach statistical significance.

There was no statistically significant association between the following family level characteristics: mother's occupation, family meals per day, household wealth index and region (urban versus rural) and wasting in children aged 0 to 23 months. There was no statistically significant association between the child level characteristics of child age in months and sickness in the last two weeks preceding the study survey and wasting in children aged 0 to 23 months, as shown in Table 6.2.

6.2.3 Risk factors for wasting in children aged 24 to 59 months

Results of significance from the univariate analysis indicated an association with wasting in children in the 24 to 59 months age group, as follows:

Children aged 24 to 59 months with fathers who completed senior high school had increased odds of wasting compared with children aged 24 to 59 months with fathers who completed elementary school however this result did not reach statistical significance (OR 1.57, 95%CI 0.94, 2.63). Children aged 24 to 59 months with mothers who completed senior high school had increased odds of being wasted compared to children aged 24 to 59 months (OR 1.56, 95%CI 1.00, 2.43) with borderline statistical significance. Children aged 24 to 59 months with mothers who worked as a fisherwoman or who did not work had increased odds of wasting however these results did not reach statistical significance (OR 2.03, 95%CI 0.66, 6.22 and OR 1.54, 95%CI 0.90, 2.63, respectively).

The unadjusted ORs indicate that children aged 24 to 59 months from the richest households had more than double the odds of being wasted compared with children aged 24 to 59 months from the poorest households (OR 2.53, 95%CI 1.49, 4.30) and reduced odds compared to the middle wealth families (OR 1.64, 95%CI 1.02, 2.65); both results were statistically significant.

Children aged 24 to 59 months from rural areas had reduced odds of wasting compared with from urban areas (OR 0.60, 95%CI 0.35, 1.01) however this result was of borderline statistical significance. Children aged 24 to 59 months had statistically significantly reduced odds of wasting if they lived in the Central Halmahera district, West Halmahera or the North Halmahera district compared with children aged 24 to 59 months who lived in the Ternate district (OR 0.15, 95%CI 0.04, 0.52, OR 0.45, 95%CI 0.23, 0.87 and OR 0.39 95%CI 0.19, 0.81, respectively). Children aged 24 to 59 months had increased odds of wasting if they lived in the Sula Island district compared with children aged 24 to 59 months who lived in the Ternate district (OR 1.57, 95%CI 0.73, 3.35), however this result did not reach statistical significance. The remaining districts in North Maluku did not have a statistically significant association with wasting in children aged 24 to 59 months.

Children aged 24 to 59 months had a two percent increased odds of wasting for every month of increased aged (OR 1.02, 95%CI 1.00, 1.04). Girls aged 24 to 59 months had reduced odds of wasting compared to boys aged 24 to 59 months, however this result did not reach statistical significance (OR 0.80, 95%CI 0.54, 1.17). Children aged 24 to 59 months who were immunised had increased odds of wasting compared with children aged 24 to 59 months not immunised, however this result did not reach statistical significance (OR 1.61, 95%CI 0.78, 3.34). Children aged 24 to 59 months who were sick in the previous two weeks had statistically significantly increased odds of wasting compared to children who were not sick during the previous two weeks (OR 1.7, 95%CI 1.02, 2.84). Children aged 24 to 59 months who visited local health services more than three times in the previous three months had statistically significantly reduced odds of wasting compared with children aged 24 to 59 months who did not visit health services in the preceding three months (OR 0.45, 95%CI 0.28, 0.73).

The following family level characteristics were not associated with wasting in children aged 24 to 59 months: the numbers of family meals per day and the number of household members. Details are shown in Table 6.2.

6.2.4 Risk factors for wasting in children aged 0 to 59 months

Results of significance from the univariate analysis indicated an association with wasting in children in the 0 to 59 months age group, as follows:

Children aged 0 to 59 months with mothers who completed junior high school had reduced odds of being wasted compared to children aged 0 to 59 months (OR 0.80, 95%CI 0.60, 1.11) however this result did not reach statistical significance. Children aged 0 to 59 months with mothers who worked as a fisherwoman had increased odds of wasting compared to children aged 0 to 59 months whose mother worked doing any labour; however these results did not reach statistical significance (OR 1.49, 95%CI 0.75, 2.98).

The unadjusted ORs indicate that children aged 0 to 59 months from the richest households had increased odds of wasting compared with children aged 0 to 59 months from the poorest households (OR 1.37, 95%CI 0.96, 1.95) however this result did not reach statistical significance. Children aged 0 to 59 months had statistically significantly reduced odds of wasting if they lived in the Central Halmahera district, West Halmahera or the North Halmahera district compared with children aged 0 to 59 months who lived in the Ternate district (OR 0.38, 95%CI 0.22, 0.69, OR 0.57, 95%CI 0.36, 0.89 and OR 0.43 95%CI 0.25, 0.72, respectively). The remaining districts in North Maluku did not have a statistically significant association with wasting in children aged 0 to 59 months. Children aged 0 to 59 months from households with 6 to 12 members had reduced odds of being wasted compared to children aged 0 to 59 months from households of five members or less, however this result was not statistically significant (OR 0.83, 95%CI 0.62, 1.12).

Girls aged 0 to 59 months had statistically significantly reduced odds of wasting compared to boys aged 0 to 59 months (OR 0.77, 95%CI 0.60, 0.98). Children aged 0 to 59 months who were sick in the previous two weeks had increased odds of wasting compared to children aged 0 to 59 months who were not sick during the previous two weeks (OR 1.30 95%CI 0.97, 1.75), however this result did not reach statistical significance. Children aged 0 to 59 months who visited local health services twice or three or more times in the previous three months had statistically significantly reduced odds of wasting compared with children aged 0 to 59 months who did not visit health services in the preceding three months (OR 0.64, 95%CI 0.44, 0.92 and OR 0.54, 95%CI 0.35, 0.84, respectively).

The following family level characteristics were not associated with wasting in children aged 0 to 59 months: father’s education, number of family meals per day and region. The child level characteristics of age in months and immunisation status were also not associated with wasting in children aged 0 to 59 months on univariate analysis.

6.2.5 Risk factors for severe wasting in children aged 0 to 23 months

Results of significance from the univariate analysis indicated an association with severe wasting in children in the 0 to 23 months age group, as follows:

Children aged 0 to 23 months with fathers who completed senior high school had reduced odds of severe wasting compared with children aged 0 to 23 months with fathers who completed elementary school (OR 0.53, 95%CI 0.27, 1.04), however this result did not reach statistical significance. Children aged 0 to 23 months with mothers who completed junior high school or senior high school were associated with reduced odds of severe wasting compared with children aged 0 to 23 months with mothers who completed elementary school (OR 0.61, 95%CI 0.31, 1.19 and OR 0.56, 95%CI 0.26, 1.21, respectively) however these results did not reach statistical significance.

Children aged 0 to 23 months from the district of Central Halmahera had statistically significantly reduced odds of severe wasting compared with children aged 0 to 23 months from Ternate district (OR 0.16, 95%CI 0.04, 0.70). Children aged 0 to 23 months from the districts of Tidore, West Halmahera and North Halmahera had reduced odds of severe wasting compare to children aged 0 to 23 months from Ternate district, however these results were not statistically significant

(OR 0.28, 95%CI 0.04, 1.96, OR 0.17, 95%CI 0.02, 1.18 and OR 0.40, 95%CI 0.13, 1.27, respectively).

Girls aged 0 to 23 months had half the odds of severe wasting compared with boys aged 0 to 23 months (OR 0.50, 95%CI 0.27, 0.91), and this result was statistically significant. Immunised children aged 0 to 23 months had reduced odds of severe wasting compared with children aged 0 to 23 months who were not immunised (OR 0.67 95%CI 0.38, 1.20) however this result did not reach statistical significance. Children aged 0 to 23 months who were sick in the past two weeks had increased odds of being severe wasting compared to children aged 0 to 23 months who were not sick (OR 1.53, 95%CI 0.87, 2.67) however this result did not reach statistical significance. Children aged 0 to 23 months who visited local health services three or more times in past three months had reduced odds of severe wasting (OR 0.63, 95%CI 0.29, 1.37) however this result also did not reach statistical significance.

The family level characteristics of mother's occupation, family meals per day, household wealth index, region, and number of household members were not associated with severe wasting in children aged 0 to 23 months. The child level factor of child age in months was not associated with severe wasting in children aged 0 to 23 months (refer to Table 6.3).

6.2.6 Risk factors severe wasting in children aged 24 to 59 months

Results of significance from the univariate analysis indicated an association with severe wasting in children in the 24 to 59 months age group, as follows:

Children aged 24 to 59 months with mothers who worked as a fisherwoman or who did not work or who worked as a government or private officer had increased odds of severe wasting however these results did not reach statistical significance (OR 2.33, 95%CI 0.59, 9.26, OR 1.56, 95%CI 0.79, 3.09 and OR 3.01, 95%CI 0.82, 11.0, respectively). Children aged 24 to 59 months where more than two meals per day were provided had increased odds of severe wasting compared to children aged 24 to 59 months from families who provided two meals per day (OR 1.37, 95%CI 0.80, 2.33), however this results did not reach statistical significance.

The unadjusted ORs indicate that children aged 24 to 59 months from the richest households had more than double the odds of severe wasting compared with children aged 24 to 59 months from the poorest households (OR 2.52, 95%CI 1.13, 5.65). This result was statistically significant as the 95% confidence interval did not cross one.

Children aged 24 to 59 months had reduced odds of severe wasting if they lived in the Central Halmahera or West Halmahera districts compared with children aged

24 to 59 months who lived in the Ternate district (OR 0.28, 95%CI 0.06, 1.38, OR 0.34, 95%CI 0.07, 1.60, respectively), however these results were not statistically significant. Children aged 24 to 59 months had increased odds of severe wasting if they lived in the Sula Island district compared with children aged 24 to 59 months who lived in the Ternate district (OR 2.17, 95%CI 0.78, 6.06), however this result did not reach statistical significance. The remaining districts in North Maluku did not have an association with severe wasting in children aged 24 to 59 months.

Children aged 24 to 59 months had a statistically significant five percent increase in odds of severe wasting for every one month of increased aged (OR 1.05, 95%CI 1.01, 1.09). Girls aged 24 to 59 months had reduced odds of severe wasting compared to boys aged 24 to 59 months, however this result did not reach statistical significance (OR 0.60, 95%CI 0.35, 1.05). The unadjusted ORs indicated that children who visited local health services once, twice or three or more times in the previous three months had statistically significantly reduced odds of severe wasting compared with children who did not visit the local health services (OR 0.29, 95%CI 0.10, 0.85, OR 0.41, 95%CI 0.19, 0.90 and OR 0.23, 95%CI 0.09, 0.57, respectively). These results are reported in Table 6.3.

The family level characteristics of father’s education, mother’s education, region and number of household family members were not associated with severe wasting in children aged 24 to 59 months. Nor was child immunisation status associated with severe wasting on univariate analysis.

6.2.7 Risk factors for severe wasting in children aged 0 to 59 months

Results of significance from the univariate analysis indicated an association with severe wasting in children in the 0 to 59 months age group, as follows:

Children aged 0 to 59 months with mothers who worked as a fisherwoman had increased odds of severe wasting however these results did not reach statistical significance (OR 1.88, 95%CI 0.88, 4.02). Children aged 0 to 59 months where more than two meals per day were provided had increased odds of severe wasting compared to children aged 0 to 59 months from families who provided two meals per day (OR 1.34, 95%CI 0.83, 2.15), however this results did not reach statistical significance.

The unadjusted ORs indicate that children aged 0 to 59 months from the richest households and the middle wealth households had increased odds of severe wasting compared with children aged 0 to 59 months from the poorest households (OR 1.52, 95%CI 0.89, 2.60 and OR 1.30, 95%CI 0.83, 2.04, respectively) however this result did not reach statistical significance.

Children aged 0 to 59 months had statistically significantly reduced odds of severe wasting if they lived in the Central Halmahera district and West Halmahera district compared with children aged 0 to 59 months who lived in the Ternate district (OR 0.21 95%CI 0.06, 0.68 and OR 0.25, 95%CI 0.09, 0.68, respectively). Children aged 0 to 59 months had reduced odds of severe wasting if they lived in the Tidore district compared with children aged 0 to 59 months who lived in the Ternate district (OR 0.40 95%CI 0.11, 1.39), however this result did not reach statistical significance. Children aged 0 to 59 months had increased odds of severe wasting if they lived in the Sula island district compared with children aged 0 to 59 months who lived in the Ternate district (OR 1.83 95%CI 1.00, 3.36); this result just reaching statistical significance. The remaining districts in North Maluku did not have a statistically significant association with wasting in children aged 0 to 59 months.

The unadjusted ORs indicated that girls aged 0 to 59 months had statistically significantly reduced odds of severe wasting compared with boys aged 0 to 59 months (OR 0.55, 95%CI 0.35, 0.85). The unadjusted ORs also indicated that children aged 0 to 59 months who visited the local health services twice or three or more times in the previous three months had statistically significantly reduced odds of severe wasting compared with children aged 0 to 59 months who did not visit the local health services in the previous three months (OR 0.57, 95%CI 0.35, 0.94 and OR 0.40, 95%CI 0.22, 0.74 respectively). Children aged 0 to 59 months who visited the local health service once in the past three months also had reduced odds of severe wasting however this result did not reach statistical significance (OR 0.56, 95%CI 0.30, 1.04), as shown in Table 6.3.

The following family level characteristics were not associated with severe wasting in children aged 0 to 59 months: father's education, mother's education, mother's occupation, number of family meals per day, region and number of household family members. The child level characteristics of age in months, gender and immunisation status were also not associated with severe wasting in children aged 0 to 59 months on univariate analysis.

6.2.8 Multivariate analysis for the outcome of wasting

The interpretation of the results for the multivariate analysis (adjusted OR) is provided below under the two age groups 0 to 23 and 24 to 59 months and for the overall 0 to 59 month study population.

6.2.9 Risk factors for wasting in children aged 0 to 23 months

From the multivariate analysis, none of the characteristics included in the model were statistically significantly associated with wasting in children aged 0 to 23 months in North Maluku in 2004. The characteristics included in the multivariate model included the family level and child level characteristics with a p-value of less than 0.250 on univariate analysis including father education, mother education, district, number of household members, child age in months, gender, immunisation status and local health service visits in the past three (see Table 6.2)

6.2.10 Risk factors for wasting in children aged 24 to 59 months

Results of significance from the multivariate analysis indicate an independent association with wasting and visiting local health service in children aged 24 to 59 months are described below.

The adjusted ORs indicate that children aged 24 to 59 months who visited the local health services twice or three or more times in the previous three months had statistically significantly reduced odds of being wasted compared with those children who did not visit the local health services in the previous three months (OR 0.44, 95%CI 0.25, 0.79 and OR 0.50, 95%CI 0.31, 0.79, respectively). Children aged 24 to 59 months who visited the local health services once during the previous three months had reduced odds of being wasted compared with those children who did not visit the local health services (OR 0.69, 95%CI 0.36, 1.32), however this result was not statistically significant, Details are shown in Table 6.2.

This analysis was adjusted for the following family level characteristics: father education, mother education, mother occupation, household wealth index, region, and district, plus the following child level characteristics: child age in months, gender, immunisation status and sickness in the last two weeks.

6.2.11 Risk factors for wasting in children aged 0 to 59 months

From the multivariate analysis, none of the characteristics included in the model were statistically significantly associated with wasting in children aged 0 to 59 months in North Maluku in 2004. The characteristics included in the multi-variable model included the family level and child level characteristics with a p-value of less than 0.250 on univariate analysis including mother education, mother occupation, household wealth index, number of household members, gender, sickness in the last two weeks and visits to health local services (see Table 6.2).

6.2.12 Risk factors for severe wasting in children aged 0 to 23 months

Results of significance from the multivariate analysis indicate an independent association with severe wasting and district in children aged 0 to 23 months.

From the multivariable model for severe wasting, children aged 0 to 23 months who lived in Central Halmahera district had statistically significantly decreased odds of being severely wasted compared to children aged 0 to 23 months from the Ternate district (OR 0.16, 95%CI 0.04, 0.70). Children aged 0 to 23 months from the district of West Halmahera had reduced odds of being severely wasted however this result did not reach statistical significance (OR 0.17, 95%CI 0.02, 1.18).

This analysis was adjusted for the family level characteristics of father education and mother education, plus the child level characteristics of gender, immunisation status, and sickness in the last two weeks and visits to local health services.

6.2.13 Risk factors for severe wasting in children aged 24 to 59 months

Results of significance from the multivariate analysis indicate an independent association with severe wasting and child age in months, visiting local health service in children aged 24 to 59 months.

From the multivariable model for severe wasting in children aged 24 to 59 months, a child's age in months was found to be statistically significantly associated with severe wasting (OR 1.05, 95%CI 1.01, 1.09). For each month increase in age the odds of being wasted increased by five percent. The adjusted ORs indicated that children aged 24 to 59 months who visited the local health services once, twice or three or more times in the three months preceding the study survey had statistically significantly reduced odds of severe wasting compared with children who did not visit the local health services (OR 0.31, 95%CI 0.11, 0.89, OR 0.45, 95%CI 0.21, 0.97 and OR 0.26, 95%CI 0.11, 0.63, respectively) as shown in Table 6.3.

This analysis was adjusted for the family level characteristics of mother occupation, number of family meals per day and household wealth index, plus the child level characteristic of gender.

6.2.14 Risk factors for severe wasting in children aged 0 to 59 months

From the multivariable model for severe wasting in children aged 0 to 59 months gender was found to be statistically significant. The adjusted ORs indicated girls aged 0 to 59 months had reduced odds of being severely wasted compared with boys aged 0 to 59 months (OR 0.55, 95%CI 0.35, 0.85). See Table. 6.3.

This analysis was adjusted for the family level characteristics of mother education, mother occupation, number of family meals per day, household wealth index and district, plus the child level characteristic of number of local health service visits in the previous three months.

