PREVALENCE AND FACTORS ASSOCIATED WITH UNDERNUTRITION AMONG CHILDREN AGED 0-59 MONTHS IN MUGU DISTRICT NEPAL

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ความชุกและปัจจัยที่เกี่ยวข้องกับภาวะโภชนาการต่ำในเด็กอายุน้อยกว่า 0-59 เดือน ในอำเภอมูกู ประเทศเนปาล

นายซาอิล รานา

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาสาธารณสุขศาสตรมหาบัณฑิต
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Field of Study	Public Health
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ซาอิล รานา : ความชุกและปัจจัยที่เกี่ยวข้องกับภาวะโภชนาการต่ำในเด็กอายุน้อยกว่า 0-59 เดือน ในอำเภอมูกู ประเทศเนปาล (PREVALENCE AND FACTORS ASSOCIATED WITH UNDERNUTRITION AMONG CHILDREN AGED 0-59 MONTHS IN MUGU DISTRICT NEPAL) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ดร. อเลซซิโอ พันซ่า, 108 หน้า.

เด็กอายุน้อยกว่า 5 ปี ทั่วโลก จำนวนมากกว่า 1 ใน 3 เสียชีวิต เนื่องจากภาวะขาดโภชนาการ ภาวะขาดโภชนาการ ส่งผลกระทบทั้งระยะสั้นและระยะยาวต่อพัฒนาการของเด็ก เพิ่มความเสี่ยงต่อการติดเชื้อและการเป็นโรคเรื้อรังเพิ่มขึ้น มูกู (Mugu) เป็นตำบลที่มีจำนวนเด็กที่มีภาวะโภชนาการต่ำกว่ามาตรฐานมากที่สุดในประเทศเนปาล การศึกษานี้มีวัตถุประสงค์ เพื่อสำรวจความชุกและระบุปัจจัยที่เกี่ยวข้องกับการมีภาวะโภชนาการต่ำกว่ามาตรฐานของเด็กอายุ 0 – 59 เดือน ในตำบลมูกู (Mugu) การวิจัยแบบตัดขวางดำเนินการระหว่างเดือนมิถุนายน 2014 โดยเก็บข้อมูลของกลุ่มตัวอย่างเด็กอายุ 0 – 59 ปี ซึ่งอาศัยอยู่ใน 2 หมู่บ้านที่ถูกเลือกในตำบลมูกู (Mugu) การวัดร่างกายตามหลักวิทยาศาสตร์ถูกนำมาใช้วัดมารดาและเด็กที่เข้าร่วมในการศึกษา และใช้แบบสอบถามที่สร้างขึ้นเพื่อเก็บข้อมูลจากมารดา วิเคราะห์ข้อมูลโดยใช้การทดสอบไคว์สแควร์ หรือการทดสอบฟิชเชอร์ในการวิเคราะห์อย่างหยาบ (Bivariate analysis) และใช้การวิเคราะห์พหุตัวแปร (Multivariate Analysis) ในการทดสอบสมการถดถอยโลจิสติกที่ค่าความเชื่อมั่น $p < 0.05$ ความชุกของภาวะมีน้ำหนักน้อยมากเมื่อเทียบกับความสูงคิดเป็นร้อยละ 6.1 ความชุกโดยรวมของเด็กที่มีส่วนสูงเทียบตามอายุน้อยกว่ามาตรฐานคิดเป็นร้อยละ 61.8 และความชุกโดยรวมของเด็กที่อยู่ในการศึกษานี้ ซึ่งมีภาวะน้ำหนักเทียบตามอายุต่ำกว่ามาตรฐานคิดเป็นร้อยละ 48.8 ซึ่งสูงกว่ารายงานสถิติแห่งชาติโดย NDHS 2011 ปัจจัย เช่น ความไม่มั่นคงทางอาหาร เด็กที่มีรูปร่างขนาดเล็กในเวลาแรกเกิด คุณภาพการเลี้ยงลูกด้วยนมแม่ที่ไม่ดี ประวัติของโรคอุจจาระร่วงมีความสัมพันธ์ทางบวกกับภาวะมีน้ำหนักน้อยมากเมื่อเทียบกับความสูง ค่าดัชนีมวลกายต่ำกว่ามาตรฐาน

การเว้นช่วงการมีบุตรที่น้อยกว่า 24 เดือน และเด็กที่อยู่ในกลุ่มอายุ 12-35 เดือน มีความสัมพันธ์ทางบวกกับเด็กที่มีส่วนสูงเทียบตามอายุน้อยกว่ามาตรฐาน แต่การติดตามการเจริญเติบโตมีความสัมพันธ์ทางลบกับเด็กที่มีส่วนสูงเทียบตามอายุน้อยกว่ามาตรฐาน สำหรับมารดาที่มีค่าดัชนีมวลกายต่ำกว่ามาตรฐาน เด็กในกลุ่มอายุ 12-35 เดือนที่มีรูปร่างขนาดเล็กในเวลาแรกเกิดและมีประวัติของโรคอุจจาระร่วงมีความสัมพันธ์ทางบวกกับน้ำหนักต่ำกว่าเกณฑ์มาตรฐาน และพบว่าความชุกของเด็กที่มีภาวะโภชนาการต่ำกว่ามาตรฐานมีระดับสูงในตำบลมูกู (Mugu) การแก้ปัญหาที่เกิดจากปัจจัย เช่น วิธีการบริโภคอาหารที่ไม่ดีและความไม่มั่นคงทางอาหารควรแก้ไขโดยการพัฒนาโครงสร้างพื้นฐานและการสอดแทรกโปรแกรมที่เกี่ยวข้อง ปัจจัย เช่น การเว้นช่วงการมีบุตร การติดตามการเจริญเติบโต ภาวะไข้สูงและโรคอุจจาระร่วงในเด็กสามารถแก้ไขได้โดยการจัดเตรียมสิ่งอำนวยความสะดวกด้านสุขภาพที่เพียงพอและบริการสุขภาพเชิงรุกแก่ประชาชนผ่านการบริการหน่วยสุขภาพเคลื่อนที่โดยมุ่งเน้นการให้สุขศึกษาและส่งเสริมสุขภาพ

สาขาวิชา สาธารณสุขศาสตร์ ลายมือชื่อนิสิต .....