Table 6.2: Univariate and multivariate analyses of wasting in children aged 0 to 23, 24 to 59 and 0 to 59 months, North Maluku Province, Indonesia 2004

Characteristic	Children with wasting aged 0-23 months							Children with wasting aged 24-59 months							Children with wasting aged 0-59 months						
	Unadjusted				Adjusted			Unadjusted				Adjusted			Unadjusted				Adjusted		
	OR	95% CI		*p*	OR	[95% CI]	*p*	OR	95% CI		*p*	OR	95% CI	*p*	OR	95% CI		*p*	OR	95% CI	*p*
Family level factors																					
Father education																					
Completed Elementary school	1.00							1.00							1.00						
Completed Junior High School	0.89	0.59	1.33	0.551				1.02	0.57	1.84	0.942				0.93	0.69	1.26	0.646			
Completed Senior High school	0.77	0.52	1.13	0.176				1.57	0.94	2.63	0.087				1.05	0.77	1.43	0.742			
Mother Education																					
Completed Elementary school	1.00							1.00							1.00						
Completed Junior High School	0.60	0.37	0.95	0.030				1.19	0.78	1.82	0.405				0.81	0.60	1.11	0.192			
Completed Senior High school	0.67	0.42	1.05	0.078				1.56	1.00	2.43	0.051				0.97	0.74	1.29	0.846			
Mother Occupation																					
Any Labour	1.00							1.00							1.00						
Fisher woman	1.20	0.50	2.86	0.682				2.03	0.66	6.22	0.213				1.49	0.75	2.98	0.249			
No work	0.94	0.58	1.54	0.817				1.54	0.90	2.63	0.115				1.16	0.80	1.66	0.431			
Government /Private officer	0.71	0.26	1.94	0.500				1.56	0.49	4.95	0.443				0.98	0.47	2.05	0.958			
Family Meals per day																					
2 Times	1.00							1.00							1.00						
>2 Times	1.24	0.82	1.88	0.309				1.01	0.62	1.64	0.967				1.13	0.80	1.59	0.477			
Household wealth Index																					
Poorest								1.00													
Middle	1.06	0.71	1.58	0.765				1.64	1.02	2.65	0.042				1.27	0.94	1.72	0.114			
Richest	0.83	0.47	1.47	0.525				2.53	1.49	4.30	0.001				1.37	0.96	1.95	0.077			
Region																					
Urban	1.00							1.00							1.00						
Rural	1.13	0.66	1.95	0.645				0.60	0.35	1.01	0.054				0.84	0.58	1.23	0.367			

OR: odd ratio; CI – confidence interval. Multiple logistic regression analysis was used to adjust the ORs for the characteristics listed in the table where the p-value from the univariate analysis was <0.250.

Table 6.2 Continued

Characteristic	Children with wasting aged 0-23 months							
	Unadjusted				Adjusted			
	OR	95% CI		*p*	OR	[95% CI]		*p*
District								
Ternate	1.00							
Tidore	0.55	0.23	1.27	0.156				
Central Halmahera	0.64	0.28	1.46	0.287				
East Halmahera	1.22	0.46	3.22	0.678				
West Halmahera	0.73	0.37	1.44	0.363				
North Halmahera	0.47	0.18	1.20	0.112				
South Halmahera	1.26	0.62	2.55	0.510				
Sula Island	1.28	0.66	2.47	0.460				
Household member								
≤5 members	1.00							
6-12 members	0.67	0.43	1.05	0.077				
Child level factors								
Children Age	0.99	0.96	1.01	0.262				
Gender								
Boy	1.00							
Girl	0.75	0.52	1.08	0.122				
Immunisation Status								
Never	1.00							
Ever	0.63	0.37	1.05	0.076				
Sick in the last 2 weeks								
No	1.00							
Yes	1.05	0.71	1.55	0.803				
Visit local health services								
0	1.00							
Once	0.81	0.46	1.40	0.437				
2 times	0.83	0.51	1.35	0.444				
>=3 times	0.63	0.35	1.13	0.119				

Characteristic	Children with wasting aged 24-59 months							
	Unadjusted				Adjusted			
	OR	95% CI		*p*	OR	95% CI		*p*
District								
Ternate	1.00							
Tidore	0.62	0.18	2.16	0.450				
Central Halmahera	0.15	0.04	0.52	0.003				
East Halmahera	0.54	0.24	1.22	0.135				
West Halmahera	0.45	0.23	0.87	0.019				
North Halmahera	0.39	0.19	0.81	0.013				
South Halmahera	0.72	0.37	1.40	0.330				
Sula Island	1.23	0.65	2.32	0.512				
Household member								
≤5 members	1.00							
6-12 members	1.08	0.72	1.63	0.703				
Child level factors								
Children Age	1.02	1.00	1.04	0.039				
Gender								
Boy	1.00							
Girl	0.80	0.54	1.17	0.241				
Immunisation Status								
Never	1.00							
Ever	1.61	0.78	3.34	0.194				
Sick in the last 2 weeks								
No	1.00							
Yes	1.70	1.02	2.84	0.041				
Visit local health services								
0	1.00				1.00			
Once	0.62	0.32	1.22	0.161	0.69	0.36	1.32	0.255
2 times	0.39	0.21	0.71	0.003	0.44	0.25	0.79	0.006
>=3 times	0.45	0.28	0.73	0.002	0.50	0.31	0.79	0.004

Characteristic	Children with wasting aged 0-59 months							
	Unadjusted				Adjusted			
	OR	95% CI		*p*	OR	95% CI		*p*
District								
Ternate	1.00							
Tidore	0.56	0.29	1.08	0.084				
Central Halmahera	0.38	0.22	0.69	0.002				
East Halmahera	0.88	0.45	1.70	0.694				
West Halmahera	0.57	0.36	0.89	0.015				
North Halmahera	0.43	0.25	0.72	0.002				
South Halmahera	0.97	0.61	1.55	0.913				
Sula Island	1.26	0.83	1.91	0.281				
Household member								
≤5 members	1.00							
6-12 members	0.83	0.62	1.12	0.221				
Child level factors								
Children Age	1.00	0.99	1.01	0.983				
Gender								
Boy	1.00							
Girl	0.77	0.60	0.98	0.035				
Immunisation Status								
Never	1.00							
Ever	0.80	0.53	1.22	0.293				
Sick in the last 2 weeks								
No	1.00							
Yes	1.30	0.97	1.75	0.081				
Visit local health services								
0	1.00							
Once	0.71	0.43	1.17	0.173				
2 times	0.64	0.44	0.92	0.017				
>=3 times	0.54	0.35	0.84	0.006				

OR: odd ratio; CI – confidence interval. Multiple logistic regression analysis was used to adjust the ORs for the characteristics listed in the table where the p-value from the univariate analysis was <0.250.

Table 6.3: Univariate and multivariate analyses of severe wasting in children 0 to 23, 24 to 59 and 0 to 59 months, North Maluku Province, Indonesia 2004

Characteristic	Children with severe wasting aged 0-23 months						Children with severe wasting aged 24-59 months						Children with severe wasting aged 0-59 months					
	Unadjusted			Adjusted			Unadjusted			Adjusted			Unadjusted			Adjusted		
	OR	95% CI	*p*	OR	95% CI	*p*	OR	95% CI	*p*	OR	95% CI	*p*	OR	95% CI	*p*	OR	95% CI	*p*
Family level factors																		
Father education																		
Completed Elementary school	1.00						1.00						1.00					
Completed Junior High School	1.18	0.64 2.17	0.586				1.20	0.54 2.64	0.648				1.18	0.79 1.77	0.418			
Completed Senior High school	0.53	0.27 1.04	0.066				1.35	0.67 2.72	0.390				0.83	0.53 1.29	0.400			
Mother Education																		
Completed Elementary school	1.00						1.00						1.00					
Completed Junior High School	0.61	0.31 1.19	0.142				1.04	0.58 1.87	0.895				0.78	0.51 1.18	0.231			
Completed Senior High school	0.56	0.26 1.21	0.135				1.37	0.77 2.43	0.274				0.85	0.52 1.38	0.507			
Mother Occupation																		
Any Labour	1.00						1.00						1.00					
Fisher woman	1.60	0.60 4.26	0.336				2.33	0.59 9.26	0.224				1.88	0.88 4.02	0.101			
No work	1.06	0.54 2.06	0.869				1.56	0.79 3.09	0.196				1.25	0.76 2.05	0.379			
Government /Private officer	0.38	0.05 2.88	0.346				3.01	0.82 11.00	0.094				1.15	0.40 3.30	0.793			
Family Meals per day																		
2 Times	1.00						1.00						1.00					
>2 Times	1.31	0.69 2.49	0.397				1.37	0.80 2.33	0.250				1.34	0.83 2.15	0.225			
Household wealth Index																		
Poorest	1.00						1.00						1.00					
Middle	1.24	0.71 2.18	0.445				1.38	0.69 2.74	0.359				1.30	0.83 2.04	0.250			
Richest	0.95	0.46 1.97	0.884				2.52	1.13 5.65	0.025				1.52	0.89 2.60	0.124			
Region																		
Urban	1.00						1.00						1.00					
Rural	0.98	0.46 2.07	0.952				1.05	0.46 2.41	0.913				1.01	0.60 1.70	0.975			

OR: odd ratio; CI – confidence interval. Multiple logistic regression analysis was used to adjust the ORs for the characteristics listed in the table where the p-value from the univariate analysis was <0.250.

Table 6.3 Continued

Characteristic	Children with severe wasting aged 0-23 months								Children with severe wasting aged 24-59 months								Children with severe wasting aged 0-59 months							
	Unadjusted				Adjusted				Unadjusted				Adjusted				Unadjusted				Adjusted			
	OR	95% CI		p	OR	95% CI		p	OR	95% CI		p	OR	95% CI		p	OR	95% CI		p	OR	95% CI		p
District																								
Ternate	1.00				1.00				1.00								1.00							
Tidore	0.28	0.04	1.96	0.197	0.28	0.04	1.96	0.197	0.61	0.08	4.81	0.637					0.40	0.11	1.39	0.146				
Central Halmahera	0.16	0.04	0.70	0.015	0.16	0.04	0.70	0.015	0.28	0.06	1.38	0.115					0.21	0.06	0.68	0.010				
East Halmahera	1.06	0.39	2.86	0.904	1.06	0.39	2.86	0.904	0.80	0.29	2.21	0.659					0.99	0.51	1.93	0.988				
West Halmahera	0.17	0.02	1.18	0.072	0.17	0.02	1.18	0.072	0.34	0.07	1.60	0.169					0.25	0.09	0.68	0.008				
North Halmahera	0.40	0.13	1.27	0.118	0.40	0.13	1.27	0.118	0.96	0.31	2.97	0.939					0.65	0.31	1.38	0.257				
South Halmahera	1.03	0.44	2.46	0.937	1.03	0.44	2.46	0.937	1.32	0.52	3.31	0.553					1.16	0.65	2.06	0.614				
Sula Island	1.57	0.73	3.35	0.240	1.57	0.73	3.35	0.240	2.17	0.78	6.06	0.137					1.83	1.00	3.36	0.050				
Household member																								
≤5 members	1.00								1.00								1.00							
6-12 members	0.84	0.45	1.55	0.569					1.21	0.67	2.20	0.515					1.01	0.99	1.02	0.289				
Child level factors																								
Children Age	0.98	0.94	1.03	0.453					1.05	1.01	1.09	0.013	1.05	1.01	1.09	0.010	1.01	0.99	1.02	0.289				
Gender																								
Boy	1.00								1.00								1.00				1.00			
Girl	0.50	0.27	0.91	0.025					0.60	0.35	1.05	0.073					0.55	0.35	0.85	0.008	0.55	0.35	0.85	0.008
Immunisation Status																								
Never	1.00								1.00								1.00							
Ever	0.67	0.38	1.20	0.174					1.14	0.40	3.25	0.799					0.80	0.49	1.30	0.355				
Sick in the last 2 weeks																								
No	1.00								1.00								1.00							
Yes	1.53	0.87	2.67	0.138					0.87	0.44	1.73	0.693					1.19	0.79	1.80	0.392				
Visit local health Services																								
0	1.00								1.00				1.00				1.00							
Once	0.96	0.43	2.12	0.910					0.29	0.10	0.85	0.025	0.31	0.11	0.89	0.029	0.56	0.30	1.04	0.067				
2 times	0.80	0.42	1.51	0.480					0.41	0.19	0.90	0.026	0.45	0.21	0.97	0.041	0.57	0.35	0.94	0.029				
>=3 times	0.63	0.29	1.37	0.240					0.23	0.09	0.57	0.002	0.26	0.11	0.63	0.004	0.40	0.22	0.74	0.004				

OR – odd ratio; CI – confidence interval. Multiple logistic regression analysis was used to adjust the ORs for the characteristics listed in the table where the p-value from the univariate analysis was <0.250

6.3 Discussion

In this Chapter socio-economic factors were assessed to determine if any association existed with wasting and severe wasting in pre-school aged children in North Maluku Indonesia in 2004. The analysis for wasting and severe wasting in children was categorised into three age groups (1) 0 to 23 months; (2) 24 to 59 months; and (3) overall 0 to 59 months; to highlight any differences between younger and older children.

This is the first study to assess the risk factors associated with wasting and severe wasting among children aged less than five years in North Maluku Indonesia. It is also the first study in South East Asia, including Indonesia, to consider risk factors associated with severe wasting using the 2006 WHO international growth standards (WHO, 2006).

The prevalence of wasting and severe wasting was similar in both younger and older infants: 0 to 23 months and 24 to 59 months, respectively. The prevalence of wasting was 14% and 13% for younger and older infants respectively and the prevalence of severe wasting was 5.4 and 5.5%, respectively.

The results from the multivariate analysis indicate that for children aged 0 to 23 months none of the family or child level factors included in this analysis were found to be independently associated with wasting however district was independently associated with severe wasting with children residing in the district of Central

Halmahera having reduced odds of wasting. A previous nutrition program was implemented in Central Halmahera which may explain this result

For children aged 24 to 59 months the multivariate models established that frequency of visits to the local health services (twice or more) within the three months preceding the study survey were independently associated with reduced odds of wasting by 50% or more and reduced odds of severe wasting by 55% to 74%. Also within this age group severe wasting increased as age in months increased. As older infants had increased odds of severe wasting they may be an appropriate group to target for nutrition programs through local health services, however programs targeted at younger children may prevent wasting in this older group of young children.

The results from the multivariate analysis indicate that for children aged 0 to 59 months none of the family or child level factors included in this analysis were found to be significantly associated with wasting however gender was independently associated with severe wasting with females having a 45% reduction in the odds of being severely wasted, suggesting that boys may be an appropriate target for a nutritional intervention program.

The key associations found with wasting and severe wasting in children aged less than five years with district, age, gender and visits to health services should provide assistance to public health planners in North Maluku, to facilitate the design of appropriate interventions. The data from this study did not support the hypothesis that children from wealthier families will have lower odds of wasting compared to children from poorer households.

Ternate is the new capital city and Tidore is the old capital city of North Maluku, respectively. These two cities were the site of the refugee camps established after the riot and the areas where food aid was available and may have helped to protect some children from acute under-nutrition or wasting, however the study was unable to distinguish between children living in the refugee camps and those not. Most of the public health nutrition programs have been implemented in these two main districts before being delivered to the other six districts of North Maluku: Central Halmahera, West Halmahera, East Halmahera, North Halmahera, South Halmahera and Sula Island. Poor transportation and lack of qualified human resources resulted in an unsuccessful government nutritional program. Importantly the government nutrition program did not have base line data on wasting in young children. Targeting individual districts may be useful and this thesis contributes baseline data to guide development and evaluation of an appropriate data nutrition program in North Maluku.

Interventions may be best undertaken via the local health services so that the children’s nutritional status can be more closely monitored and so that children with poorer health can be targeted. Intervention programs may have a greater impact if they specifically target boys and younger children with the objective of preventing older children from developing wasting.

There are various factors associated with under-nutrition including wasting and severely wasting worldwide. In Asia, risk factors for child under-nutrition include older age, being male, ethnicity, rural area, mother’s poor education, lower family income, higher birth order of the child, lower parental height, use of dung or firewood as fuel, mother’s child rearing behaviours and social support (Bucens IK 2006; Hotta M 2005). This study showed a statistically significant association between the child’s age and severe wasting in children. Results from the current study highlight age of the child, gender of the child and the local health service for the family as being important factors associated with wasting and severe wasting in North Maluku, particularly in older pre-school aged children, are similar to previous findings.

Previous studies suggest that wasting and severe wasting is more likely to be associated with being male in North Maluku (WHO, 2006). This finding is also similar to previous studies conducted worldwide (Agbedana et al., 1979; Arrowsmith et al., 2006; Dewey, 1983; Donald et al., 1958, 1962; Gibson et al., 1989; Graham et al., 1980; Ricci and Becker, 1996; Spady et al., 1976; Sugarman et al., 1990) and highlights the importance of understanding why this is so through further research.

This survey was a cross sectional study and therefore no association with causality can be determined. A major limitation for the current study is that secondary data analysis was nested within existing research, and a greater variety of data could have improved the internal and external validity of this study. For example the inclusion of a child's food intake diary and breast feeding data, and exploration of food security and food availability issues would enhance the results. In addition data provided for this survey is subject to recall bias and therefore provides an estimate only of nutritional status. Response bias may have resulted in an under estimate of wasting and of the true nutritional status of young children in North Maluku at this time.

However, despite this, the findings from this study contribute to our understanding of the factors associated with child wasting in the new Indonesian province of North Maluku. These findings may provide a basis for planning interventions to prevent wasting in young children particularly for boys and older infants and perhaps appropriately centred in the local health service. Further longitudinal studies of the risk factors for wasting in young children are required and recommended to determine changes over time and to monitor the effectiveness of available nutritional support programs.

6.4 References

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CHAPTER 7

COMPARISON OF NUTRITIONAL STATUS OF PRESCHOOL CHILDREN BASED ON WORLD HEALTH ORGANIZATION GROWTH REFERENCES

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7.1 Introduction

Chapter 3 provided a description of the methodology used to conduct the original North Maluku Province Health Survey of nutrition status and risk factors for under-nutrition in young children in North Maluku Province, Indonesia, in which this current research is nested. The aim of this Chapter is to compare the prevalence of anthropometric indicators of nutritional status of children aged less than five years in North Maluku Province Indonesia using the current 2006 WHO international child growth standards (WHO, 2006) and the former 1978 NCHS/WHO international child growth references (WHO, 1978). Results reported in this Chapter reflect the comparison between the current and former growth references for nutritional status indicators by age and geographical location, including anthropometric Z-score curves.