ปีการศึกษา 2557 ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

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SALIL RANA: PREVALENCE AND FACTORS ASSOCIATED WITH UNDERNUTRITION AMONG CHILDREN AGED 0-59 MONTHS IN MUGU DISTRICT NEPAL. ADVISOR: ALESSIO PANZA, M.D., 108 pp.

Under-nutrition is responsible for greater than a third of under-five child deaths in the world. The short and long term effects of under-nutrition include delayed developmental milestones, an increased risk of infections and greater susceptibility to chronic disease as an adult. Prevalence of child under-nutrition in Mugu was the highest among districts in Nepal. The main objective of this study was to determine the prevalence and factors associated with under-nutrition among children aged 0-59 months in Mugu district. A cross-sectional study was conducted in July-August 2014 involving 246 children aged 0-59 months residing in selected 2 VDCs in Mugu district. Anthropometric measurements were conducted on the children participating in the study along with their mothers. A structured questionnaire was then administered to the mothers. Data analysis was done using Chi Squared test or Fishers Exact test for bivariate analysis and a final multivariable model was created using Logistic Regression with statistical significance of each analysis accepted at a p value < 0.05. The prevalence of severe wasting (6.1%), the overall prevalence of stunting (61.8%) and the overall prevalence of underweight (48.8%) among children in the study was higher than the national statistics as reported by NDHS 2011. A small size at birth, not exclusively breastfed and history of diarrhoea had a positive association with wasting. Low maternal BMI, a birth interval less than 24 months, poor dietary diversity and child age group of 12-35 months had a positive association whereas growth monitoring visits had a negative association with stunting. Low maternal BMI, child age group of 12-35 months, small size at birth and history of diarrhoea had a positive association with underweight. The prevalence of under-nutrition among children in Mugu district is high. The situation regarding factors such as dietary diversity and food security needs to be resolved through infrastructure development and intervention programs. Factors such as birth spacing, growth monitoring visits, high levels of fever and diarrhoea among children can be resolved through adequately staffed health facilities and outreach programs with a special focus on health education and promotion.

Field of Study: Public Health Student's Signature .....

Academic Year: 2014 Advisor's Signature .....

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CHAPTER I
INTRODUCTION

1.1 Background

Nutritional status can be defined as the physiological condition of an individual that results from the balance between nutrient requirements and intake and the ability of the body to use these nutrients. Under-nutrition is a condition in which the body does not have enough of the right kind of food to meet its energy, macronutrient (proteins, carbohydrates and fats) and micronutrient (vitamins and minerals) needs. Both under- and over-nutrition are forms of malnutrition. However, the term malnutrition is still widely used in the development literature and amongst the international development community to refer to under-nutrition and micronutrient deficiency(1). In order to avoid confusion the term under-nutrition and not malnutrition will therefore be used throughout this study.

Under-nutrition is responsible for greater than a third of under-five child deaths in the world. The short and long term effects of under-nutrition, include delayed developmental milestones, an increased risk of infections and greater susceptibility to chronic disease as an adult(2).

Child under-nutrition has effects which last a lifetime. The consequences can be both short term and long term. Malnourished children tend to be physically, emotionally and intellectually less productive and suffer more from chronic illnesses and disabilities compared to healthy children. Child under-nutrition is believed to be

a consequence of the complex interactions between socio-demographic, environmental, reproductive, institutional, cultural, political and regional factors(3).

Under-nutrition among children is presumed to be a consequence of being poor in low income countries; this is usually reflected by low family income, poor housing, inadequate food intake, lack of safe drinking water and access to health care. It can be seen in many countries, the prevalence of stunting, which means low height for age, is more among the urban poor children compared to rural poor children(4).

Under-nutrition plays an important role among children in low income countries as a factor contributing to morbidity and mortality; it can also negatively impact growth and is a risk factor for disease and death during their adult years. Roughly, half of all child deaths can be linked to under-nutrition. More than three quarters of the deaths related to malnutrition have been attributed to mild and moderate forms rather than severe malnutrition(5).

Under-nutrition in early childhood can result in behavioural problems, deficient social skills and even a lower Intelligence Quotient. Under-nutrition can be associated with approximately 60% of mortality among children under 5 years in Sub-Saharan Africa(6). Since they are more prone to infectious diseases; mortality could be a result of diarrhoea or respiratory tract infections which are common among children. Also, those undernourished children who survive will have frequent bouts of illness, which will negatively impact their nutritional status converting their lives into a cycle of under-nutrition, frequent bouts of illness and decreased learning ability(7).

Under-nutrition in Nepal

According to the National Demographic and Health Survey (NDHS 2011) of Nepal, proper nutrition is vital for the growth and development of children. Early childhood is important for optimal physical, mental and cognitive growth, health and development. Unfortunately, this period is often marked by protein-energy and micronutrient deficiencies that interfere with optimal growth(8).

Mortality among children in Nepal has seen a decline in the last fifteen years and the expectation is that the 'Millennium Development Goal (MDG) Four' will be achieved before time(9). A good improvement is seen in the prevention of micro-nutrient deficiencies and childhood illnesses in the country, yet child under-nutrition is still a significant problem which is affecting physical and cognitive child development and is a challenge to sustainability to what has been achieved in saving child lives. Figures from the National Demographic and Health Survey (NDHS) 2006, NDHS 2001, Nepal Family Health Survey (NFHS) 1996 and the first national nutrition survey in 1975 conducted in Nepal show no significant reduction in child under-nutrition in the last 35 years(10-13). During this period, many strategies, programs and policies to improve the nutritional status of children have been implemented with limited success.

Data from the NDHS 2011shows, 41 percent of children under age 5 are stunted, and 16 percent are severely stunted. Overall, 11 percent of children are wasted and 3 percent are severely wasted. 29 percent of children under age 5 are underweight (low weight-for-age), and 8 percent are severely underweight(8).

1.2 Rationale

Prevalence of Under 5 child under-nutrition in Mugu was reported to be the highest among districts in Nepal in the Annual Health Report of 2010. Prevalence was calculated only on the basis of weight for age(14). Weight for Age or underweight cannot give a clear picture of the prevalence of acute and chronic forms of malnutrition as this indicator cannot distinguish between stunted and wasted.