7.2 Mean differences in nurtional status

7.2.1 Mean weight-for-age differences

The data indicate significant differences in mean weight-for-age results between the current and former WHO international child growth references: mean difference 0.07 (95%CI 0.05, 0.08) as shown in

Table 7.1.

Table 7.1: Weight-for-age paired t-test between current and former WHO growth references in children aged 0 to 59 months, North Maluku Province Indonesia, 2004

WHO growth reference	N	Mean	SE	SD	95%CI		p-value
Current (2006)	2168	-1.20	0.03	1.31	-1.26	-1.15	
Former (1978)	2168	-1.27	0.03	1.35	-1.33	-1.21	
Difference		0.07	0.01	0.42	0.05	0.08	<0.001

SE = Standard Error, SD= Standard Deviation, CI = Confidence Interval, Current refers to the 2006 WHO child growth standards and Former refers to the 1978 NCHS/WHO child growth reference

7.2.2 Mean height-for-age differences

The results indicate a significant difference in mean height-for-age figures between the current and former growth references, (mean difference 0.15, 95%CI 0.17, 0.14), $p < 0.05$), as shown in Table 7.2.

Table 7.2: Height-for-age paired t-test between current and former WHO growth references, in children aged 0 to 59 months, North Maluku Province Indonesia

WHO growth reference	N	Mean	SE	SD	95%CI		p-value
Current (2006)	2168	-1.39	0.05	2.25	1.48	1.29	
Former (1978)	2168	-1.23	0.04	2.03	1.32	1.15	
Difference	2168	0.15	0.01	0.35	0.17	0.14	<0.001

SE = Standard Error, SD= Standard Deviation, CI = Confidence Interval, Current refers to the 2006 WHO child growth standards and Former refers to the 1978 NCHS/WHO child growth reference

7.2.3 Mean weight-for-height differences

There were significant differences in mean weight-for-height between the current WHO child growth standard and the former child growth reference: mean difference 0.04 (95%CI 0.01, 0.07, p< 0.05), as shown in Table 7.3.

Table 7.3: Weight-for-height paired t-test between current and former WHO growth references in children aged 0 to 59 months, North Maluku Province Indonesia 2004

WHO growth reference	N	Mean	SE	SD	95%CI		p-value
Current (2006)	2156	-0.58	0.03	1.52	-0.64	-0.51	
Former (1978)	2156	-0.57	0.03	1.48	-0.68	-0.55	
Difference	2156	0.04	0.01	0.65	0.01	0.07	<0.001

SE = Standard Error, SD= Standard Deviation, CI = Confidence Interval, Current refers to the 2006 WHO child growth standards and Former refers to the 1978 NCHS/WHO child growth reference

7.3 Comparison of nutritional status of children aged 0 to 59 months in North Maluku Province, Indonesia in 2004

A total of 2168 children aged between 0 and 59 months from North Maluku Province, Indonesia were included in this comparative study. Results from assessing weight-for-age, weight-for-height and height-for-age by age are presented below. Additional data analyses for the former 1978 NCHS/WHO growth references including the percentage of nutritional status indicators for children aged less than five years by gender and age group; by gender and district; and by gender and background characteristics are attached in Appendices 7.1 to 7.9.

7.2.4 Weight-for-age

Table 7.4 presents the mean and standard deviation Z-score by six-month age groups inclusive of 95% confidence intervals (CIs) of children in North Maluku Province aged less than five years who are underweight and severely underweight (weight-for-age <-2.00 Z score and <-3.00 Z score) using the *former* 1978 NCHS/WHO international growth reference (WHO, 1978).

Table 7.4: Prevalence of underweight and severely underweight children less than five years of age, using the former 1978 NCHS/WHO international growth reference, North Maluku Province, Indonesia, 2004

Age Groups in Months		<-2.00 SD (Underweight)				<-3.00SD (Severely underweight)				Mean Z-Score	SD Z-Score
	N	n	%	95%CI		n	%	95%CI			
0-5	266	5	1.9	0.8	4.6	0	0			0.33	1.29
11-Jun	365	57	16	12	20	16	4.4	2.7	7	-0.89	1.34
17-Dec	318	110	35	30	40	28	8.8	6.1	13	-1.55	1.14
18-23	234	89	38	32	45	20	8.6	5.3	14	-1.49	1.25
24-29	238	95	40	35	45	31	13	9.1	18	-1.5	1.3
30-35	169	58	34	27	42	15	8.9	5.4	14	-1.61	1.04
36-41	215	68	32	25	39	18	8.4	5.1	14	-1.64	0.92
42-47	147	52	35	28	44	17	12	7.3	18	-1.77	1.02
48-53	135	64	47	39	56	20	15	9.7	22	-2.05	0.99
54-59	81	37	46	36	56	4	4.9	1.8	13	-1.93	0.75
Total	2168	635	29	27	32	169	7.8	6.7	9	-1.27	1.35

Percentage (%) of children aged less than five years who are underweight and severely underweight (weight-for-age <-2.00 and <-3.00 Z-score) with 95% confidence interval (CI), mean and standard deviation (SD) by six-month age groups, North Maluku Province, Indonesia 2004 using the former 1978 NCHS/WHO international growth reference.

Table 7.5 presents the mean and standard deviation Z-score by six-month age groups inclusive of 95% confidence intervals of children in North Maluku Province aged less than five years who are underweight and severely underweight (weight-for-age <-2.00 Z and <-3.00 Z) using the *current* WHO international growth standards (WHO, 2006).

Table 7.5: Prevalence of underweight and severely underweight children less than five years of age, using the current 2006 WHO international growth standard, North Maluku Province, Indonesia, 2004

Age Groups in Months	N	<-2.00SD (Underweight)				<-3.00SD (Severely underweight)				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
0-5	266	25	9.4	6.4	14	7	2.6	1.3	5.5	-0.25	1.35
6-11	365	66	18	14	23	18	4.9	3.1	7.7	-0.86	1.35
12-17	318	69	22	17	27	24	7.5	4.9	11	-1.14	1.22
18-23	234	72	31	25	37	14	6.0	3.3	11	-1.26	1.31
24-29	238	62	26	21	31	25	10.5	7.3	14.9	-1.30	1.29
30-35	169	50	30	23	38	13	7.7	4.4	13	-1.48	1.13
36-41	215	62	29	23	36	19	8.8	5.4	14	-1.54	1.00
42-47	147	47	32	24	41	22	15	9.8	22	-1.73	1.11
48-53	135	62	46	38	54	22	16	11	23	-2.03	1.14
54-59	81	33	41	31	51	4	4.9	1.8	13	-1.88	0.80
Total	2168	548	25	23	28	168	7.7	6.6	9.1	-1.20	1.31

Percentage of children aged less than five years who are underweight and severely underweight (weight-for-age <-2.00 and < -3.00 Z-score) and 95% CI, mean and SD, by six-month age groups, North Maluku Province, Indonesia 2004 using the current 2006 WHO international child growth standard.

7.2.1.1 Underweight

Overall, the prevalence of underweight children in North Maluku Province aged less than five years using the current growth standards was lower than when the former growth reference was applied; 25% (95%CI 23, 28) and 29% (95%CI 27, 32) respectively, however this result is not statistically significantly different as shown in Table 7.1 and 7.2.

The prevalence of underweight children aged 0 to five months was statistically significantly higher using the new growth reference compared to the previous growth reference: 9.4% (95%CI 6.4, 14) vs 1.9% (95%CI 0.8, 4.6). For the six to 11 months aged group the current growth reference was higher than when using the former growth reference; however this difference was not statistically significant.

For children aged from 12 to 17 months and 24-29 months, the prevalence of the underweight condition using the current growth standard was statistically significantly lower than when the former growth reference was applied: 35% (95%CI 30, 40) versus 22% (95%CI 17, 27%) and 40% (95%CI 35, 45) versus 26% (95%CI 21, 31). For the age groups 18 to 23, 30 to 35, 36 to 41, 42 to 47, 48 to 53 and 54 to 59 the prevalence was lower when using the current growth standard compared to the former growth reference however the differences were not statistically significant. This is illustrated in Figure 7.1.

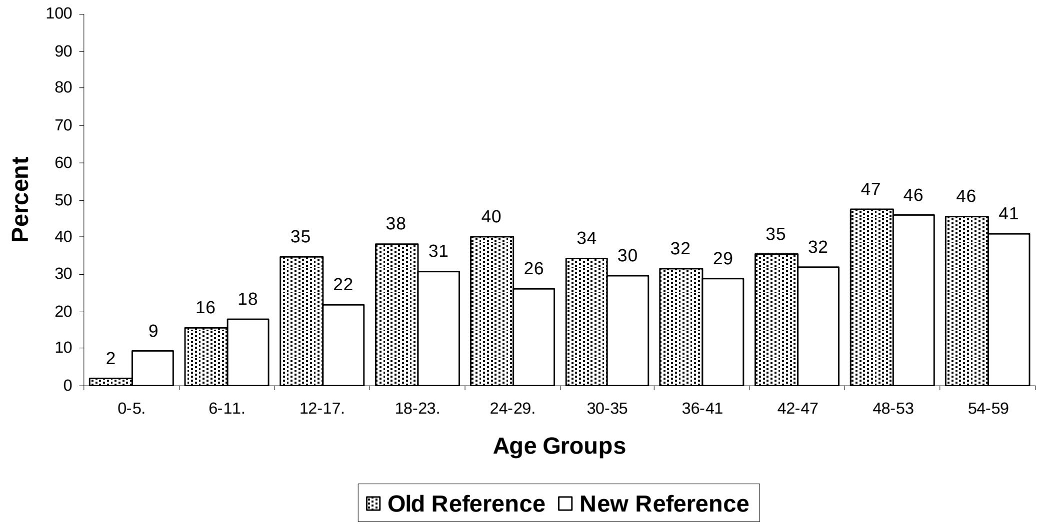

Figure 7.1: Prevalence of underweight children by six-month age group

A comparison of the prevalence of underweight (weight - for - age < -2.00 Z) by six-month age group when the anthropometric index is calculated using the current 2006 WHO international child growth standard versus the former 1978 NCHS/WHO international child growth reference

7.2.1.2 Severely underweight

The prevalence of severely underweight children in North Maluku Province aged less than five years using the current growth standard was similar to when the former growth reference was applied; 7.8% (95%CI 6.7, 9.1) and 7.7% (95%CI 6.6, 9.1) respectively, as shown in Table 7.1 and 7.2.

The prevalence of severely underweight children varied when comparing former and current growth references as illustrated in Figure 7.2. For the age group 0 to 5 months the difference was statistically significant with zero prevalence of severely underweight children using the former growth reference and 2.6%

(95%CI 1.3, 5.5) using the current growth reference. For the age groups six to 11, 36 to 41, 42 to 47 and 48 to 53 months the prevalence of severely underweight children using the former reference was lower than when using the current growth standard, however this difference was not statistically significant. For children aged 12 to 17, 18 to 23, 24 to 29 and 30 to 35 months the prevalence of severely underweight children using the former growth reference was higher than when using the current growth standard, however these differences were not statistically significant.

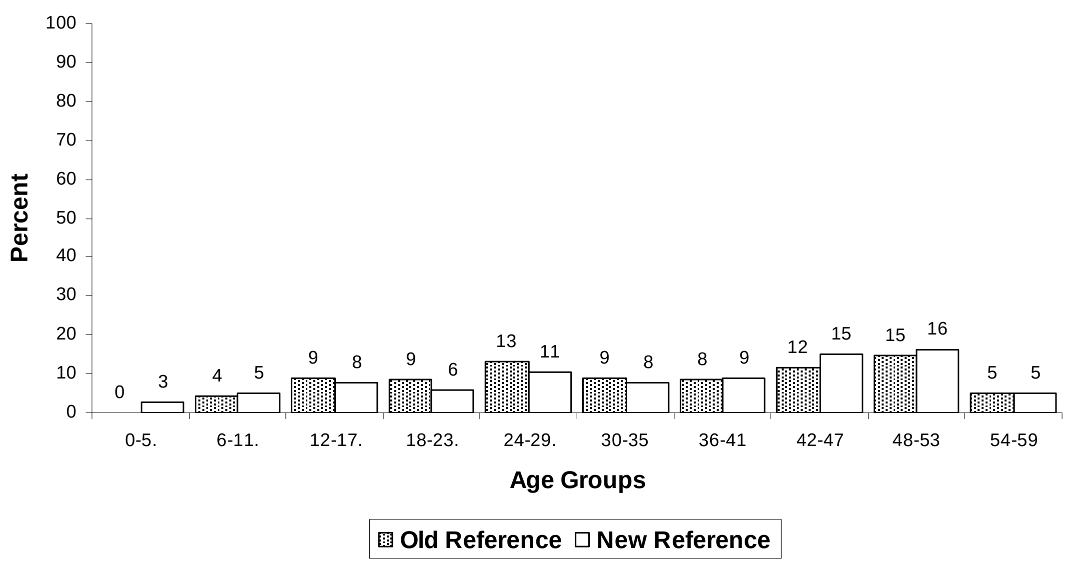

Figure 7.2: Prevalence of severely underweight children by six-month age group

A comparison of the prevalence of severely underweight (weight-for-age < -3 Z) children by six-month age group when the anthropometric index is calculated using the current 2006 WHO international growth standard versus the former 1978 NCHS/WHO international growth reference.

7.2.5 Height-for-age

Table 7.6 presents the mean and standard deviation Z-score by six-month age groups inclusive of 95% confidence intervals of children in North Maluku Province aged less than five years who were stunted and severely stunted (weight-for-age <-2.00 Z and <-3.00 Z) using the former 1978 NCHS/WHO international growth reference (WHO, 1978).

Table 7.6: Prevalence of stunting and severe stunting in children less than five years of age using the former 1978 NCHS/WHO international growth reference, North Maluku Province Indonesia, 2004

Age Groups in Months	N	<-2.00SD (Stunting)				<-3.00SD (Severe stunting)				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
0-5	266	23	8.7	6.0	12	18	6.8	4.6	10	0.14	2.13
6-11	365	79	22	17	27	20	5.5	3.0	10	-0.54	2.02
12-17	318	97	31	26	35	38	12	8.5	17	-1.18	1.97
18-23	234	102	44	36	52	50	21	15	29	-1.69	1.99
24-29	238	93	39	33	46	34	14	10	20	-1.39	1.82
30-35	169	68	40	33	48	29	17	12	25	-1.74	1.64
36-41	215	99	46	39	53	45	21	16	27	-1.89	1.86
42-47	147	61	41	31	53	25	17	11	26	-1.77	1.63
48-53	135	65	48	39	58	32	24	17	32	-2.27	2.00
54-59	81	32	39	29	50	11	14	6.7	26	-1.77	1.24
Total	2168	719	33	31	36	302	14	12	16	-1.23	2.03

Percentage of children aged less than five years who are stunted and severely stunted (height-for-age < -2.00 and <-3.00 Z-score) and 95% CI, mean and standard deviation by six-month age groups, North Maluku Province, Indonesia 2004 using the former 1978 NCHS/WHO international child growth reference.

Table 7.7 presents the mean and standard deviation Z-score by six-month age groups inclusive of 95% confidence intervals of children in North Maluku Province aged less than five years who are stunted and severely stunted (weight-for-age <-2.00 Z and <-3.00 Z) using the current WHO international growth standard (WHO, 2006).

Table 7.7: Prevalence of stunting and severe stunting in children less than five years of age using the current 2006 WHO international growth reference, North Maluku Province, Indonesia 2004

Age Groups in Months	N	<-2.00SD (Stunting)				<-3.00SD (Severe stunting)				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
0-5	266	34	13	9.1	18	21	7.9	5.6	11	0.11	2.70
6-11	365	88	24	19	30	37	10	6.6	15	-0.53	2.37
12-17	318	108	34	29	40	50	16	12	21	-1.23	2.18
18-23	234	113	48	40	56	59	25	19	33	-1.82	2.18
24-29	238	116	49	42	55	63	26	20	34	-1.86	1.86
30-35	169	87	51	43	60	39	23	17	31	-2.11	1.65
36-41	215	113	53	46	59	55	26	20	31	-2.18	1.86
42-47	147	70	48	38	58	29	20	13	29	-1.96	1.59
48-53	135	67	50	40	59	32	24	17	32	-2.37	1.95
54-59	81	36	44	35	55	13	16	8.7	28	-1.85	1.18
Total	2168	832	38	36	41	398	18	16	21	-1.39	2.25

Percentage of children aged less than years who are stunting and severely stunting (height-for-age <-2.00 and <-3.00 Z-score) and 95% CI, mean and standard deviation by six-month age groups, North Maluku Province, Indonesia 2004 using the current 2006 WHO international growth standard.

7.2.2.1 Stunting

The prevalence of stunting in North Maluku Province children aged less than five years using the current growth reference was higher than when the former growth reference was applied, 38% (95%CI 36, 41) and 33% (95%CI 31, 36) respectively, however this difference was not statistically significant as indicated by overlapping confidence intervals shown in Table 7.4 and 7.5.

Figure 7.3 demonstrates that the prevalence of stunting in children aged less than five years in North Maluku Province tended to be higher for all age groups when using the current WHO growth reference however these differences were not statistically significant.

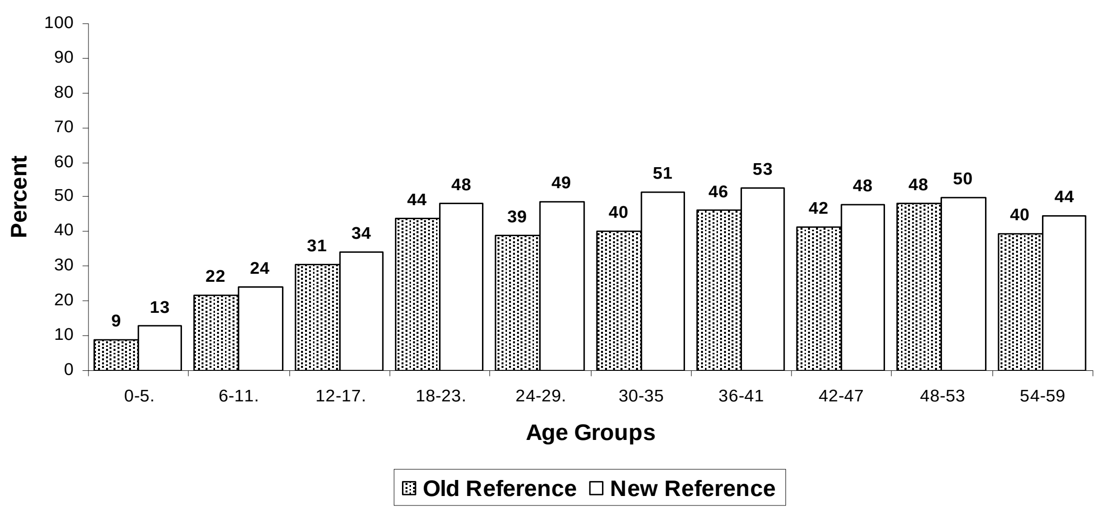

Figure 7.3: Prevalence of stunting in children by six month age group

A comparison of the prevalence of stunting (height-for-age < -2 Z) by six-month age group when the anthropometric index is calculated using the current 2006 WHO international child growth standard versus the former 1978 NCHS/WHO international growth reference.

7.2.2.2 Severe stunting

The prevalence of severe stunting in North Maluku Province children aged less than five years using the current growth reference was higher than when using the former reference, 18% (95%CI 16, 21) and 14% (95%CI 12, 16) respectively, however this difference was not statistically significant as indicated by overlapping 95% confidence intervals as shown in Table 7.4 and 7.5.

Figure 7.4 illustrates that the prevalence of severe stunting in children aged less than five years in North Maluku Province tended to be higher for all age groups, except the 48 to 53 month age group, when using the current WHO growth reference however these differences were not statistically significant. The prevalence in the 48 to 53 month age group was the same using both references.

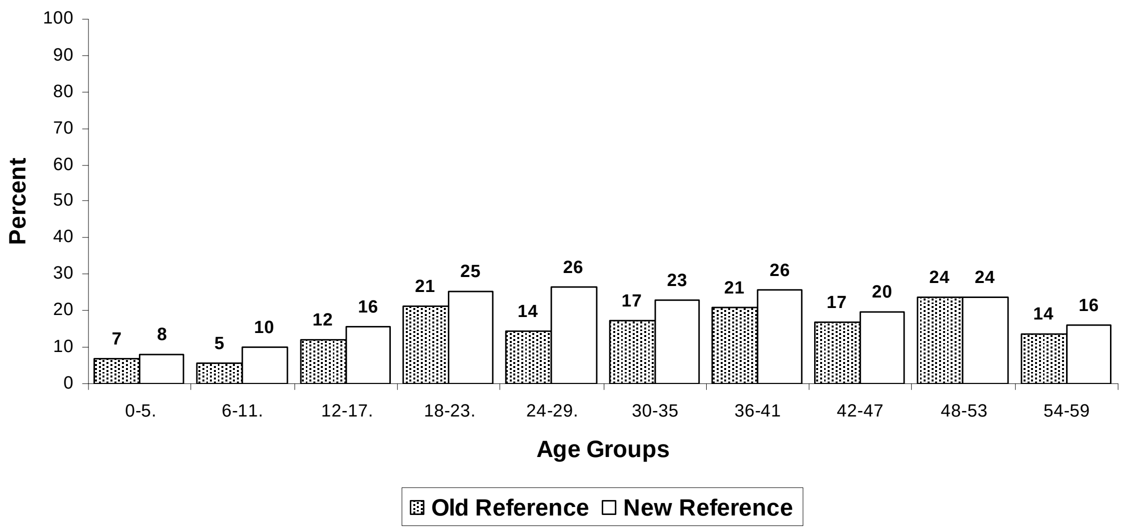

Figure 7.4: Prevalence of severe stunting in children by six month age group

A comparison of the prevalence of severe stunting (height‑for‑age < ‑3.00 Z) by six-month age group when the anthropometric index is calculated using the current 2006 WHO international growth standard versus the former 1978 NCHS/WHO international growth reference.

7.2.6 Weight-for-height

The 95%CI, mean and SD Z-score of the children in North Maluku Province aged less than five years who have wasting and severe wasting (weight-for-height <-2.00 Z score and <-3.00 Z score), by six-month age groups using the former WHO international growth reference (WHO, 1978) are presented in Table 7.8

Table 7.8: Prevalence of wasting and severe wasting in children less than five years of age using the former 1978 NCHS/WHO international growth reference, North Maluku Province, Indonesia 2004

Age Groups in Months	N	<-2.00SD (Wasting)				<-3.00SD (Severe wasting)				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
0-5	266	18	6.8	4.4	10	5	1.9	0.8	4.4	0.53	2.64
6-11	365	47	13	10	17	12	3.3	1.8	6.0	-0.47	1.51
12-17	318	51	16	12	22	21	6.6	4.1	10	-0.89	1.41
18-23	234	41	17	13	23	10	4.3	2.2	8.0	-0.73	1.44
24-29	238	27	11	7.6	17	6	2.5	1.0	6.0	-0.68	1.08
30-35	169	13	7.7	4.6	13	3	1.8	0.58	5.3	-0.67	1.05
36-41	215	21	9.8	6.2	15	5	2.3	0.99	5.4	-0.61	1.33
42-47	147	23	16	10	23	7	4.8	2.3	9.8	-0.90	1.17
48-53	135	20	15	9.5	22	8	5.9	2.9	12	-0.95	1.20
54-59	81	14	17	10	28	7	8.6	3.8	18	-1.16	1.15
Total	2168	275	13	11	15	84	3.9	3.0	4.9	-0.57	1.60

Percentage of children aged less than five years who present as wasting and severely wasting (weight-for-height <-2.00 and < -3.00 Z-score) and 95% CI, mean and SD by six-month age groups, North Maluku Province, Indonesia 2004 using the former 1978 NCHS/WHO international growth reference

The 95%CI, mean and SD Z-score of the children in North Maluku Province aged less than five years who have wasting and severe wasting (weight for height <-2.00 Z score and <-3.00 Z score), by six-month age groups using the current 2006 WHO international growth standards (WHO, 2006) are presented in Table 7.9.

Table 7.9: Prevalence of wasting and severe wasting in children less than five years of age using the current 2006 WHO international growth standards, North Maluku Province, Indonesia in 2004

Age Groups in Months	N	<-2.00SD (Wasting)				<-3.00SD (Severe Wasting)				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
0-5	266	37	14	9.7	21	16	6.0	3.8	9.5	-0.35	1.90
6-11	365	55	15	11	20	17	4.7	2.8	7.7	-0.59	1.55
12-17	318	44	14	9.7	19	22	6.9	4.4	11	-0.68	1.46
18-23	234	27	11	7.9	17	9	3.8	1.9	7.6	-0.47	1.45
24-29	238	30	13	9.1	17	8	3.4	1.5	7.4	-0.42	1.36
30-35	169	13	7.7	4.6	13	5	3.0	1.2	6.8	-0.45	1.26
36-41	215	24	11	7.1	17	11	5.1	2.8	9.2	-0.47	1.48
42-47	147	23	16	10	23	12	8.2	4.5	14	-0.83	1.43
48-53	135	19	14	8.9	22	10	7.4	3.7	14	-0.90	1.49
54-59	81	17	21	13	31	8	9.9	4.7	19	-1.15	1.41
Total	2168	289	13.4	11	16	118	5.4	4.4	6.7	-0.58	1.52

Percentage of children aged less than five years who are wasting and severely wasting (weight-for-height <-2.00 and <-3.00 Z-score) and 95% CI, mean and SD by six-month age groups, North Maluku Province, Indonesia 2004 using the current 2006 WHO international growth standards.

7.2.3.1 Wasting

The prevalence of wasting in North Maluku Province children aged less than five years using the current growth reference was similar than when the former growth reference was applied; 13% (95%CI 11, 16) and 13% (95%CI 11, 15) respectively as shown in Table 7.7 and Table 7.8. Figure 7.5 demonstrates that the prevalence of wasting in children aged less than five years in North Maluku Province tended to be higher for the age groups of 0 to 5, 6 to 11, 24 t 29, 36 to 41 and 54 to 59 month when using the current WHO growth reference and lower for the 12 to 17, 18 to 23 and 48 to 53 month age groups, however none of these differences were statistically significant. The prevalence of wasting was the same for the 30 to 35 and 42 to 47 month age groups regardless of the reference used.

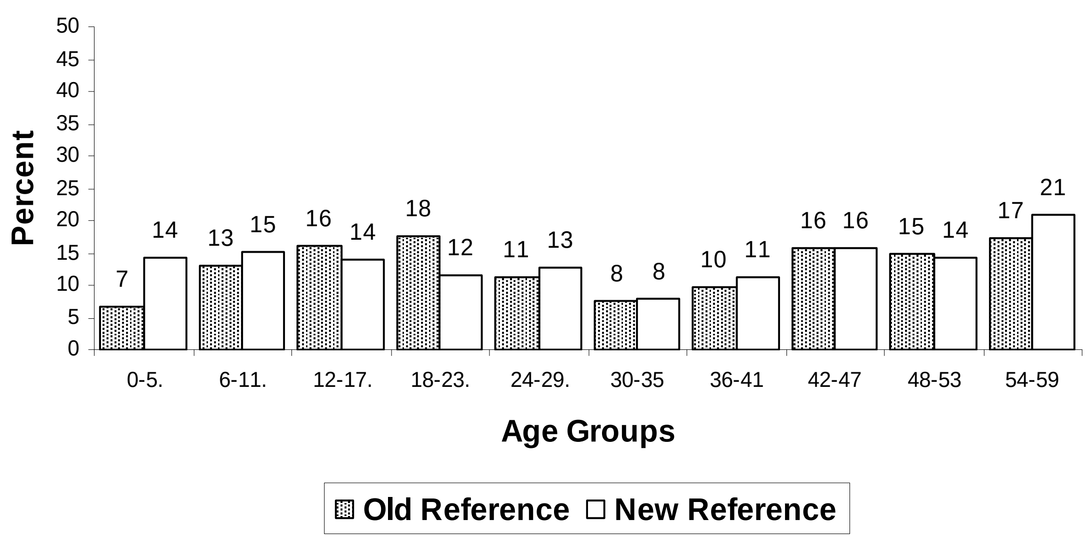

Figure 7.5: Prevalence of wasting in children by six month age group

A comparison of the prevalence of wasting (weight for height < -2.00 Z) by six-month age group when the anthropometric index is calculated using the current 2006WHO international growth standards versus the former 1978 NCHS/WHO international growth reference.

7.2.3.2 Severe wasting

The prevalence of severe wasting in North Maluku Province children aged less than five years using the current growth reference was higher than when the former growth reference was applied; 5.4% (95%CI 4.4, 6.7) and 3.9% (95%CI 3.0, 4.9) respectively, however this result was not statistically significantly different as indicated by the overlapping 95% confidence intervals as shown in Table 7.7 and Table 7.8.

Figure 7.6 illustrates prevalence of severe wasting in children aged less than five years in North Maluku Province was the same in the 12 to 17, 18 to 23 and 24 to 29 month age groups regardless of the reference used. The prevalence of severe wasting tended to be higher for all other age groups when using the current WHO growth reference and lower however these differences were not statistically significant.

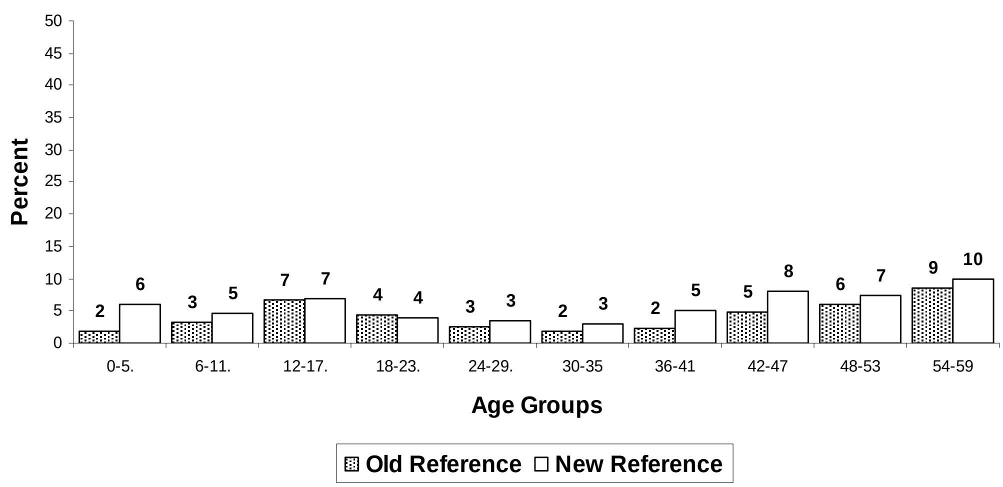

Figure 7.6: Prevalence of severe wasting in children by six month age group

A comparison of the prevalence of severe wasting (weight for height < - 3 Z) by six-month age group when the anthropometric index is calculated using the current 2006 WHO international growth standards versus the former1978 NCHS/WHO international growth reference.

Figure 7.5 and Figure 7.6 indicate that the prevalence of wasting tended to be higher for the current WHO growth reference in the age groups 0 to 5, 6 to 11, 24 to 29, 36 to 41 and 54 to 59 months, lower for age groups 12 to 17, 18 to 23 and 48 to 53 months and similar for age groups 30 to 35 and 42 to 47 months, when compared with the former growth reference. Conversely, the prevalence of children with severe wasting for the current growth standards is higher for the most part, compared with former growth reference except the children age group 18 to 23 and 24 to 29, which were similar across both growth references.

7.4 Comparison of nutritional status in children aged 0 to 59 months by district in North Maluku Province, Indonesia, 2004

Results from assessing weight-for-age, weight-for-height and height-for-age by geographical districts in North Maluku Province, Indonesia, in 2004:

7.3.1 Weight for age

The 95%CI, mean and SD Z-score of the children in North Maluku Province aged less than five years who are underweight and severely underweight (weight-for-age <-2.00 Z score and <-3.00 Z score), by District in North Maluku Province using the former 1978 WHO international growth reference are presented in Table 7.10.

Table 7.10: Prevalence of underweight and severely underweight children less than five years of age by district using the former 1978 NCHS/WHO international growth reference North Maluku Province, Indonesia 2004

Districts	N	<-2.00SD (Underweight)				<-3.00SD (Severely underweight)				Mean Z-score	SD Z-score
		n	%	95%CI		n	%	95%CI			
Ternate	387	118	30	25	36	28	7.2	5.6	9.4	-1.4	1.2
Tidore	149	27	18	12	27	6	4	2.1	7.7	-0.84	1.38
Central Halmahera	280	71	25	19	33	17	6.1	3.2	11	-1.2	1.37
East Halmahera	280	89	32	24	41	28	10	6.3	15	-1.32	1.4
West Halmahera	178	44	25	21	29	9	5.1	3	8.4	-1.29	1.1
North Halmahera	279	86	31	24	39	19	6.8	4.7	9.7	-1.23	1.4
South Halmahera	446	138	31	28	34	42	9.4	7.4	12	-1.22	1.45
Sula Island	169	62	37	33	41	20	12	9.4	15	-1.56	1.29
North Maluku	2168	635	29	27	32	169	7.8	6.7	9.1	-1.27	1.35

Percentage of children aged less than five years who are underweight and severely underweight (weight-for-age < -2.00 and < -3.00 Z-score) and 95%CI, mean and SD by District, North Maluku Province, Indonesia 2004 using the former 1978 NCHS/WHO international growth reference.

The 95%CI, mean and SD Z-score of the children in North Maluku Province aged less than five years who are underweight and severely underweight (weight-for-age <-2.00 Z score and <-3.00 Z score), by District in North Maluku Province using the current 2006 WHO international growth standards are presented in Table 7.11.

Table 7.11: Prevalence of underweight and severely underweight children less than five years of age by district using the current 2006 WHO international growth standards, North Maluku Province, Indonesia 2004

Districts		<-2.00SD (Underweight)				<-3.00SD (Severely underweight)				Mean Z-score	SD Z-score
	N	n	%	95% CI		n	%	95% CI			
Ternate	387	102	26	20	34	28	7.2	5.2	10	-1.32	1.2
Tidore	149	24	16	9.4	26	7	4.7	2.8	7.8	-0.82	1.3
Central Halmahera	280	71	25	19	33	19	6.8	4.5	10	-1.17	1.35
East Halmahera	280	71	25	16	38	29	10	6.2	17	-1.19	1.32
West Halmahera	178	36	20	17	24	8	4.5	2.5	7.9	-1.19	1.08
North Halmahera	279	65	23	18	29	17	6.1	4.7	7.8	-1.14	1.35
South Halmahera	446	125	28	26	30	38	8.5	6.0	12	-1.18	1.42
Sula Island	169	54	32	27	37	22	13	9.8	17	-1.49	1.3
North Maluku	2168	548	25	23	28	168	7.7	6.6	9.1	-1.2	1.31

Percentage of children aged less than five years who are underweight and severely underweight (weight-for-age <-2.00 and <-3.00 Z-score) and 95%CI, mean and SD by District, North Maluku Province, Indonesia 2004 using the current 2006 WHO international growth standards.

7.3.3.1 Underweight

Sula island district has the highest prevalence of underweight children when using the former and current references; 37% (95%CI 33, 41) and 32% (95%CI 27, 37), respectively. The district of Tidore had the lowest prevalence when using both growth references: 18% (95%CI 12, 27, former) and 16% (95%CI 9.4, 26, current). Figure 7.7 illustrates that the prevalence of underweight children was slightly lower using the current growth standards compared with the former growth reference, in each district excepting in Central Halmahera where the prevalence was the same. These differences in district prevalence were not statistically significant.