A nutritional survey was carried out exclusively in Mugu by ACF International network in 2008 which included all three indices of wasting, stunting and underweight but no work was done on factors which could be associated with under-nutrition(15).

The Annual Health Report of 2010 calculated the prevalence of under-nutrition only on the basis of Weight for Age and did not use the two indices of under-nutrition Weight for Height and Height for Age which are indicators of acute and chronic under-nutrition respectively. Therefore, it does not present a complete profile of under-nutrition trends in Mugu. The nutritional survey carried out by ACF International network did not study the factors which could be associated with under-nutrition. The data used for these studies are more than 4 years old and can be considered outdated. The rationale behind this study was to provide a complete and updated profile of under-nutrition among children aged 0-59 months in Mugu and to study factors which could be associated with under-nutrition.

1.3 Research Questions

1.3.1 What is the prevalence of under-nutrition among children aged 0-59 months in Mugu district?

1.3.2 What are the factors affecting the prevalence of under-nutrition among children aged 0-59 months in Mugu district?

1.4 Specific Objectives

1.4.1 To determine the prevalence of under-nutrition among children aged 0-59 months in Mugu district.

1.4.2 To determine the socio-demographics of under-nutrition among children aged 0-59 months in Mugu district.

1.4.3 To find the association between various factors and under-nutrition among children aged 0-59 months in Mugu District.

1.5 Hypothesis

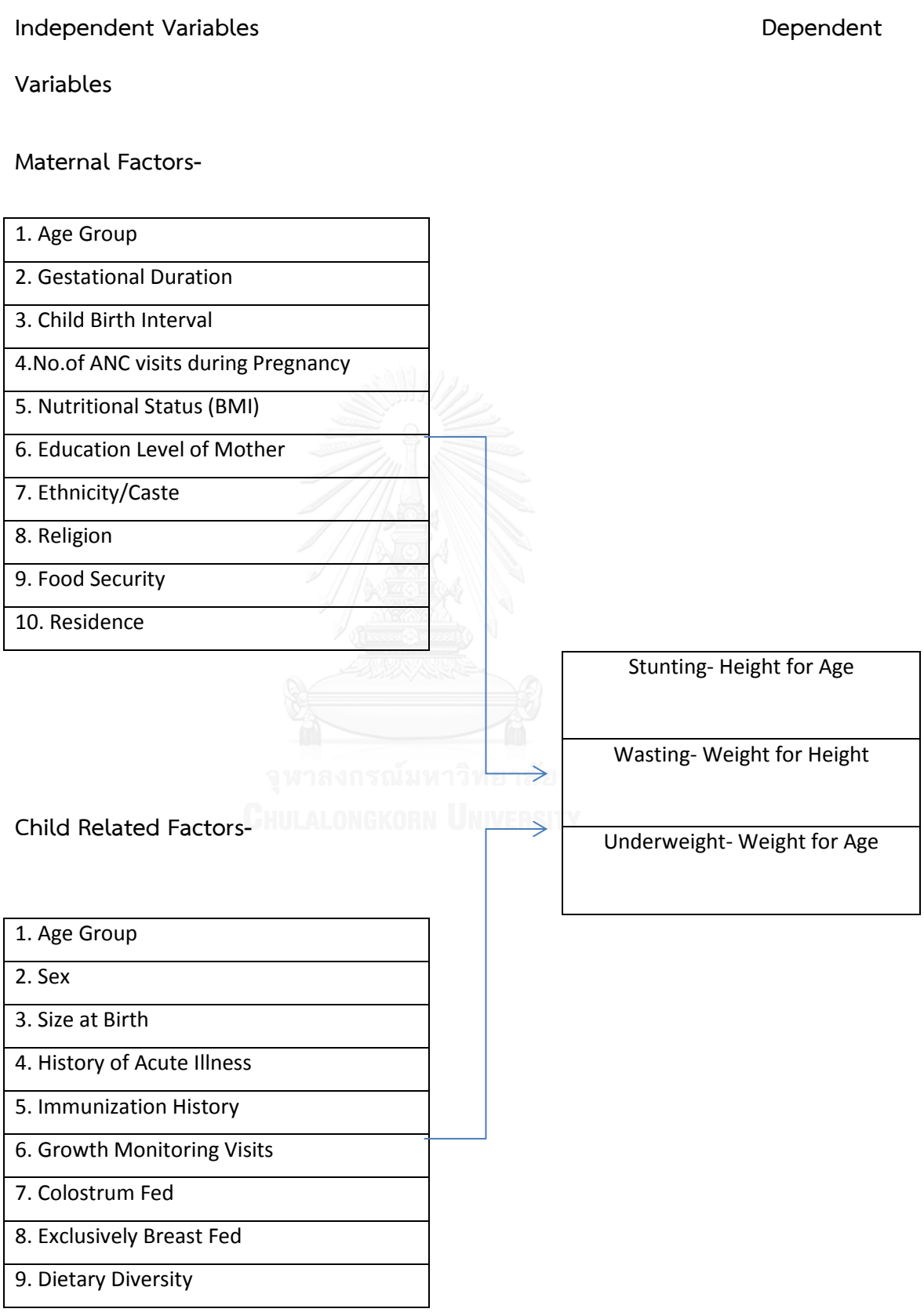
1.5.1 Null Hypothesis

There **is no** association between the factors being studied and under-nutrition among children aged 0-59 months in Mugu District.

1.5.2 Alternate Hypothesis

There **is** an association between the factors being studied and under-nutrition among children aged 0-59 months in Mugu District.

1.6 Conceptual Framework



1.7 Operational Definitions

Age- Calculation of age in completed months from date of birth to current day

Sex- It is a biological determination of a person to be male or female.

Height/Length- The height in centimeters of the respondent without wearing the shoes from heel to vertex (highest point of the head).

Weight – The weight in kilogram of the respondent without any heavy things which might change the weight significantly.

Size at birth – Perception of the mother of the size of her child at birth (very small, small, average or larger). This is used as a substitute for birth weight in situations where this data is unavailable and was based upon recall by the mother.

Mother's gestational duration - Term birth: gestational age ≥ 37 completed weeks (259 days) and < 42 completed weeks (294 days)**.** Preterm < 37 weeks and Post Term or Post Date ≥ 42 weeks. The data collected was based on recall by the mother.