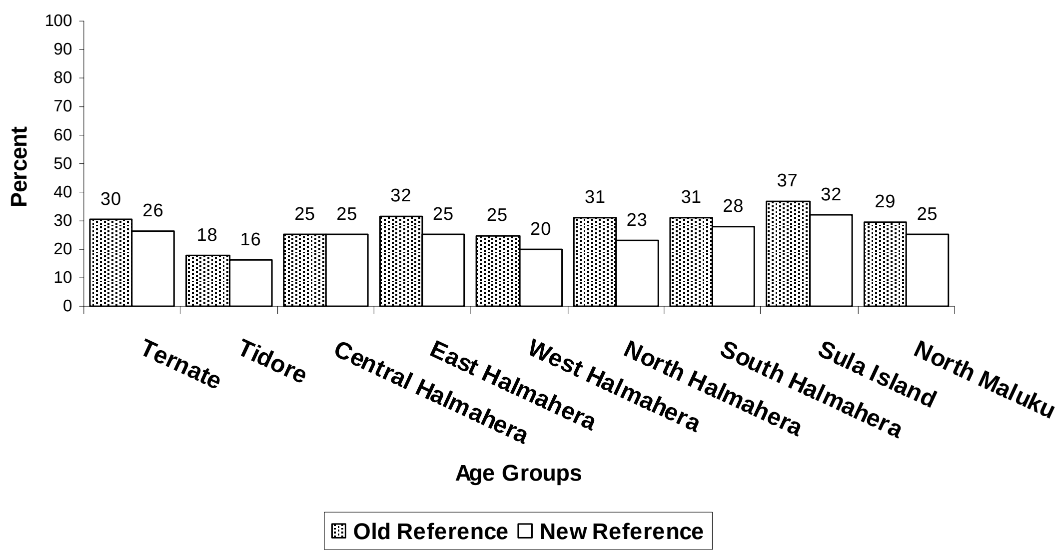

Figure 7.7: Prevalence of underweight children by district

A comparison prevalence of underweight (weight-for-age < -2.00 Z) by District when the anthropometric index is calculated using the current 2006 WHO international growth standards versus the former 1978 NCHS/WHO international growth reference.

7.3.3.2 Severely underweight

In the Sula Island district, the prevalence of severely underweight children using the former and current 2006 WHO reference was above 10%: 12% (95%CI 9.4, 15) and 13% (95%CI 9.8, 17) respectively. Using the former growth reference the district of Tidore had the lowest prevalence (4.0%, 95%CI 2.1, 7.7) and using the current growth reference the district of West Halmahera had the lowest prevalence (4.5%, 95%CI 2.5, 7.9). As illustrated in Figure 7.8 the prevalence of severely underweight children was similar when comparing both growth reference results, with no statistically significant differences. Under the current growth reference, the prevalence of severely underweight children was slightly higher in Tidore, Central Halmahera and Sula Island districts and slightly lower in West, North and South Halmahera, however these differences were not statistically significant..

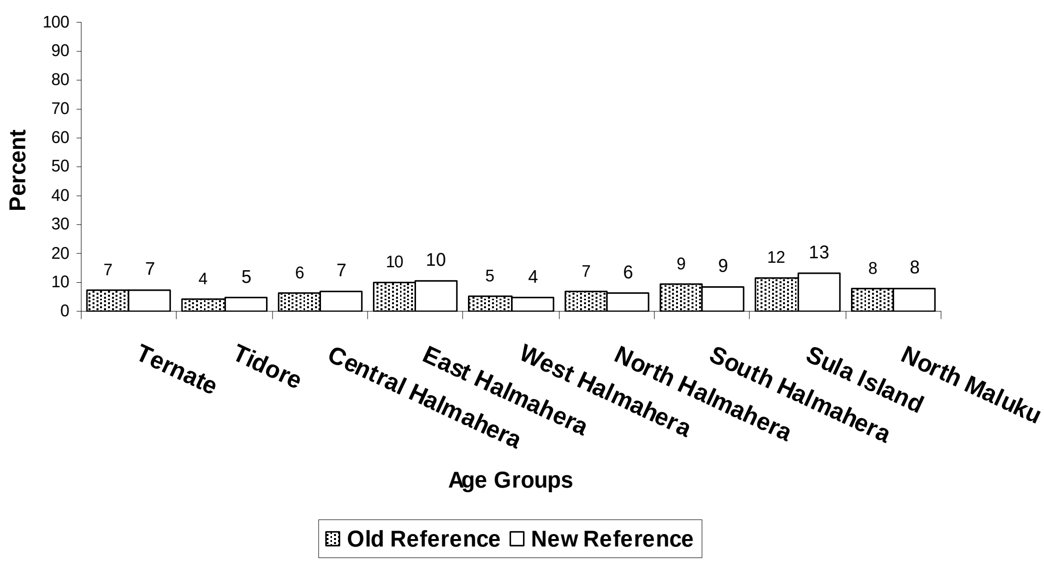

Figure 7.8: Prevalence of severely underweight children by district

A comparison prevalence of severely underweight (weight-for-age < - 3.00 Z) by District when the anthropometric index is calculated using the current 2006 WHO international growth standard versus the former 1978 WHO international growth reference.

7.3.2 Height-for-age

The 95%CI, mean and SD Z-score of children aged less than five years by District in North Maluku Province with stunting and severe stunting (height-for-age <-2.00 Z and <-3.00 Z), referenced against the former 1978 NCHS/WHO growth reference are presented in Table 7.12.

Table 7.12: Prevalence of stunting and severe stunting in children less than five years of age by district using the former 1978 NCHS/WHO international growth reference in North Maluku Province, Indonesia 2004

Districts	<-2.00SD (Stunting)					<-3.00SD (Severe stunting)				Mean Z-score	SD Z-score
	N	n	%	95% CI		n	%	95% CI			
Ternate	387	119	31	27	35	45	12	8.4	16	45	1.74
Tidore	149	32	22	14	32	14	9.4	4.9	17	14	1.88
Central Halmahera	280	109	39	32	46	44	16	11	21	44	2.2
East Halmahera	280	98	35	27	44	60	21	13	34	60	2.08
West Halmahera	178	52	29	25	34	20	11	6.9	18	20	1.85
North Halmahera	279	100	36	29	43	37	13	9.3	19	37	2.17
South Halmahera	446	158	35	32	39	68	15	11	20	68	2.23
Sula Island	169	51	30	27	34	14	8.3	5.7	12	14	1.71
North Maluku	2168	719	33	31	36	302	14	12	16	302	2.03

Percentage of children aged less than five years who are Stunting and severely stunting (height-for-age <-2.00 and <-3.00 Z-score) and 95%CI, mean and SD by District, North Maluku Province, Indonesia 2004 using the former 1978 NCHS/WHO international growth reference.

The 95%CI, mean and SD Z-score of children aged less than five years by District in North Maluku Province with stunting and severe stunting (height-for-age <-2.00 Z score and <-3.00 Z score) using the current WHO international growth reference (2006) are presented in Table 7.13.

Table 7.13: Prevalence of stunting and severe stunting in children less than five years of age by district using the current 2006 WHO international growth standard, North Maluku Province, Indonesia 2004

Districts	N	<-2.00SD (Stunting)				<-3.00SD (Severe stunting)				Mean Z-score	SD Z-score
		n	%	95% CI		n	%	95% CI			
Ternate	387	141	36	31	42	62	16	12	21	-1.48	1.87
Tidore	149	38	25	19	33	23	15	8.6	26	-0.9	2.11
Central Halmahera	280	120	43	36	50	65	23	18	29	-1.57	2.45
East Halmahera	280	119	43	33	52	66	24	15	36	-1.6	2.29
West Halmahera	178	68	38	33	44	29	16	13	21	-1.55	1.94
North Halmahera	279	116	42	34	49	48	17	13	23	-1.36	2.54
South Halmahera	446	172	39	35	42	86	19	15	24	-1.22	2.45
Sula Island	169	58	34	30	39	19	11	9	14	-1.26	1.93
North Maluku	2168	832	39	36	41	398	18	16	21	-1.39	2.25

Percentage of children aged less than five years who are Stunting and severely stunting (height-for-age <-2.00 and <-3.00 Z-score) and 95%CI, mean and SD by District, North Maluku Province, Indonesia 2004 using the current 2006 WHO international growth standard.

7.3.2.1 Stunting

Central Halmahera district had the highest prevalence of stunting in children using the former and current growth references: 39% (95%CI 32, 46) and 43% (95%CI 36, 48), respectively. Tidore had the lowest prevalence of stunting using the former and current growth references: 22% (95%CI 14, 32) and 25% (95%CI 19, 33), respectively.

Figure 7.9 illustrates the variation in prevalence of stunting across districts suggesting that prevalence rates are higher using the current growth standards compared with the former growth reference however these differences are not statistically significant.

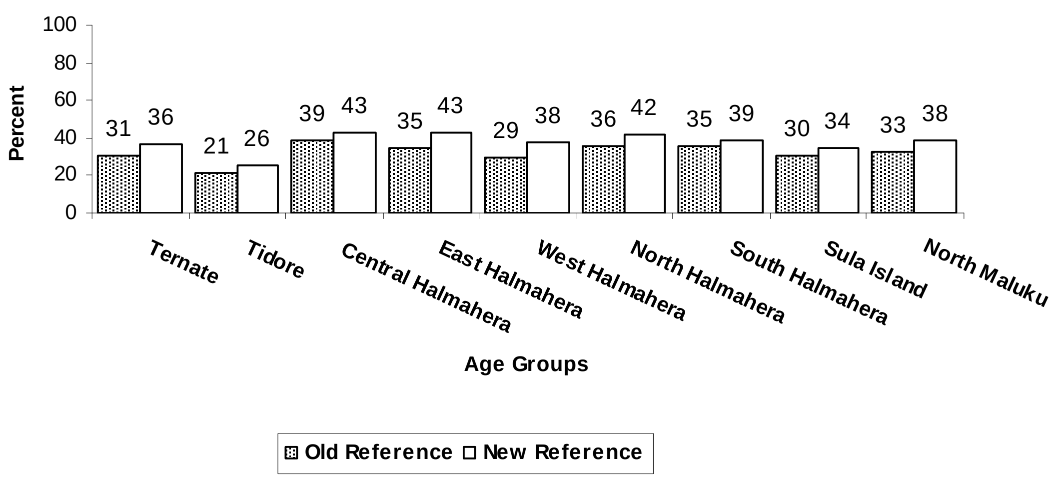

Figure 7.9: Prevalence of stunting in children by district

A comparison prevalence of stunting (height-for-age < -2 Z) by District when the anthropometric index is calculated using the current 2006 WHO international growth standards versus the former 1978 NCHS/WHO international growth reference.

7.3.2.2 Severe stunting

From the eight districts in North Maluku Province, the prevalence of severely stunted children was highest in the East Halmahera district when using both the former and the current WHO references: 21% (95%CI 13, 34) and 24% (95%CI 15, 36), respectively. The prevalence of severely stunted children was lowest in the Sula Island district when using both the former and the current WHO references: 8.3% (95%CI 5.7, 12) and 11% (95%CI 9, 14), respectively.

Figure 7.10 illustrates the variation in prevalence of severe stunting across districts suggesting that prevalence rates are higher using the current growth standards compared with the former growth reference, however these differences are not statistically significant.

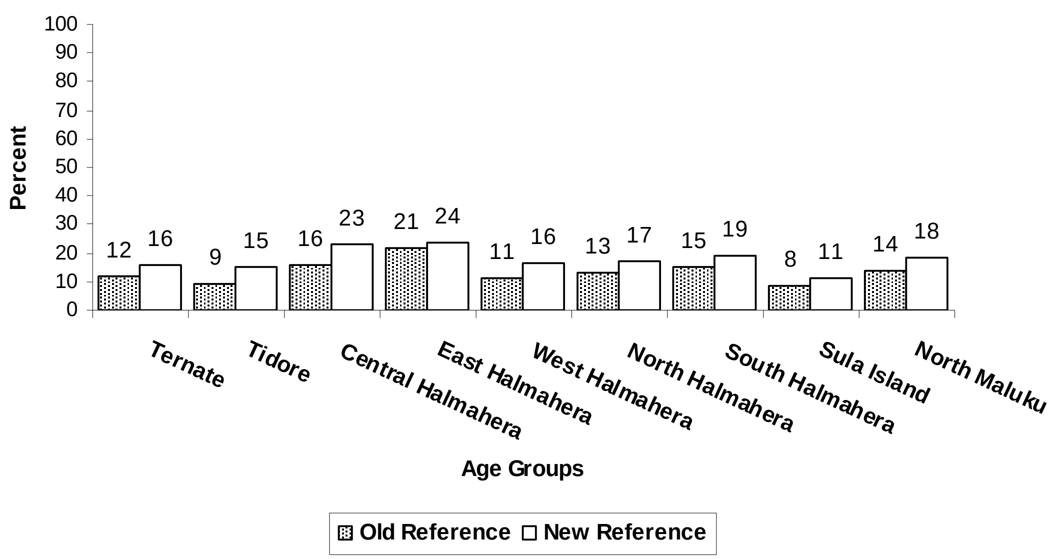

Figure 7.10: Prevalence of severe stunting in children by district

A comparison prevalence of severely stunting (height-for-age < -3 Z) by District when the anthropometric index is calculated using the current 2006 WHO international growth standards versus the former 1978 NCHS/WHO international growth reference.

7.3.3 Weight-for-height

The 95%CI, mean and SD Z-score of the children aged less than five years with wasting and severe wasting (weight-for-height <-2.00 Z score and <-3.00 Z score), by District in North Maluku Province Indonesia using the former WHO International growth reference are presented in Table 7.14.

Table 7.14: Prevalence of wasting and severe wasting in children less than five years of age by district using the former 1978 NCHS/WHO international growth reference, North Maluku Province, Indonesia 2004

Districts	N	<-2.00SD (Wasting)				<-3.00SD (Severe wasting)				Mean Z-score	SD Z-score
		n	%	95% CI		n	%	95% CI			
Ternate	387	60	16	11	21	10	2.6	1.1	5.9	-0.68	1.61
Tidore	149	13	8.7	5.3	14	3	2.0	0.5	7.2	-0.39	1.57
Central Halmahera	280	16	5.7	2.5	13	4	1.4	0.5	4.1	-0.3	1.53
East Halmahera	280	38	14	9.2	20	13	4.6	2.8	7.6	-0.51	1.76
West Halmahera	178	13	7.3	4.9	11	5	2.8	1.3	6.2	-0.57	1.29
North Halmahera	279	27	9.7	6.6	14	13	4.7	2.8	7.8	-0.53	1.47
South Halmahera	446	69	15	12	19	22	4.9	3.4	7.2	-0.62	1.64
Sula Island	169	39	23	18	28	14	8.3	5.3	13	-0.99	1.78
North Maluku	2168	275	13	11	15	84	3.9	3.0	4.9	-0.57	1.6

Percentage of aged less than five years who are wasting and severely wasting (weight-for-height <-2.00 and <-3.00 Z-score) and 95%CI, mean and SD by District, North Maluku Province, Indonesia 2004 using the former 1978 NCHS/WHO international growth reference.

The 95%CI, mean and SD Z-score of the children aged less than five years with wasting and severe wasting (weight-for-height <-2.00 Z score and <-3.00 Z score), by District in North Maluku Province Indonesia using the current 2006 WHO international growth standard are presented in Table 7.15.

Table 7.15: Prevalence of wasting and severe wasting in children aged less than five years of age by district using the current 2006 WHO international growth standards, North Maluku Province, Indonesia 2004

		<-2SD (Wasting)				<-3SD (Severe wasting)				Mean Z-score	SD Z-score
Districts	**N**	**n**	**%**	**95%CI**		**n**	**%**	**95%CI**			
Ternate	387	65	17	12	22	25	6.5	4.1	9.9	-0.67	1.66
Tidore	149	15	10	6.1	16	4	2.7	0.9	8.1	-0.46	1.4
Central Halmahera	280	20	7.2	4.7	11	4	1.4	0.5	4.1	-0.34	1.18
East Halmahera	280	42	15	9.2	24	18	6.4	4.1	9.9	-0.45	1.68
West Halmahera	178	18	10	7.9	13	3	1.7	0.7	4.0	-0.53	1.19
North Halmahera	279	22	7.9	5.5	11	12	4.3	2.4	7.5	-0.47	1.42
South Halmahera	446	73	16	13	21	33	7.4	5.4	10	-0.65	1.65
Sula Island	169	34	20	17	24	19	11	8.0	16	-1.09	1.49
North Maluku	2168	289	13	11	16	118	5.4	4.4	6.7	-0.58	1.52

Percentage of children aged less than five years who are wasting and severely wasting (weight-for-height <-2.00 and <-3.00 Z-score) and 95%CI, mean and SD by District, North Maluku Province, Indonesia 2004 using the current 2006 WHO international growth standard.

7.3.3.1 Wasting

Sula Island district had the highest prevalence of wasting in children using the former and current growth references: 23% (95%CI 18, 28) and 20% (95%CI 16, 24), respectively. Central Halmahera had the lowest prevalence of stunting using the former and current growth references: 5.7% (95%CI 2.5, 13) and 7.2% (95%CI 4.7, 11), respectively.

The prevalence of children with wasting was mostly higher using the current WHO growth standards compared to the former growth reference (refer to Figure 7.11), however these differences were not statistically significant.

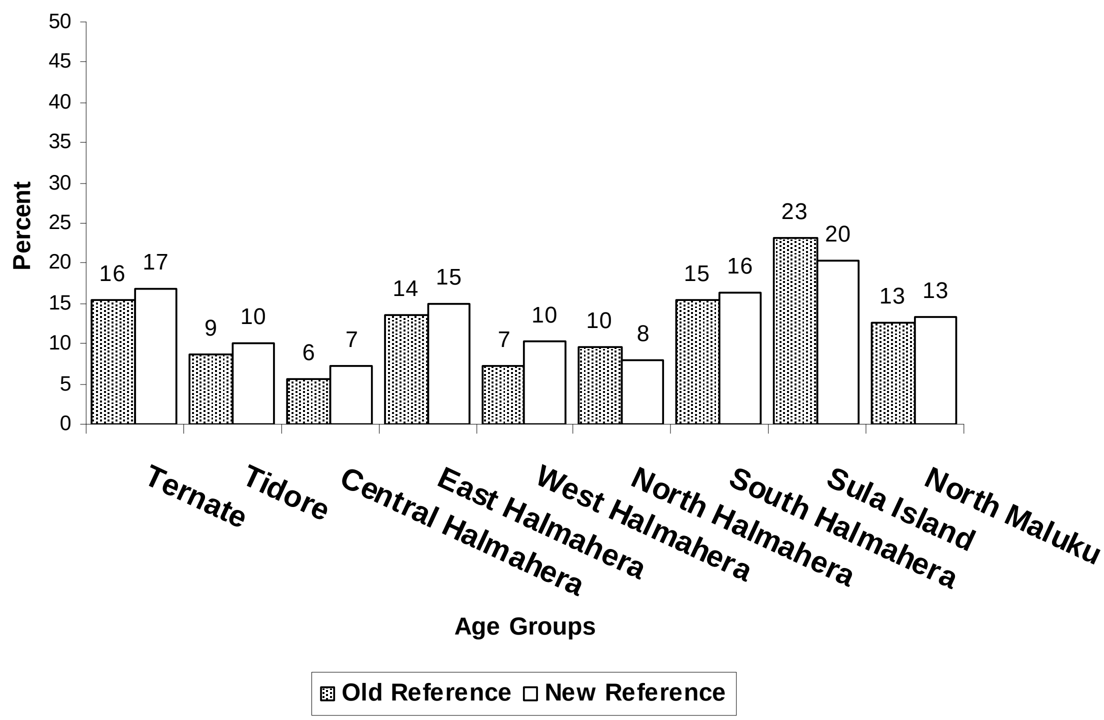

Figure 7.11: Prevalence of wasting in children by district

A comparison prevalence of wasting (height-for-age < -2.00 Z) by District when the anthropometric index is calculated using the current 2006 WHO international growth standards versus the former 1978 NCHS/WHO international growth reference.

7.3.3.2 Severe wasting

Sula island had the highest prevalence of severe wasting using the former and current references; 8.3% (95%CI 5.3, 13) and 11% (95%CI 7.9, 16) respectively. Central Halmahera District had the lowest prevalence of severely wasted children, using the former and current references; 1.4% (95%CI 0.5, 4.1) and 1.4% (95%CI 0.5, 4.1) respectively.

Refer to Figure 7.13 for a comparison of Districts using both growth references for severely wasted children. There was a tendency for the prevalence rates to be higher in most districts using the current growth references compared to the former however these differences were not statistically significant.

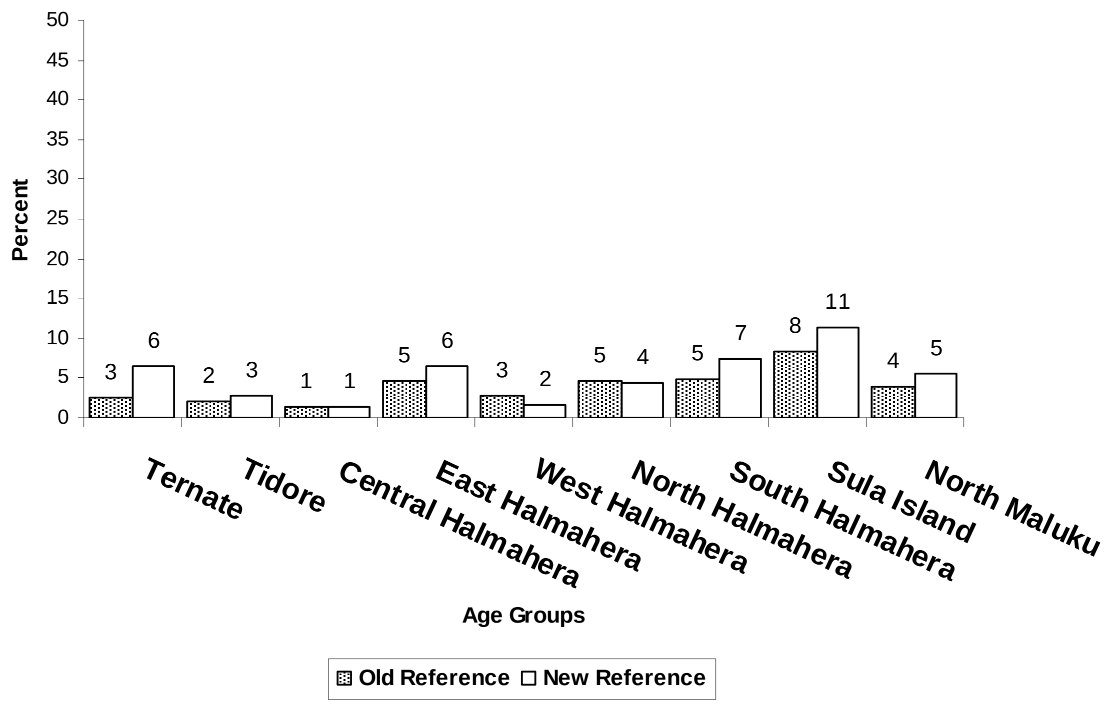

Figure 7.12: Prevalence of severe wasting in children by district

A comparison prevalence of severely wasting (height-for-age < -3 Z) by District when the anthropometric index is calculated using the current 2006 WHO international growth standards versus the former 1978 NCHS/WHO international growth reference.

7.5 A comparison of the anthropometric Z-score curves for children aged 0 to 59 months in North Maluku Province, Indonesia in 2004

7.4.1 Weight-for-age Z-score distributions

The mean weight-for-age Z-scores for children aged less than five years in North Maluku Province for the current and the former growth references were -1.20 and -1.27 respectively (refer to Table 7.4 and Table 7.5). This indicates that the distribution of the anthropometric indicators shifted significantly to below zero (the expected value of the reference distribution). Figure 7.13 illustrates a shift to the left for both the former and current growth references. However, the Z-score for the current growth reference shifted to the left more so than the former growth reference, indicating a greater percentage of underweight and severely underweight children in North Maluku Province using the former growth reference. It should be noted that the shape of the weight-for-age Z-score curves for both growth references were very similar to the shape of the reference curve, although they descend more rapidly on the lower side of the curve.

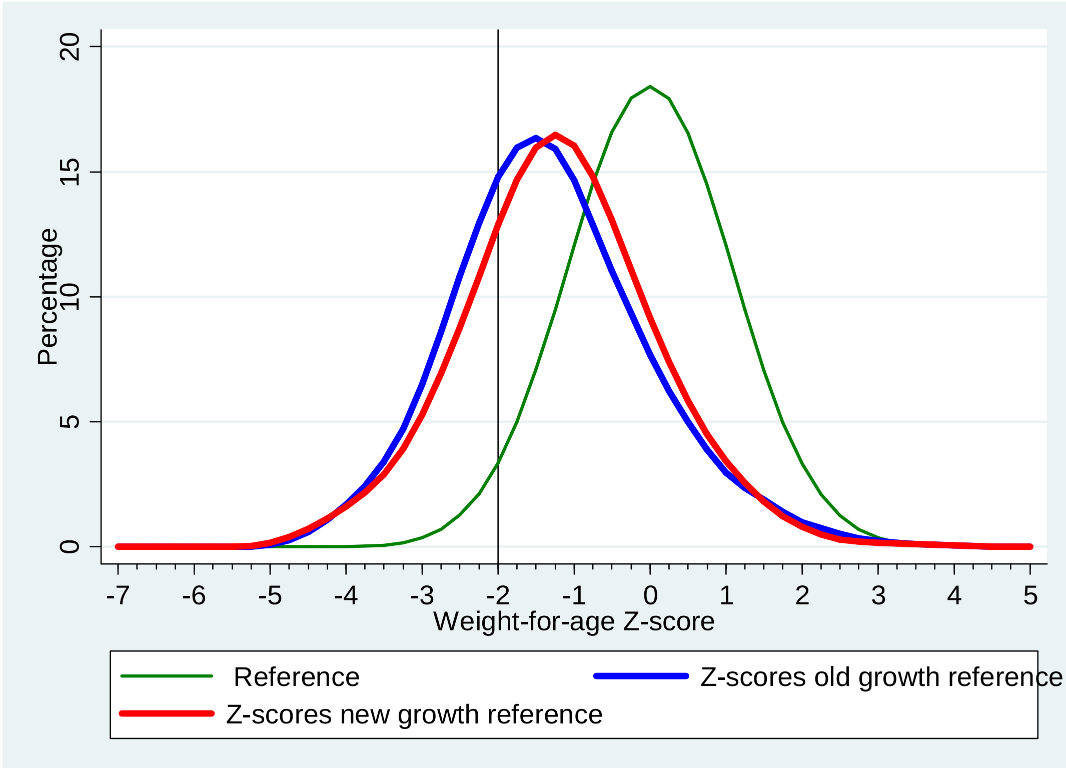

Figure 7.13: Weight for age Z score distribution

A comparison Weight–for–age Z-score curve for children aged 0 to 59 months in North Maluku Province Indonesia 2004 by the current 2006 WHO international growth standard versus the former 1978 NCHS/WHO international growth reference. The vertical line is the –2 Z-score cut off to define underweight.

7.4.2 Height-for-age Z-score distributions

The mean height -for-age Z-score for children aged less than five years in North Maluku Province for the new and the former growth references were -1.39 and -1.23 respectively (refer to

Table 7.1 and Table 7.6) indicating that the distribution of these anthropometric indicators shifted significantly below zero, the expected value of the reference distribution. The Z-score curves in Figure 7.14 demonstrate a total shift of the height-for-age Z-score distribution between current and former growth references.

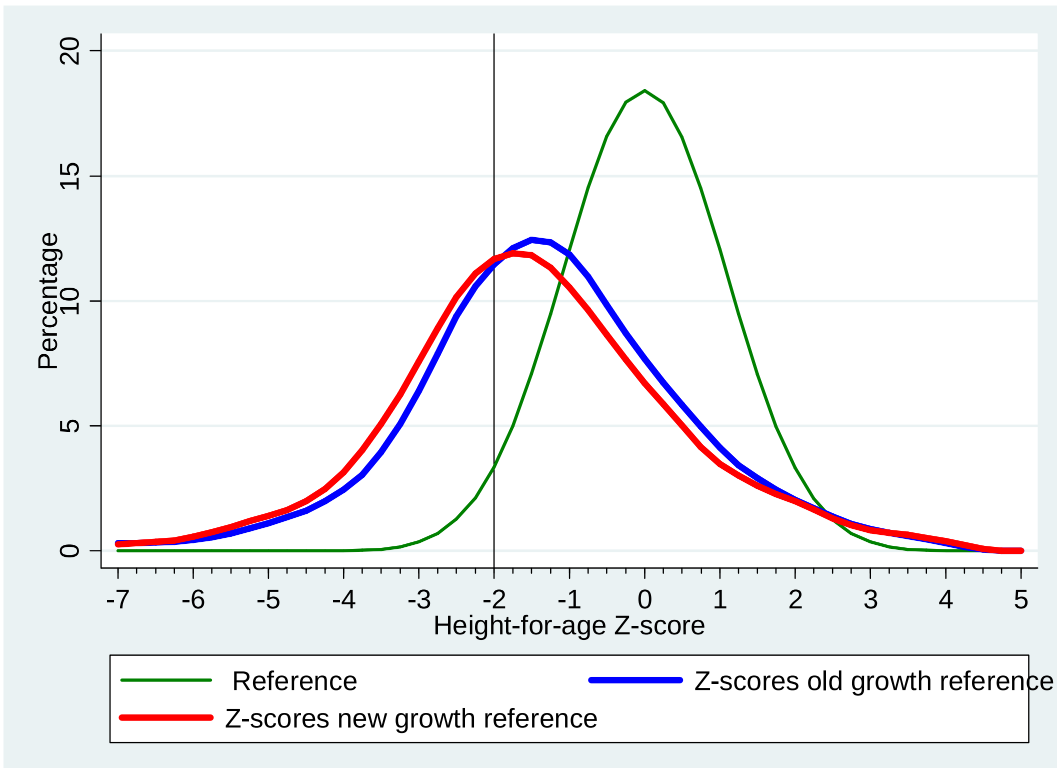

Figure 7.14: Height-for-age Z-score distributions

A comparison Height - for - age Z score curve for children aged 0 to 59 months in North Maluku Province Indonesia 2004 by the current 2006 WHO international growth standard versus the former 1978 NCHS WHO international growth reference. The vertical line is the -2.00 Z-score cut off to define stunting.

While the former reference curve shifted to the left, the curve for the current growth reference was wider at both ends of the distribution, particularly on the right hand side. Figure 7.14 shows that the current growth reference resulted in a greater reported prevalence of stunting and severe stunting than the former growth reference.

7.4.3 Weight-for-height Z-score distributions

The mean weight-for−height Z−scores for children aged less than five years in North Maluku Province for the current and the former growth references were -0.58 and -0.57 respectively indicating that the distribution of these anthropometric indicators shifted significantly below zero. Figure 7.15 shows a shift to the left for both curve the current and former growth references. However, the Z-score curve for the former reference shifted to the left more so than results for the current growth reference, indicating that the current growth reference resulted in a lower prevalence of stunting and less severe stunting compared with the former growth reference.

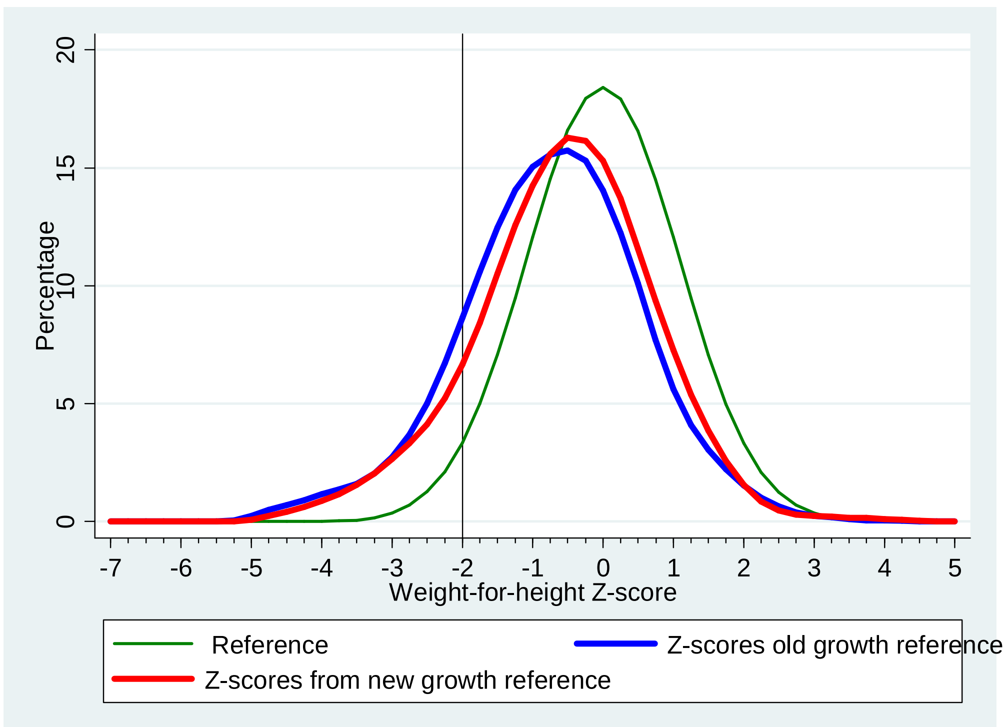

Figure 7.15: Weight-for-height Z-score distributions

A comparison weight -for- height Z-score curve for children aged 0 to 59 months in North Maluku Province Indonesia 2004 by the current 2006 WHO international growth standards versus the former 1978 NCHS/ WHO international growth reference. The vertical line is the -2.00 Z-score cut off to define wasting.

Table 7.16 indicates the similarity in prevalence of nutritional status indicators for children in North Maluku Province aged less than five years when using either the former or current growth reference.

Table 7.16: Group prevalence of nutritional status in children less than five years of age, using the former and current WHO growth references in North Maluku Province Indonesia, 2004

WHO Growth Reference	Weight-for-age Group Prevalence %		Height-for-age Group Prevalence %		Weight-for-height Group Prevalence %	
	<-2.00 SD	**<-3.00 SD**	**<-2.00 SD**	**<-3.00 SD**	**<-2.00 SD**	**<-3.00 SD**
Former	29 High	7.7 Low	33 High	14 Low	13 High	3.9 Low
Current	25 High	7.8 Low	38 High	18 Low	13 High	5.4 Low

A comparison utilising the former 1978 NCHS/WHO growth reference and the current 2006 WHO growth standard between three nutritional status indicators using the recommendations of a WHO Expert Committee that reported on the use and interpretation of anthropometry (WHO, 1995a). The classification of 'high' and 'low' are based on WHO prevalence ranges as shown in Table 3.8 in Chapter 3.

7.6 Discussion

Mean weight for age, weight for height and height for age differences were all statistically significantly different when comparing the *former* 1978 NCHS/WHO growth reference (WHO, 1978) and the *current* 2006 WHO growth reference (WHO, 2006). The mean weight for age was lower for the former growth reference compared to current. The mean height for age was lower for the current growth reference and the mean weight for height was similar.

The results from this study show that the prevalence of nutritional status indicators using the former NCHS/WHO growth reference (WHO, 1978) compared with the current WHO growth reference (WHO, 2006) in children less than five years of age in North Maluku Province Indonesia in 2004, were similar for the majority of indicators: underweight, severely underweight, stunting, severe stunting, wasting and severe wasting when assessed by age group with the exception of underweight and severely underweight.

The prevalence of underweight and severely underweight children aged zero to five months was significantly higher using the new growth reference compared to the old growth reference. The prevalence of underweight children aged 12 to 17 months and 24-29 months was lower when using the current growth reference compared to the former. Therefore our hypothesis that the prevalence of stunting in children aged zero to six months would be higher using the current growth reference was not supported. For stunting the prevalence was higher in every age group using the current growth reference; however none of these differences were statistically significant.

The prevalence of nutritional status indicators using the *former* NCHS/WHO growth reference compared with the *current* WHO growth reference in children less than five years of age in North Maluku Province Indonesia in 2004, were similar for all nutritional indicators when assessed by district.

The National Centre for Health Statistics (NCHS WHO 1978) growth curves were constructed by combining two distinct data sets compiled in different time periods. The data came from nationally representative cross-sectional surveys of children in the United States and included all ethnic groups and social classes. The new 2006 WHO child growth standards used the Multi-centre Growth Reference Study (MGRS), a community-based, multi-country project involving more than eight thousand children from Brazil, Ghana, India, Norway, Oman, and the United States of America. The children in the study were selected based on an optimal environment for proper growth: recommended infant and young child feeding practices, good healthcare, mothers who did not smoke, and other factors associated with good health outcomes. As different populations were used to develop these child growth references a difference in anthropometric measurements might be expected.