Birth interval in months- The number of months differing between the birth of the child and elder sibling (1st born, less than 24 months, 24-47 months and ≥ 48 months). The data collected was based on recall by the mother.

Mother's nutritional status- It refers to weight in kilograms divided by height in meter square. It is a reliable indicator of adult nutritional status. Low (BMI<18.5),

Normal Range (BMI 18.5-22.9), Overweight- At Risk (BMI 23-24.9), Overweight- Moderately Obese (BMI 25-29.9), Overweight- Severely Obese (BMI ≥ 30) as recommended by Hospital Authority of Hong Kong for Asian populations.

Mother's level of education – No education, Primary School (≤ Grade 5), Some Secondary School (≥ Grade 6), Graduated high school or more (≥ Grade10).

Religion – A particular system of faith and worship. In this study we have 2 groups: Hindu and Buddhist.

Ethnicity/Caste - It is social stratification of a community. For the purposes of this study Hill Brahmin, Thakuri and Chettri were combined to form the Higher or Forward caste groups and Dalit, Tamang and Raut were combined to form the Lower or Backward caste groups.

Maternal Age- The age of the mother in completed years up to her last birthday.

History of Acute Illness i) **History of Diarrhoea-** It refers to whether a child has suffered an episode of diarrhoea in the past 2 weeks. Diarrhoea is defined as the production of watery stools more than three times during a 24-h period**.**

ii) **History of Fever -** It refers to whether a child has suffered an episode of fever in the past 2 weeks. Fever is defined as a temperature of more than 38 degrees Celsius.

Colostrum Fed- Whether the child fed the orange to yellow, thick and sticky secretions from the breast produced during the first few days after birth.

Number of Growth Monitoring Visits- The number of times the child has been taken to a health facility for growth monitoring (measurement of height and weight) over the last 2 months. (0, ≤2, >2).

Immunization History- Whether the child been fully vaccinated according to the National Immunization Program Schedule of Nepal keeping in mind child's age.

BCG- Bacillus Calmette–Guérin Vaccine against Tuberculosis (Recommended administration at birth or on first contact. 1 dose.)

OPV- Oral Polio Vaccine (At 6,10 and 14 weeks. 3 doses)

DPT- Vaccine against Diptheria, Pertusis and Tetanus and Hep B- Vaccine against Hepatitis B (At 6,10 and 14 weeks. 3 doses)

Number of ANC visits- Number of times the mother visited the Antenatal Care Clinic at a health care facility during pregnancy (1, 2, ≥3). The Nepal maternal health program recommends at least four ANC visits: at least one visit in the first trimester, at least one visit in the second trimester and at least two visits in third trimester.

Exclusively Breast Fed- Whether the child was fed only his/her mother's breast milk over the first 6 months of life. If the child was below the age of 6 months, current status of exclusive breastfeeding was recorded.

Dietary Diversity- Defined as either the number of foods or the number of food groups consumed over the last 24 hour period. It was calculated based on the response to a series of questions adapted from the NDHS 2011 questionnaire.

Food security- Defined as the availability and access (economic and physical) to food and its utilization and stability. For the purpose of this study a series of

questions adapted from the NDHS 2011 questionnaire is used which provided information on a households access to food over the past 1 year.

Stunting- The height in centimeters-for-age in completed months index provides an indicator of linear growth retardation and cumulative growth deficits in children. Children whose height-for-age Z-score is below minus two standard deviations (-2 SD) from the median of the WHO reference population are considered short for their age (stunted), or chronically malnourished. Children who are below minus three standard deviations (-3 SD) are considered severely stunted. See appendix c for graphic representation and reference

Wasting- The weight in kilograms-for-height in centimeters index measures body mass in relation to body height or length and describes current nutritional status. Children with Z-scores below minus two standard deviations (-2 SD) are considered thin (wasted) or acutely malnourished. Children with a weight-for-height index below minus three standard deviations (-3 SD) are considered severely wasted. See appendix c for graphic representation.

Underweight- Weight in kilograms-for-age in completed months is a composite index of height-for-age and weight-for-height. It is an index which takes into account both acute and chronic malnutrition. Children whose weight-for-age is below minus two standard deviations (-2 SD) are classified as underweight. Children whose weight-for-age is below minus three standard deviations (-3 SD) are considered severely underweight. See appendix c for graphic representation.

CHAPTER II
LITERATURE REVIEW

2.1 Introduction

This literature review section aims to explore and find relevant details from previously published peer-reviewed studies to address the workings of this proposed study. Among subjects that will be explored are the working definitions and diagnosis of under-nutrition as well as the relationship between various independent factors and under-nutrition amongst the study population.

2.2 Diagnosing Under-nutrition

Anthropometric Data on the nutritional status of children was collected by measuring the height and weight of all children under the age of 5 in the selected households in the district. This data was used to calculate three indices: weight-for-age, height-for-age, and weight-for-height.

These three indices are expressed in standard deviation units from the Multicenter Growth Reference Study median. The nutritional status of a child is best reflected by anthropometry. New growth standards published by the World Health Organization (WHO) in 2006 will be used to calculate the nutritional status of a child. The new standards were established from data collected in the WHO Multicenter Growth Reference Study (WHO, 2006)(8).

The WHO Multicentre Growth Reference Study (MGRS) was undertaken between 1997 and 2003 to generate new growth curves for assessing the growth and development

of infants and young children around the world. The MGRS collected primary growth data and related information from approximately 8500 children from widely different ethnic backgrounds and cultural settings (Brazil, Ghana, India, Norway, Oman and the USA). The new growth curves are expected to provide a single international standard that represents the best description of physiological growth for all children from birth to five years of age and to establish the breastfed infant as the normative model for growth and development(16).

The height-for-age index provides an indicator of linear growth retardation and cumulative growth deficits in children. Children whose height-for-age Z-score is below minus two standard deviations (-2 SD) from the median of the WHO reference population are considered short for their age (stunted), or chronically malnourished. Children who are below minus three standard deviations (-3 SD) are considered severely stunted. Stunting reflects inadequate nutritional status over an extended period of time. Height-for-age, shows the long-term effects of malnutrition in a population and is not sensitive to recent, short-term changes in dietary intake(8).