Utilising the *current* and *former* growth references based on the recommendations of a WHO Expert Committee (WHO, 1995b) revealed that the prevalence of children in North Maluku province in 2004 with underweight was high (20-29%), with stunting was high (30-39%), and with wasting was high (10-12%). The prevalence of severely underweight children remained low (less than 10%) and the prevalence of severe stunting was low (less than 20%). The prevalence of severe wasting was low (less than five percent) using the former

WHO growth reference (WHO, 1978) and medium (5-9%) using the current WHO growth reference (WHO, 2006).

While the prevalence of underweight children in the age groups of zero to five months was statistically significantly higher for the *current* growth reference when compared to the *former* growth reference 9.4% (95%CI 6.4, 14) versus 1.9% (95%CI 0.8, 4.6) the remainder of the six-month age groups were similar. The overall lower prevalence of underweight children using the *current* 2006 WHO growth standard was not statistically significantly different. The prevalence of severely underweight children was statistically significantly higher in the zero to five month age group when comparing *current* versus *former* growth standards (2.6%, 95%CI 1.3, 5.5) versus 0%. For the remaining six-month age group the prevalence rates were not statistically significantly different in the *former* versus the *current* WHO growth references.

The prevalence of stunting and severe stunting using the *current* 2006 WHO growth reference was slightly higher for all six-month age groups compared with the *former* reference, however the differences were not statistically significant. The prevalence of wasting using the *current* reference was also slightly higher in the younger age groups of zero to five months and six to 11 months compared to the *former* growth reference; however these results were not statistically significantly different. The remaining prevalence rates for wasting and severe wasting were statistically similar.

In this study severe wasting was low (less than five percent) using the former WHO growth reference (WHO, 1978) and medium (5-9%) using the current WHO growth reference (WHO, 2006). For the rest of the nutritional status indicators for children under five years old they were similar when comparing the *former* 1978 NCHS/WHO growth reference and the *current* 2006 WHO growth reference.

These findings are similar to those of earlier reports (Adu-Afarwuah et al., 2007; Kramer et al., 2007; Veni Hadju, 2007) where the prevalence of under-nutrition in Indonesian children differed under the *current* and *former* WHO referencing system. Prevalence of under-nutrition (weight-for-age and weight-for-height, Z-score) of children less than five years old was lower under the *current* reference while height-for-age Z-score was higher. The prevalence of severe under-nutrition in early life (weight-for-age and weight-for-height Z-score) was higher under the *current* reference.

These finding are also similar to a WHO report (2006) which stated that when nutritional status indicators were assessed using the *current 2006* WHO reference there would be an increase in the prevalence of underweight during the first half of infancy (zero to six months) and a decrease thereafter. The prevalence of stunting would be greater throughout childhood and the prevalence of wasting higher during infancy (up to about 70 cm length) using the current WHO reference (WHO, 2006).

There are relatively few studies of nutritional status comparing the *current* 2006 WHO growth standards with the former 1978 NCHS/WHO growth reference. Some studies have focused on a comparison between different growths references other than the *current* 2006 WHO child growth standards (de Onis et al., 2007a; de Onis et al., 2007b; Garza and De Onis, 1999; Onyango et al., 2007; Veni Hadju, 2007). Further analysis including all appropriate growth references may be beneficial to provide a more comprehensive analysis across a greater number of variables.

This study is limited by the quality of the anthropometric data collected and the accuracy of age that was reported. Importantly breast feeding data was not able to be including limiting the accuracy and completeness of data. The 95% confidence intervals for prevalence rates are quite wide indicating some loss of precision in these rates. While statistically the prevalence rates were not significantly different there may be some clinically significant differences with using the current growth standards, including an absolute increase in the number of children classified as being under-nourished and requiring nutritional support.

In summary, this Chapter reported that the prevalence of the nutritional status indicators of children aged less than five years in North Maluku Province Indonesia in 2004 were similar whether using the *current* 2006 WHO international child growth standards or the *former* 1978 NCHS/WHO child growth reference. The prevalence of nutritional status indicators in those children aged less than 12-months was generally higher when assessed under the 2006 *current* growth standards compared with the *former* growth reference; however these differences were not statistically significant, excepting for the prevalence of under nutrition This means that previous policy and programs based on the *former* 1978 NCHS/WHO child growth reference remain relevant using the *current* 2006 WHO international child growth standards.

Therefore, the nutritional status of young children remains a major public health problem in Indonesia. This is a challenge for the local government and local communities of North Maluku to allocate funding and resources to establish appropriate nutrition intervention programs to improve the health of children aged less than five years, particularly those less than 12 months in North Maluku province, Indonesia.

7.7 References

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Appendix 7. 1: Percentage of children aged less than five years with underweight and severely underweight by gender and six month age group in North Maluku Province, Indonesia 2004

Table 7.17: Percentage of boys aged less than five years who are underweight (weight-for-age <-2.00 Z) and severely underweight (weight-for-age <-3.00 Z) by gender and six-month age group, North Maluku Province, Indonesia 2004

Age Groups in months	Boys										
	Weight for Age										
		<-3.00SD				<-2.00SD				Mean Z-scr	SD Z-scr
	N	n	%	CI		n	%	CI			
0-5	146	6	4.1	1.8	9.0	17	12	7	18	-0.39	1.40
6-11	190	15	7.9	4.8	13	42	22	17	29	-1.01	1.41
12-17	159	16	10	5.8	17	45	28	21	37	-1.31	1.25
18-23	114	4	3.5	1.3	9.1	40	35	28	43	-1.31	1.34
24-29	126	13	10	6.0	17	33	26	20	34	-1.35	1.32
30-35	94	9	9.6	4.8	18	32	34	25	44	-1.53	1.27
36-41	107	8	7.5	3.5	15	35	33	24	43	-1.63	0.95
42-47	66	7	11	4.5	23	20	30	19	44	-1.70	0.98
48-53	75	14	19	11	30	37	49	37	61	-2.07	1.14
54-59	38	3	7.9	2.6	21	16	42	30	55	-2.05	0.82
Total	1115	95	8.5	6.8	11	317	28	25	32	-1.29	1.34

Data was analysed by using 1978 NCHS/WHO child growth reference

Table 7.18 Percentage of girls aged less than five years who are underweight (weight-for-age <-2.00 Z) and severely underweight (weight-for-age <-3.00 Z) by gender and six-month age group, North Maluku Province, Indonesia 2004

Age Groups in months	Girls										
	Weight for Age										
		<-3.00SD				<-2.00SD				Mean Z-scr	SD Z-scr
	N	n	%	CI		n	%	CI			
0-5	120	0	0.0			1	0.8	0.1	6.0	0.50	1.32
6-11	175	3	1.7	0.5	5.3	26	15	9.9	22	-0.80	1.34
12-17	159	11	6.9	4.0	12	50	31	25	39	-1.39	1.10
18-23	120	11	9.2	4.8	17	42	35	26	45	-1.48	1.26
24-29	112	13	12	6.8	19	43	38	31	46	-1.47	1.29
30-35	75	7	9.3	4.2	19	25	33	24	44	-1.61	0.93
36-41	108	12	11	5.8	20	35	32	24	42	-1.62	1.01
42-47	81	14	17	10	28	31	38	28	50	-1.82	1.14
48-53	60	7	12	5.6	23	24	40	28	54	-2.00	1.05
54-59	43	1	2.3	0.3	16	17	40	26	55	-1.75	0.74
Total	1053	79	7.5	6.0	9.3	294	28	25	31	-1.22	1.37

Data was analysed by using 1978 NCHS/WHO child growth reference

Table 7.19: Percentage of boys and girls aged less than five years who are underweight (weight-for-age <-2.00 Z) and severely underweight (weight-for-age <-3.00 Z) by gender and six-month age group, North Maluku Province, Indonesia 2004

Age Groups in months	Both Sexes										
	Weight for Age										
		<-3.00SD				<-2.00SD				Mean Z-scr	SD Z-scr
	N	n	%	CI		n	%	CI			
0-5.	266	0	0.0			5	1.9	0.8	4.6	0.33	1.29
6-11.	365	16	4.4	2.7	7.2	57	16	12	20	-0.89	1.34
12-17.	318	28	8.8	6.1	13	110	35	30	40	-1.55	1.14
18-23.	234	20	8.6	5.3	14	89	38	32	45	-1.49	1.25
24-29.	238	31	13	9.1	18	95	40	35	45	-1.50	1.30
30-35	169	15	8.9	5.4	14	58	34	27	42	-1.61	1.04
36-41	215	18	8.4	5.1	14	68	32	25	39	-1.64	0.92
42-47	147	17	12	7.3	18	52	35	28	44	-1.77	1.02
48-53	135	20	15	9.7	22	64	47	39	56	-2.05	0.99
54-59	81	4	4.9	1.8	13	37	46	36	56	-1.93	0.75
Total	2168	169	7.8	6.7	9.1	635	29	27	32	-1.27	1.35

Data was analysed by using 1978 NCHS/WHO child growth reference

Appendix 7. 2: Percentage of children aged less than five years with stunting and severe stunting by gender and six-month age group in North Maluku Province, Indonesia 2004

Table 7.20 Percentage of boys aged less than five years who are stunted (height-for-age <-2.00 Z) and severely stunted (height-for-age <-3.00 Z) by gender and six-month age group, North Maluku Province, Indonesia 2004

Age Groups in months	Boys										
	Height for Age										
		<-3.00SD				<-2.00SD				Mean	SD Z-
	N	n	%		CI	n	%	CI		Z-scr	scr
0-5.	146	10	6.9	4.0	11	13	8.9	5.6	14	0.05	2.06
6-11.	190	13	6.8	3.7	12	47	25	19	32	-0.64	2.15
12-17.	159	25	16	10	23	59	37	30	45	-1.45	1.96
18-23.	114	27	24	15	35	51	45	34	56	-1.72	2.13
24-29.	126	17	13	8.9	20	50	40	31	49	-1.37	1.90
30-35	94	14	15	8.7	24	39	41	31	53	-1.68	1.63
36-41	107	26	24	17	33	58	54	43	65	-2.07	1.69
42-47	66	9	14	6.7	26	27	41	28	55	-1.72	1.39
48-53	75	17	23	13	36	33	44	32	57	-2.16	1.94
54-59	38	6	16	6.3	34	15	39	27	54	-1.84	1.16
Total	1115	164	15	12	18	392	35	32	39	-1.29	2.03

Data was analysed by using 1978 NCHS/WHO child growth reference

Table 7.21: Percentage of girls aged less than five years who are stunted (height-for-age <-2.00 Z) and severely stunted (height-for-age <-3.00 Z) by gender and six-month age group, North Maluku Province, Indonesia 2004

Age Groups in months	Girls										
	Height for Age										
		<-3.00SD				<-2.00SD				Mean	SD Z-
	N	n	%	CI		n	%	CI		Z-scr	scr
0-5.	120	8	6.7	3.3	13	10	8.3	4.5	15	0.26	2.22
6-11.	175	7	4.0	1.5	10	32	18	12	26	-0.44	1.86
12-17.	159	13	8.2	4.3	15	38	24	18	32	-0.92	1.95
18-23.	120	23	19	12	29	51	43	32	53	-1.66	1.86
24-29.	112	17	15	10	23	43	38	31	47	-1.41	1.72
30-35	75	15	20	13	30	29	39	30	49	-1.80	1.67
36-41	108	19	18	12	25	41	38	30	47	-1.71	2.01
42-47	81	16	20	12	31	34	42	29	56	-1.81	1.81
48-53	60	15	25	16	38	32	53	41	66	-2.42	2.08
54-59	43	5	12	4.9	25	17	40	26	55	-1.70	1.32
Total	1053	138	13	11	16	327	31	28	35	-1.17	2.03

Data was analysed by using 1978 NCHS/WHO child growth reference

Table 7.22: Percentage of boys and girls aged less than five years who are stunted (height-for-age <-2.00 Z) and severely stunted (height-for-age <-3.00 Z) by gender and six-month age group, North Maluku Province, Indonesia 2004

Age Groups in months	Both Sexes										
	Height for Age										
	N	<-3.00SD				<-2.00SD				Mean Z-scr	SD Z-scr
		n	%	CI		n	%	CI			
0-5.	266	18	6.8	4.6	10	23	8.7	6.0	12	0.14	2.13
6-11.	365	20	5.5	3.0	10	79	22	17	27	-0.54	2.02
12-17.	318	38	12	8	17	97	31	26	35	-1.18	1.97
18-23.	234	50	21	15	29	102	44	36	52	-1.69	1.99
24-29.	238	34	14	10	20	93	39	33	46	-1.39	1.82
30-35	169	29	17	12	25	68	40	33	48	-1.74	1.64
36-41	215	45	21	16	27	99	46	39	53	-1.89	1.86
42-47	147	25	17	11	26	61	42	31	53	-1.77	1.63
48-53	135	32	24	17	32	65	48	39	58	-2.27	2.00
54-59	81	11	14	6.7	26	32	40	29	50	-1.77	1.24
Total	2168	302	14	12	16	719	33	31	36	-1.23	2.03

Data was analysed by using 1978 NCHS/WHO child growth reference

Appendix 7. 3: Percentage of children aged less than five years who are wasted and severely wasted by gender and six-month age group in North Maluku Province Indonesia 2004

Table 7.23: Percentage of boys aged less than five years who are wasted (weight-for-height <-2.00 Z) and severely wasted (weight-for-height <-3.00 Z) by gender and six-month age group, North Maluku Province, Indonesia 2004

Age Groups in months	Males										
	Weight for Height										
	N	<-3.00SD				<-2.00SD				Mean Z-scr	SD Z-scr
		n	%	CI		n	%	CI			
0-5.	146	3	2.1	0.7	6.2	12	8.2	4.8	14	0.40	2.56
6-11.	190	8	4.2	2.1	8.4	28	15	10	20	-0.54	1.50
12-17.	159	10	6.3	3.4	11	26	16	11	23	-0.91	1.39
18-23.	114	6	5.3	2.1	13	21	18	12	27	-0.69	1.54
24-29.	126	5	4.0	1.4	11	17	13	8.0	22	-0.68	1.17
30-35	94	2	2.1	0.5	8.0	8	8.5	4.5	16	-0.75	0.97
36-41	107	3	2.8	0.9	8.5	8	7.5	4.0	14	-0.59	1.17
42-47	66	4	6.1	2.33	15	10	15	8.0	27	-0.92	1.12
48-53	75	8	11	5.21	21	13	17	9.7	29	-1.12	1.30
54-59	38	4	11	3.82	26	8	21	11	36	-1.41	1.15
Total	1115	53	4.8	3.58	6.3	151	14	11	16	-0.61	1.59

Data was analysed by using 1978 NCHS/WHO child growth reference

Table 7.24: Percentage of girls aged less than five years who are wasted (weight-for-height <-2.00 Z) and severely wasted (weight-for-height <-3.00 Z) by gender and six-month age group, North Maluku Province, Indonesia 2004

Age Groups in months	Females										
	Weight for Height										
	N	<-3.00SD				<-2.00SD				Mean Z-scr	SD Z-scr
		n	%	CI		n	%	CI			
0-5.	120	2	1.7	0.4	6.6	6	5.0	2.3	11	0.69	2.74
6-11.	175	4	2.3	0.8	6.1	19	11	7.2	16	-0.39	1.52
12-17.	159	11	6.9	3.8	12	25	16	9.5	25	-0.88	1.44
18-23.	120	4	3.3	1.3	8.4	20	17	11	25	-0.76	1.34
24-29.	112	1	0.9	0.1	5.9	10	8.9	5.0	15	-0.68	0.98
30-35	75	1	1.3	0.2	9.3	5	6.7	2.7	16	-0.57	1.15
36-41	108	2	1.9	0.5	7.2	13	12	6.2	22	-0.64	1.47
42-47	81	3	3.7	1.2	11	13	16	8.8	27	-0.89	1.22
48-53	60	0	0.0			7	12	5.7	22	-0.74	1.05
54-59	43	3	7.0	2.2	20	6	14	6.2	28	-0.94	1.11
Total	1053	31	2.9	2.0	4.4	124	12	9.5	14	-0.53	1.61

Data was analysed by using 1978 NCHS/WHO child growth reference

Table 7.25: Percentage of boys and girls aged less than five years who are wasted (weight-for-height <-2.00 Z) and severely wasted (weight-for-height <-3.00 Z) by gender and six-month age group, North Maluku Province, Indonesia 2004

Age Groups in months	Both Sexes										
	Weight for Height										
	N	<-3.00SD				<-2.00SD				Mean Z-scr	SD Z-scr
		n	%		CI	n	%	CI			
0-5.	266	5	1.9	0.8	4.4	18	6.8	4.4	10	0.53	2.64
6-11.	365	12	3.3	1.8	6.0	47	13	10	17	-0.47	1.51
12-17.	318	21	6.6	4.1	10	51	16	12	22	-0.89	1.41
18-23.	234	10	4.3	2.2	8.0	41	18	13	23	-0.73	1.44
24-29.	238	6	2.5	1.0	6.0	27	11	7.6	17	-0.68	1.08
30-35	169	3	1.8	0.6	5.3	13	7.7	4.6	13	-0.67	1.05
36-41	215	5	2.3	1.0	5.4	21	9.8	6.2	15	-0.61	1.33
42-47	147	7	4.8	2.3	9.8	23	16	10	23	-0.90	1.17
48-53	135	8	5.9	2.9	12	20	15	9.5	22	-0.95	1.20
54-59	81	7	8.6	3.8	18	14	17	10	28	-1.16	1.15
Total	2168	84	3.9	3.0	4.9	275	13	11	15	-0.57	1.60

Data was analysed by using 1978 NCHS/WHO child growth reference

Appendix 7. 4: Percentage of children aged less than five years who are underweight and severely underweight by gender and district, North Maluku Province, Indonesia 2004

Table 7.26: Percentage of boys aged less than five years who are underweight (weight-for-age <-2.00 Z) and severely underweight (weight-for-age <-3.00 Z) by gender and district, North Maluku Province, Indonesia 2004

	Boys										
	Weight for Age										
Districts		<-3.00SD				<-2.00SD				Mean	SD Z-
	N	n	%		CI	n	%	CI		Z-scr	scr
Ternate	200	13	6.5	4.2	10.00	63	32	25	39	-1.46	1.13
Tidore	78	1	1.3	0.2	7.4	13	17	8.2	31	-0.86	1.21
Central Halmahera	147	12	8.2	4.2	15	42	29	20	39	-1.28	1.42
East Halmahera	139	12	8.6	4.7	15	49	35	26	45	-1.35	1.38
West Halmahera	91	4	4.4	1.6	12	25	27	23	33	-1.36	1.09
North Halmahera	148	10	6.8	4.2	11	47	32	24	41	-1.27	1.33
South Halmahera	222	26	12	7.9	17	69	31	25	38	-1.24	1.47
Sula Island	90	12	13	9.1	19	33	37	26	49	-1.63	1.37
Total	1115	90	8.1	6.5	10	341	31	27	34	-1.32	1.33

Data was analysed by using 1978 NCHS/WHO child growth reference

Table 7.27: Percentage of girls aged less than five years who are underweight (weight-for-age <-2.00 Z) and severely underweight (weight-for-age <-3.00 Z) by gender and district, North Maluku Province, Indonesia 2004

	Girls										
	Weight for Age										
Districts		<-3.00SD				<-2.00SD				Mean	SD Z-
	N	n	%	CI		n	%		CI	Z-scr	scr
Ternate	187	15	8.0	5.4	11.7	55	29	23	36	-1.34	1.26
Tidore	71	5	7.0	3.5	13.6	14	20	14	26	-0.81	1.57
Central Halmahera	133	5	3.8	1.5	9.3	29	22	16	29	-1.11	1.32
East Halmahera	141	16	11.4	6.5	19.0	40	28	20	39	-1.29	1.42
West Halmahera	87	5	5.8	3.0	10.6	19	22	17	27	-1.22	1.11
North Halmahera	131	9	6.9	4.2	10.9	39	30	20	42	-1.17	1.49
South Halmahera	224	16	7.1	3.9	12.8	69	31	27	35	-1.20	1.43
Sula Island	79	8	10	8.4	12.2	29	37	28	47	-1.49	1.20
Total	1053	79	7.5	6.0	9.3	294	28	25	31	-1.22	1.37

Data was analysed by using 1978 NCHS/WHO child growth reference

Table 7.28: Percentage of boys and girls aged less than five years who are underweight (weight-for-age <-2.00 Z) and severely underweight (weight-for-age <-3.00 Z) by gender and district, North Maluku Province, Indonesia 2004

Districts	Both Sexes										
	Weight for Age										
	N	<-3.00SD				<-2.00SD				Mean Z-scr	SD Z-scr
		n	%	CI		n	%	CI			
Ternate	387	28	7.2	5.6	9.4	118	30	25	36	-1.40	1.20
Tidore	149	6	4.0	2.1	7.7	27	18	12	27	-0.84	1.38
Central Halmahera	280	17	6.1	3.2	11	71	25	19	33	-1.20	1.37
East Halmahera	280	28	10	6.3	15	89	32	24	41	-1.32	1.40
West Halmahera	178	9	5.1	3.0	8.4	44	25	21	29	-1.29	1.10
North Halmahera	279	19	6.8	4.7	9.7	86	31	24	39	-1.23	1.40
South Halmahera	446	42	9.4	7.4	12	138	31	28	34	-1.22	1.45
Sula Island	169	20	12	9.4	15	62	37	33	41	-1.56	1.29
Total	2168	169	7.8	6.7	9.1	635	29	27	32	-1.27	1.35

Data was analysed by using 1978 NCHS/WHO child growth reference

Appendix 7.5: Percentage of children aged less than five years who are stunted and severely stunted by gender and district, North Maluku Province, Indonesia 2004

Table 7.29: Percentage of boys aged less than five years who are stunted (height-for-age <-2.00 Z) and severely stunted (height-for-age <-3.00 Z) by gender and district, North Maluku Province, Indonesia 2004

Districts	Boys										
	Height for Age										
		<-3.00SD				<-2.00SD				Mean	SD Z-
	N	n	%	CI		n	%	CI		Z-scr	scr
Ternate	200	25	13	8.0	19	70	35	29	41	-1.45	1.73
Tidore	78	4	5.1	2.0	13	18	23	13	38	-0.83	1.59
Central Halmahera	147	28	19.1	13	27	61	42	31	53	-1.52	2.35
East Halmahera	139	34	24	15	37	53	38	29	48	-1.57	2.15
West Halmahera	91	8	8.8	4.2	18	31	34	31	37	-1.36	1.57
North Halmahera	148	25	17	9.5	28	58	39	30	49	-1.29	2.27
South Halmahera	222	32	14	9.3	22	76	34	28	41	-1.01	2.18
Sula Island	90	8	8.9	5.6	14	25	28	21	36	-1.15	1.73
North Maluku	1115	164	15	12	18	392	35	32	39	-1.29	2.03

Data was analysed by using 1978 NCHS/WHO child growth reference

Table 7.30: Percentage of girls aged less than five years who are stunted (height-for-age <-2.00 Z) and severely stunted (height-for-age <-3.00 Z) by gender and district, North Maluku Province, Indonesia 2004

Districts	Girls										
	Height for Age										
		<-3.00SD				<-2.00SD				Mean	SD Z-
	N	n	%	CI		n	%	CI		Z-scr	scr
Ternate	187	20	10.7	7.1	16	49	26.2	20	33	-1.13	1.74
Tidore	71	10	14.1	7.4	25	14	19.7	12	30	-0.76	2.17
Central Halmahera	133	16	12.0	8.1	18	48	36.1	28	45	-1.30	2.02
East Halmahera	141	26	18.4	9.3	33	45	31.9	21	45	-1.26	2.00
West Halmahera	87	12	13.8	8.9	21	21	24.1	16	34	-1.40	2.11
North Halmahera	131	12	9.2	6.3	13	42	32.1	24	41	-1.16	2.06
South Halmahera	224	36	16.1	11	23	82	36.6	30	44	-1.18	2.29
Sula Island	79	6	7.6	4.4	13	26	32.9	25	42	-1.03	1.70
North Maluku	1053	138	13.1	11	16	327	31.1	28	35	-1.17	2.03

Data was analysed by using 1978 NCHS/WHO child growth reference

Table 7.31: Percentage of boys and girls aged less than five years who are stunted (height-for-age <-2.00 Z) and severely stunted (height-for-age <-3.00 Z) by gender and district, North Maluku Province, Indonesia 2004

	Both Sexes										
	Height for Age										
		<-3.00SD				<-2.00SD				Mean	SD Z-
Districts	N	n	%	CI		n	%	CI		Z-scr	scr
Ternate	387	45	11.6	8.43	15.84	119	30.8	26.62	35.21	-1.29	1.74
Tidore	149	14	9.4	4.94	17.16	32	21.5	13.92	31.62	-0.80	1.88
Central Halmahera	280	44	15.7	11.35	21.36	109	38.9	32.25	46.05	-1.42	2.20
East Halmahera	280	60	21.4	12.55	34.13	98	35.0	27.12	43.80	-1.41	2.08
West Halmahera	178	20	11.2	6.94	17.69	52	29.2	24.59	34.31	-1.38	1.85
North Halmahera	279	37	13.3	9.32	18.52	100	35.8	29.36	42.88	-1.23	2.17
South Halmahera	446	68	15.3	11.37	20.14	158	35.4	31.93	39.08	-1.09	2.23
Sula Island	169	14	8.3	5.70	11.89	51	30.2	26.85	33.73	-1.09	1.71
North Maluku	2,168	302	13.9	11.76	16.43	719	33.2	30.82	35.60	-1.23	2.03

Data was analysed by using 1978 NCHS/WHO child growth reference

Appendix 7.6: Percentage of children aged less than five years who are wasted and severely wasted by gender and district, North Maluku Province, Indonesia 2004

Table 7.32: Percentage of boys aged less than five years who are wasted (weight-for-age <-2.00 Z) and severely wasted (weight-for-age <-3.00 Z) by gender and district, North Maluku Province, Indonesia 2004

Districts	Boys										
	Weight for Height										
		<-3.00SD				<-2.00SD				Mean Z-scr	SD Z-scr
	N	n	%	CI		n	%	CI			
Ternate	200	5	2.5	0.88	6.89	30	15	9.51	22.87	-0.66	1.60
Tidore	78	0	0.0			6	7.7	3.00	18.36	-0.46	0.98
Central Halmahera	147	4	2.7	1.01	7.14	9	6.1	2.62	13.66	-0.39	1.43
East Halmahera	139	5	3.6	1.91	6.67	20	14	10	20.02	-0.44	1.81
West Halmahera	91	2	2.2	0.68	6.83	6	6.6	3.72	11.42	-0.67	1.14
North Halmahera	148	11	7.4	4.32	12.51	18	12	8.82	16.54	-0.52	1.73
South Halmahera	222	16	7.2	4.76	10.78	41	18	14.00	23.94	-0.75	1.64
Sula Island	90	10	11	7.35	16.45	21	23	16.02	32.68	-1.02	1.86
North Maluku	1115	53	4.8	3.58	6.28	151	14	11.30	16.15	-0.61	1.59

Data was analysed by using 1978 NCHS/WHO child growth reference

Table 7.33: Percentage of girls aged less than five years who are wasted (weight-for-age <-2.00 Z) and severely wasted (weight-for-age <-3.00 Z) by gender and district, North Maluku Province, Indonesia 2004

Districts	Girls										
	Weight for Height										
		<-3.00SD				<-2.00SD				Mean Z-scr	SD Z-scr
	N	n	%	CI		n	%	CI			
Ternate	187	5	2.7	0.95	7.28	30	16	11.87	21.33	-0.71	1.63
Tidore	71	3	4.2	1.24	13.45	7	9.9	5.13	18.12	-0.31	2.04
Central Halmahera	133	0	0.0			7	5.3	2.22	11.98	-0.19	1.63
East Halmahera	141	8	5.7	2.54	12.18	18	13	6.52	23.49	-0.58	1.71
West Halmahera	87	3	3.5	0.85	12.94	7	8.1	5.22	12.20	-0.47	1.43
North Halmahera	131	2	1.5	0.43	5.28	9	6.9	3.55	12.87	-0.54	1.10
South Halmahera	224	6	2.7	1.21	5.82	28	13	9.06	17.01	-0.50	1.63
Sula Island	79	4	5.1	2.50	9.98	18	23	14.52	33.89	-0.96	1.69
North Maluku	1053	31	2.9	1.97	4.39	124	12	9.54	14.45	-0.53	1.61

Data was analysed by using 1978 NCHS/WHO child growth reference

Table 7.34: Percentage of boys and girls aged less than five years who are wasted (weight-for-age <-2.00 Z) and severely wasted (weight-for-age <-3.00 Z) by gender and district, North Maluku Province, Indonesia 2004

Districts	Both Sexes										
	Weight for Height										
		<-3.00SD				<-2.00SD				Mean	SD Z-
	N	n	%	CI		n	%	CI		Z-scr	scr
Ternate	387	10	2.6	1.11	5.90	60	16	11.23	21.03	-0.68	1.61
Tidore	149	3	2.0	0.54	7.16	13	8.7	5.32	13.98	-0.39	1.57
Central Halmahera	280	4	1.4	0.49	4.08	16	5.7	2.50	12.52	-0.30	1.53
East Halmahera	280	13	4.6	2.81	7.59	38	14	9.18	19.61	-0.51	1.76
West Halmahera	178	5	2.8	1.26	6.16	13	7.3	4.92	10.72	-0.57	1.29
North Halmahera	279	13	4.7	2.76	7.76	27	9.7	6.56	14.06	-0.53	1.47
South Halmahera	446	22	4.9	3.36	7.19	69	15	12.19	19.44	-0.62	1.64
Sula Island	169	14	8.3	5.28	12.77	39	23	18.44	28.48	-0.99	1.78
North Maluku	2168	84	3.9	3.04	4.93	275	13	10.78	14.87	-0.57	1.60

Data was analysed by using 1978 NCHS/WHO child growth reference

CHAPTER 8

CONCLUSION

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8.1 Introduction

This Chapter summarises the key findings of a secondary data analysis of nutritional status data conducted in collaboration with the wider North Maluku Province Health survey, a cross sectional survey involving households with children aged less than five years, in North Maluku province Indonesia, in 2004. This Chapter addresses the potential limitations of this work and concludes with a discussion of its application in the identification of future research and intervention opportunities.

8.2 Major findings of the study

The prevalence of underweight, stunting and wasting in children aged less than five years from North Maluku was high according to the WHO criteria during this time of unrest. The prevalence of severe underweight and severe stunting was low and the prevalence of severe wasting was of medium level. The prevalence of all nutritional status indicators was higher in boys than girls and prevalence rates tended to be higher in older compared with younger children aged less than five years suggesting that nutritional programs need to target younger children to prevent older children, particularly boys, from developing acute and chronic under-nutrition. These results are reported in Chapter 4.

Based upon the application of multivariate logistic regression analyses Chapters 5 and 6 report child and family level socioeconomic characteristics that predict stunting and wasting, respectively, in children aged less than five years.

Results indicated that for children aged 0 to 23 months, the child's gender and the child's age in months were statistically significantly associated with stunting. For children aged 24 to 59 months the mothers' education and the frequency of visits to the local health services were statistically significantly associated with stunting. Overall, for children aged in the 0 to 59 months, household wealth, gender of the child and the child's age in months plus the frequency of visits to the local health services were all statistically significantly associated with stunting.

For children aged 0 to 23 months, household wealth, the child's age, the child's gender and whether the child had been sick in the previous two weeks were statistically significantly associated with severe stunting. For children in the 24 to 59 months age group, parental employment and the district in which a child lived were statistically significantly associated with severe stunting. Overall, for children in the 0 to 59 months age group, the father's occupation, household wealth, the child's age in months and gender of the child, demonstrated a statistically significant association with severe stunting.

There were no family level or child level characteristics statistically significantly associated with wasting on multivariate analysis in children aged 0 to 23 months and 0 to 59 months. For children aged 24 to 59 months visiting a local health service was associated with wasting indicating that visiting local health services two, or three or more, times was associated with reduced odds of wasting compared with those who did not visit local health services in the previous three months.

District was statistically significantly associated with severe wasting in children aged 0 to 23 months. A child's age in months and visits to a local health service were statistically significantly associated with severe wasting in children aged 24 to 59 months. Gender was significantly associated with severe wasting in children aged 0 to 59 months with girls having reduced odds of severe wasting compared to boys.

As reported in Chapter 7, when comparing the current 2006 WHO growth standards to the former 1978 NCHS/WHO internal child growth reference, using the 2004 data collected in North Maluku it was found that the:

- Prevalence of underweight children remained high (20 to 29%);
- Prevalence of severely underweight children remained low (less than 10%);
- Prevalence of stunting in children remained high (30 to 39%);
- Prevalence of severe stunting remained low (less than 20%); and
- Prevalence of wasting remained high (10 to 14%).

However, the prevalence of severe wasting (5.4%) changed from low (less than 5%) to medium (5 to 9%) when using the current 2006 WHO growth reference.

8.3 Limitation of the thesis

There are a number of limitations to this study. Firstly, this research involves secondary data analysis which was nested within an existing cross sectional study, and all variables were previously determined. A greater variety of data could have improved the internal and external validity of the study, including the inclusion of a child's food intake diary, exploration of food security and food availability issues.

Secondly, there was a lack of additional data to support aspects of the early life of the children including breast feeding history which may have directly influenced their nutritional status.

Thirdly, there were no dietary intake data to support the anthropometric data of children being underweight, severely underweight, stunted, severely stunted, wasted and severely wasted.

Fourth, this study used two main types of characteristics only: family and child level factors. Other characteristics may have influenced nutritional status.

Fifth, there may have been a degree of measurement error with the recording of anthropometric data and the level of accuracy in calculating age cannot be determined.

Sixth, the study may have been inadequately powered to answer all the questions postulated in this thesis as the sample size was pre-determined.

Finally, given the cross-sectional design of this study causal relationships cannot be determined.

Despite these limitations, the findings from this study will contribute to the body of evidence indicating that nutritional status and risk factors for under nutrition in young children in North Maluku, Indonesia remains a major issue and a worthy topic to investigate further to help solve the public health nutrition problems in developing countries.

8.4 Implication of the findings and recommendation

This study was the first to investigate nutrition status and risk factors for under nutrition in young children in North Maluku. This study is the first to explore the factors related to stunting and severe stunting in children in North Maluku and also to assess the association between severely underweight, severe stunting and severe wasting with socio-economic factors in pre-school aged children.

The findings reported in this Thesis will contribute to a greater understanding of the behavioural and environmental factors influencing the risk of malnutrition in children aged less than five years in North Maluku. It is expected that the results of this secondary data analysis data will be used to plan future prevention programs for undernourished children. The findings of this study also may assist the local government in North Maluku establish appropriate interventions for children aged 0 to 59 months and also assist the Indonesian Government Public Health Planner to establish National nutrition programs and interventions for these children.

Longitudinal studies could provide a more complete understanding of food intake, breast feeding history, life style, food habits, nutritional programs in Indonesia, food taboos, food availability, environment and their relationship to the emergence of under-nutrition in children in North Maluku. Such studies would also provide confirmation of risk factors for under-nutrition among children and could be used to set up an appropriate intervention for pre-school children.

In the year 2000 the prospects for improved social development in North Maluku was affected by economic crisis, social conflict and political instability. As a result, it is evident that children in these areas are less secure in their future well-being as the whole of North Maluku has become a province with no clear vision for development. The majority of the study population were living in refugee camps with inherent social and nutritional limitations. Food supplies were only available from the central governments, international agencies and other Non Government Organisations which assist during times of civil unrest. Unemployment and dependence on national and international aid increased (Razak et al., 2004).

8.5 Conclusion

In conclusion, findings from this cross sectional study of nutritional status indicators in young children and their association with child and family level characteristics identified that public health nutrition intervention programs for children aged 0 to 59 months will need to address under-nutrition in order to improve the overall health of children in the North Maluku province. Nutritional intervention programs targeting young children, particularly boys, available through local health services, may allow the nutritional status of young children in North Maluku to improve by preventing both acute and chronic under-nutrition. If such programs were effective then the generalisability of these findings to other provinces within Indonesia and to other lesser developed countries need to be explored.