The weight-for-height index measures body mass in relation to body height or length and describes current nutritional status. Children with Z-scores below minus two standard deviations (-2 SD) are considered thin (wasted) or acutely malnourished. Wasting represents inadequate nutritional status just prior to the survey and this could be because of reduced intake of food or a recent illness causing weight loss and the onset of malnutrition. Children with a weight-for-height index below minus three standard deviations (-3 SD) are considered severely wasted(8).

Weight-for-age is a composite index of height-for-age and weight-for-height. It is an indicator which takes into account both acute and chronic malnutrition. Children

whose weight-for-age is below minus two standard deviations (-2 SD) are classified as underweight. Children whose weight-for-age is below minus three standard deviations (-3 SD) are considered severely underweight(8).

2.3 Factors Affecting Under-nutrition

Height-for-age

Nationally, 41 percent of children under age 5 are stunted, and 16 percent are severely stunted. The relationship between stunting and age is seen to be highest among children aged 36-47 months (53 percent) and lowest among children aged 9-11 months (14 percent). A similar pattern can be seen in severe stunting, the greatest number of cases of severe stunting seen in children aged 36-47 months (23 percent) and the lowest in children age 6-11 months (4 percent)(8).

Stunting is slightly lower among female children (40 percent) than in male children (41 percent).

Birth interval in months and the percentage of stunted children shows a positive correlation. Stunting is highest among children born within 24 to 47 months of a previous birth than among first births and births 48 or more months post a previous birth. More than half of children whose size at birth was very small or small are stunted.

The nutritional status of mothers using BMI is associated with the level of stunting in their children. Thin mothers (BMI < 18.5) have children with the highest levels of

stunting (47 percent), while overweight/obese mothers (BMI ≥25) have children with the lowest levels (27 percent)(8).

Children in urban areas (27 percent) are less likely to be stunted compared to rural areas (42 percent), and severe stunting (17 percent in rural areas and 6 percent in urban areas) also shows the same distribution.

Ecologically, prevalence of stunting is highest among children living in the mountain zone (53 percent). When we compare the Development regions the highest prevalence is seen in the Mid-western region (50 percent). Three-fifths (60 percent) of children living in the Western mountain sub-regions are stunted, as compared to one-third of the children living in the Eastern terai (plains), Far-western terai sub-regions and Central hills (31-32 percent each).

Stunting prevalence and the education levels of mothers show an inverse relation, which ranges from a low of 26 percent among children whose mothers with a School Leaving Certificate (SLC) or higher levels of education to a high of 48 percent among those whose mothers with no education.

When comparing household wealth and stunting levels an inverse relationship is seen. Children living in the poorest households are more than twice as likely to be stunted (56 percent) as children living in the wealthiest households (26 percent). Children living in households with food security (33 percent) are less likely to be stunted than children in households with mild food insecurity (41 percent), moderate food insecurity (46 percent), and severe food insecurity (49 percent)(8).

Weight-for-height

Overall, 11 percent of children are wasted and 3 percent are severely wasted. Analysis by age group shows that wasting is highest (25 percent) in children age 9-11 months and lowest (7 percent) in children age 36-47 months.

Male children are more likely to be wasted (12 percent) than female children (10 percent).

Wasting is not strongly correlated with the length of the preceding birth interval.

However, the data show a substantial correlation between wasting and birth weight. Babies who were very small at birth are more likely to be wasted (15 percent) than those whose weight at birth was average or large (10 percent).

Children born to mothers who are thin (BMI < 18.5) are 2.5 times more likely to be wasted than those born to mothers who are overweight/obese (BMI ≥25).

Children residing in urban areas are less likely to be wasted (8 percent) than children in rural areas (11 percent).

Wasting in children does not vary markedly by ecological zone or development region. However, wasting levels across sub-regions are substantial, ranging from a low of 8 percent among children in the Eastern and Central mountain, Western and Mid-western hill, and Far-western terai sub-regions to a high of 15 percent among children in the Central hill and Western terai sub-regions.

A mother's level of education generally has an inverse relationship with wasting levels, ranging from 6-10 percent of children of mothers with at least some

secondary education to 13 percent of children of mothers with no education. A similar relationship is observed between household wealth and wasting levels(8).

Weight-for-age

29 percent of children under age 5 are underweight (low weight-for-age), and 8 percent are severely underweight. The proportion of underweight children is highest (37 percent) among those age 18-23 months and lowest (18 percent) among those under 6 months.

Male children are slightly more likely to be underweight (30 percent) than female children (28 percent).

The data show a strong correlation between underweight children and birth weight. Babies perceived by mothers as very small and small at birth are much more likely to also be underweight later in life (43 percent and 45 percent, respectively) than those perceived as average or large at birth (25 percent).

Children born to mothers who are thin (BMI < 18.5) are three times more likely to be underweight (40 percent) than children born to mothers who are overweight/obese (13 percent).

Rural children are more likely to be underweight (30 percent) than urban children (17 percent).

Children living in the mountain zone are more likely to be underweight (36 percent) than those in the terai (30 percent) and hill zone (27 percent). The Mid-western region has the highest percentage of underweight children (37 percent), while the

Western region has the lowest (23 percent). Among the sub-regions, the highest percentage of underweight children is found in the Western mountain sub-region (42 percent), and the lowest percentage is found in the Western hill sub-region (17 percent).

As with wasting and stunting, mother's education is associated with underweight, with the percentage of children who are underweight being lowest among children of mothers with an SLC and higher (13 percent) and highest among children of mothers with no education (38 percent).

A similar inverse relationship is observed between household wealth and the percentage of underweight children: children in the poorest households are four times as likely to be underweight (40 percent) as children in the wealthiest households (10 percent)(8).

In various other articles the association of under-nutrition to various factors was as follows:

Important factors associated with child under-nutrition were mother's literacy (unadjusted odds ratio, OR = 2.580; 95% confidence interval, CI = 1.134-5.867 and adjusted odds ratio, OR = 3.814; 95% CI = 1.124-12.943), birth weight (OR = 3.143; 95% CI = 1.2-8.232 and adjusted OR = 2.404; 95% CI = 0.870-6.644) and socioeconomic status (OR = 2.549; 95% CI = 1.382-4.701 and adjusted OR = 1.808; 95% CI = 0.852-3.838)(17).

The results show that the child nutritional status is determined by a many factors that are genetic, social-cultural and economic, the significant factors are birth status, birth weight, diarrhoeal status, duration of breastfeeding, and residence(18).

Alcohol consumption by mother and a poor access to food are important factors in child under-nutrition. Education and income were not significant variables(19).

Mugu district has a very high incidence and prevalence of under-nutrition. Associated factors were poor access to food, bad hygienic practices and poor environment. Reduced level of child care by mother because of an increased work load and little knowledge of good practice of feeding(20).

This study concluded that low birth weight is one of the important risk factors for the prevalence of underweight and severe malnutrition and that the lack of education among mothers is also a risk factor for the prevalence of severe malnutrition in the urban children in Ghana(21).

An association between Exclusive breastfeeding and wasting is seen in a study conducted in Nairobi, Kenya which found that bottle fed babies and children discontinuing breastfeeding were more likely to be wasted; Odds ratio of 1.6(22). The association is also seen in a case control study conducted in Bangladesh which found wasting more prevalent among children who had stopped exclusive breastfeeding before 4 months of age(23).

A positive association between acute episode of fever or diarrhoea and wasting among children is seen in a study conducted among Malawian children aged 6-18

months which found greater duration of fever or diarrhoea resulted in greater levels of wasting(24).

The protective influence of Growth Monitoring Visits against stunting and under-nutrition as a whole is seen in a study which evaluated 16 projects which involved Growth Monitoring and Growth Monitoring Promotion impact over the past 3 decades. The study reports a significant reduction in rates of stunting(25).

Dietary Diversity

All people need a variety of foods to meet requirements for essential nutrients, and the value of a diverse diet has long been recognized. In the context of many developing countries, monotonous diets based on a very small number of foods contribute to micronutrient malnutrition, particularly in rural areas. In these contexts, a large proportion of calories may come from starchy staples, with relatively low energy density and very few micronutrients. For vulnerable young children the problem is particularly critical, because young children need energy- and nutrient-dense foods to grow and develop. Beyond meeting needs for essential nutrients, diverse diets are increasingly recognized as playing a role in the prevention of some chronic diseases. For all these reasons, dietary diversity is recommended as an objective to be included in each country's food-based dietary guidelines (WHO/FAO, 1998). Dietary diversity is also advocated in the recently updated guidance for complementary feeding of infants and young children (PAHO/WHO, 2003). However, while there is consensus among nutritionists that dietary diversity is good, there are a large number of unanswered questions about the definition and

measurement of diversity, and about the relationships among diversity, nutrient adequacy, and outcomes such as child nutritional status(26).

The Nepal Thematic Report on Food Security and Nutrition 2013 shows children with a Dietary Diversity score of less than 4 had a slightly higher prevalence of wasting (21.5%) and a significantly higher prevalence of stunting (76.2%) and underweight (55.7%). The paper states that there is a significant association between Dietary Diversity Score and stunting and underweight among children(27).

In addition to reflecting the quality of the diet, dietary diversity has also been linked with food security, and particularly with household-level access to calories. In models controlling for a variety of biological and household socioeconomic factors, the association between dietary diversity and Height for Age Z Scores remains significant in six countries(26).

Food Security

Food security is crucial to the achievement of adequate child nutrition. Food security exists in a nation or a household when all people, at all times, have access to sufficient, safe and nutritious food to meet their food preferences for an active and healthy life. Food production per se does not enhance food security. Families must also be able to access the food, either through their own food production or their ability to purchase it, to get support from safety-net programmes or to get food from other households. Households are said to be vulnerable in the presence of factors that place them at risk of becoming food insecure or undernourished. Most undernourished children live in vulnerable households that become food insecure.

The rapid escalation of world food prices has transformed food insecurity from a difficult development problem into a crisis.(1)

Figure 1 Nutritional Status of Children by Age: Nepal (NDHS 2011)

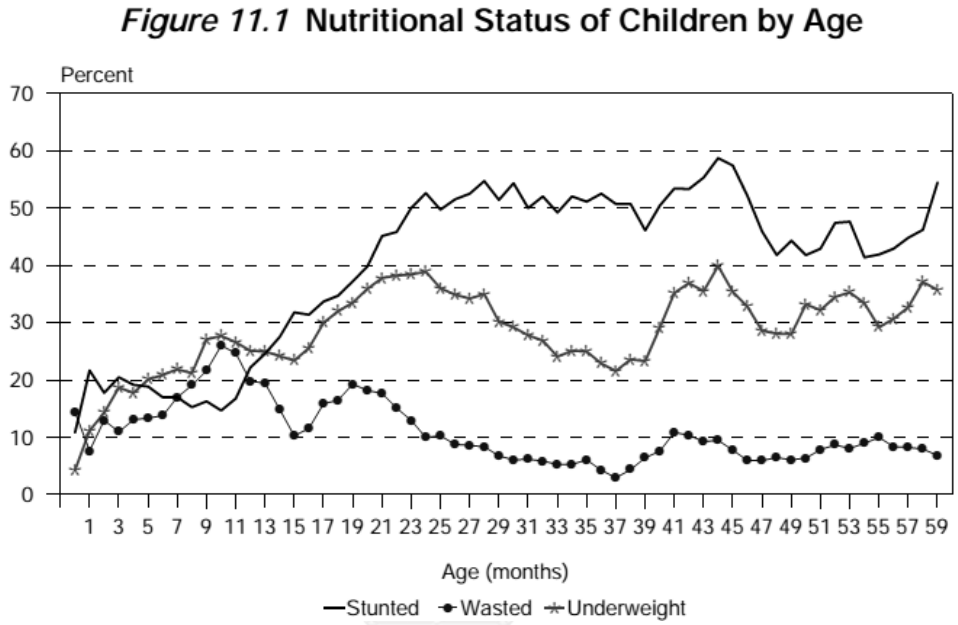
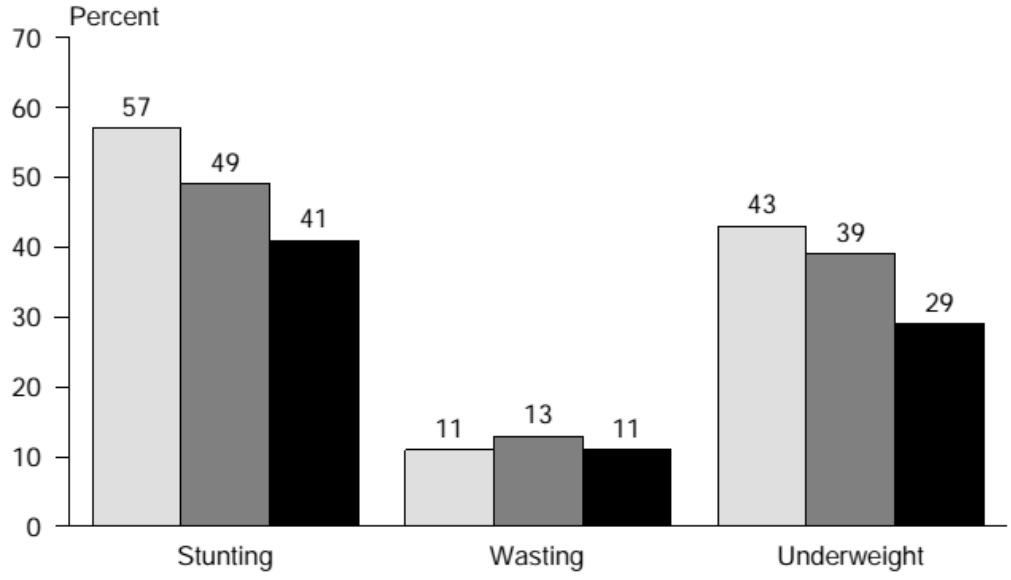


Figure 2 Prevalence of Under-nutrition in 2001, 2006 and 2011: Nepal



NDHS: 2001, 2006 and 2011

Table 1 Percentage of malnourished children by background characteristics

Percentage of children under five years classified as malnourished according to three anthropometric indices of nutritional status: height-for-age, weight-for-height, and weight-for-age, by background characteristics, Nepal 2011

Background characteristic	Height-for-age[1]			Weight-for-height				Weight-for-age				Number of children
	Percentage below -3 SD	Percentage below -2 SD[2]	Mean Z-score (SD)	Percentage below -3 SD	Percentage below -2 SD[2]	Percentage above +2 SD	Mean Z-score (SD)	Percentage below -3 SD	Percentage below -2 SD[2]	Percentage above +2 SD	Mean Z-score (SD)	
Age in months												
<6	7.5	19.4	-0.8	5.3	11.8	5.7	-0.5	7.3	18.2	0.1	-1.0	227
6-8	4.3	17.7	-0.7	3.0	16.7	1.2	-0.7	5.3	18.5	2.0	-1.0	135
9-11	4.1	13.6	-1.0	6.4	24.7	3.5	-1.1	4.3	26.8	0.0	-1.3	110
12-17	13.2	28.6	-1.4	3.7	14.2	0.4	-0.9	6.1	24.9	0.0	-1.3	266
18-23	16.2	42.2	-1.7	4.5	19.4	0.6	-0.9	10.3	37.0	0.0	-1.5	221
24-35	20.2	51.7	-2.0	1.2	7.4	1.5	-0.5	7.9	30.5	0.3	-1.5	500
36-47	22.9	53.0	-2.1	1.1	7.2	0.5	-0.5	8.6	30.4	0.1	-1.6	524
48-59	16.6	43.4	-1.8	2.1	7.8	0.7	-0.6	7.9	32.0	0.4	-1.5	492
Sex												
Male	16.7	41.4	-1.7	3.4	12.0	1.3	-0.7	8.2	29.6	0.3	-1.5	1,268
Female	15.7	39.5	-1.6	1.8	9.7	1.5	-0.6	7.2	28.0	0.3	-1.4	1,207
Birth interval in months[3]												
First birth[4]	12.6	35.0	-1.5	2.1	9.4	2.1	-0.5	4.5	23.2	0.3	-1.2	940
<24	24.4	47.3	-2.0	3.4	13.5	0.7	-0.8	13.3	35.9	0.0	-1.7	321
24-47	18.3	46.3	-1.8	2.5	11.3	0.9	-0.8	9.9	34.0	0.2	-1.6	725
48+	13.0	36.5	-1.6	2.8	11.8	1.5	-0.6	6.4	25.6	0.4	-1.4	393
Size at birth[3]												
Very small	20.8	50.6	-2.0	1.4	15.4	1.3	-1.0	12.7	42.8	0.0	-1.9	93
Small	21.6	50.8	-2.0	5.1	13.7	0.3	-0.9	13.1	44.6	0.0	-1.8	329
Average or larger	14.7	38.1	-1.6	2.2	10.2	1.6	-0.6	6.4	25.2	0.3	-1.3	1,952
Mother's interview status												
Interviewed	16.0	40.3	-1.7	2.5	10.9	1.4	-0.7	7.6	28.6	0.3	-1.4	2,379
Not interviewed but in household	(26.9)	(37.4)	(-1.6)	(7.1)	(11.9)	(0.0)	(-0.8)	(6.3)	(43.3)	(0.0)	(-1.5)	35
Not interviewed and not in household[5]	19.5	48.9	-1.9	4.1	10.4	0.9	-0.5	11.8	28.7	1.6	-1.4	62
Mother's nutritional status[6]												
Thin (BMI < 18.5)	18.6	47.0	-1.9	4.7	18.9	0.5	-1.1	12.7	40.1	0.0	-1.8	465
Normal (BMI 18.5-24.9)	16.2	40.0	-1.7	2.0	9.2	1.2	-0.6	6.8	27.5	0.2	-1.4	1,704
Overweight/ obese (BMI ≥ 25)	8.1	27.2	-1.1	2.1	7.0	4.9	-0.2	1.7	12.6	1.5	-0.8	224
Residence												
Urban	6.2	26.7	-1.2	2.7	8.2	1.8	-0.5	4.0	16.5	0.6	-1.0	216
Rural	17.2	41.8	-1.7	2.6	11.2	1.4	-0.7	8.1	30.0	0.3	-1.5	2,259
Ecological zone												
Mountain	22.2	52.9	-2.1	3.2	10.9	0.5	-0.7	9.9	35.9	0.2	-1.7	195
Hill	16.7	42.1	-1.7	1.7	10.6	1.6	-0.6	7.1	26.6	0.3	-1.4	989
Terai	14.9	37.4	-1.6	3.2	11.2	1.4	-0.7	7.8	29.5	0.3	-1.4	1,291
Development region												
Eastern	13.1	37.0	-1.6	1.8	10.2	2.1	-0.6	5.6	25.4	0.2	-1.4	596
Central	16.8	38.2	-1.6	3.1	11.6	0.9	-0.7	8.9	29.5	0.5	-1.4	767
Western	14.5	37.4	-1.6	2.5	10.4	1.9	-0.5	5.3	23.2	0.5	-1.3	463
Mid-western	21.1	50.3	-2.0	2.8	11.3	1.0	-0.7	10.7	36.9	0.0	-1.7	373
Far-western	17.5	46.4	-1.8	3.2	10.9	1.2	-0.8	8.7	32.6	0.1	-1.6	277
Subregion												
Eastern mountain	16.3	45.0	-1.7	0.7	8.4	0.0	-0.5	4.9	23.5	0.0	-1.3	46
Central mountain	14.2	45.5	-1.9	2.8	7.9	0.0	-0.7	7.6	34.7	0.9	-1.6	44
Western mountain	28.3	59.5	-2.3	4.4	13.2	1.0	-0.8	13.2	42.0	0.0	-1.9	105
Eastern hill	17.2	45.5	-1.8	1.3	10.5	1.6	-0.5	5.8	28.6	0.0	-1.4	191
Central hill	11.2	31.3	-1.4	2.7	15.0	1.9	-0.6	5.1	22.5	1.5	-1.2	216
Western hill	12.6	36.0	-1.5	1.0	7.6	2.1	-0.4	3.8	16.8	0.0	-1.1	294
Mid-western hill	23.4	51.7	-2.1	1.9	8.0	1.4	-0.6	11.5	37.1	0.0	-1.6	171
Far-western hill	26.9	57.5	-2.2	2.5	13.7	0.0	-0.9	14.9	39.7	0.0	-1.9	117
Eastern terai	10.5	31.4	-1.4	2.2	10.3	2.5	-0.7	5.6	24.0	0.3	-1.3	359
Central terai	19.5	40.5	-1.7	3.2	10.4	0.5	-0.7	10.7	32.0	0.0	-1.4	507
Western terai	17.8	39.9	-1.7	5.1	15.2	1.4	-0.7	8.1	34.4	1.4	-1.5	169
Mid-western terai	14.1	43.5	-1.7	3.4	13.9	0.6	-0.9	7.5	32.1	0.0	-1.6	142
Far-western terai	4.9	31.5	-1.3	3.4	7.9	2.4	-0.7	2.4	24.7	0.2	-1.2	115

Background characteristic	Height-for-age[1]			Weight-for-height				Weight-for-age				Number of children
	Percentage below -3 SD	Percentage below -2 SD[2]	Mean Z-score (SD)	Percentage below -3 SD	Percentage below -2 SD[2]	Percentage above +2 SD	Mean Z-score (SD)	Percentage below -3 SD	Percentage below -2 SD[2]	Percentage above +2 SD	Mean Z-score (SD)	
Mother's education[7]												
No education	22.2	47.6	-2.0	3.1	13.3	0.6	-0.8	11.6	38.4	0.0	-1.7	1,148
Primary	13.3	40.6	-1.6	3.1	11.3	1.1	-0.6	6.3	26.1	0.0	-1.4	479
Some secondary	9.8	32.0	-1.4	1.0	5.5	3.6	-0.4	2.4	18.8	1.2	-1.1	466
SLC and above	7.7	25.6	-1.0	2.2	9.7	1.5	-0.4	2.8	13.3	0.2	-0.9	321
Wealth quintile												
Lowest	25.2	56.0	-2.1	2.3	12.5	1.6	-0.7	10.5	40.3	0.0	-1.7	638
Second	20.0	45.7	-1.9	2.3	10.7	0.4	-0.8	8.7	31.6	0.0	-1.7	508
Middle	12.9	34.5	-1.5	3.0	12.8	1.6	-0.8	8.2	28.8	0.1	-1.4	580
Fourth	10.2	30.5	-1.4	3.5	8.8	1.5	-0.6	6.1	22.9	0.4	-1.2	419
Highest	6.5	25.8	-1.1	2.0	7.4	2.2	-0.3	2.0	10.0	1.6	-0.8	331
Household food insecurity												
Secure	12.1	33.2	-1.4	2.0	9.4	1.8	-0.6	5.3	21.7	0.5	-1.2	1,057
Mildly insecure	15.5	41.2	-1.7	4.7	11.6	0.7	-0.6	9.4	27.9	0.5	-1.4	304
Moderate	18.7	45.5	-1.8	3.4	12.7	1.1	-0.8	8.6	32.3	0.0	-1.6	575
Severe	22.0	49.0	-1.9	1.9	11.5	1.3	-0.7	10.5	39.5	0.0	-1.7	540
Total	16.2	40.5	-1.7	2.6	10.9	1.4	-0.7	7.7	28.8	0.3	-1.4	2,475

Note: Table is based on children who stayed in the household on the night before the interview. Each of the indices is expressed in standard deviation units (SD) from the median of the WHO Child Growth Standards adopted in 2006. The indices in this table are NOT comparable to those based on the previously used NCHS/CDC/WHO reference. Figures in parentheses are based on 25-49 unweighted cases. Total includes four children with missing information on size at birth.
Table is based on children with valid dates of birth (month and year) and valid measurement of both height and weight.
[1] Recumbent length is measured for children under age 2 and in a few cases when the age of the child is unknown and the child is less than 85 cm; standing height is measured for all other children.
[2] Includes children who are below -3 standard deviations from the WHO Child Growth Standards population median
[3] Excludes children whose mothers were not interviewed
[4] First-born twins (triplets, etc.) are counted as first births because they do not have a previous birth interval.
[5] Includes children whose mothers are deceased
[6] Excludes children whose mothers were not weighed and measured. Mother's nutritional status in terms of BMI (body mass index) is presented in Table 11.10.
[7] For women who are not interviewed, information is taken from the Household Questionnaire. Excludes children whose mothers are not listed in the Household Questionnaire.
SLC = School Leaving Certificate

2.4 Stunting and Educational Outcomes

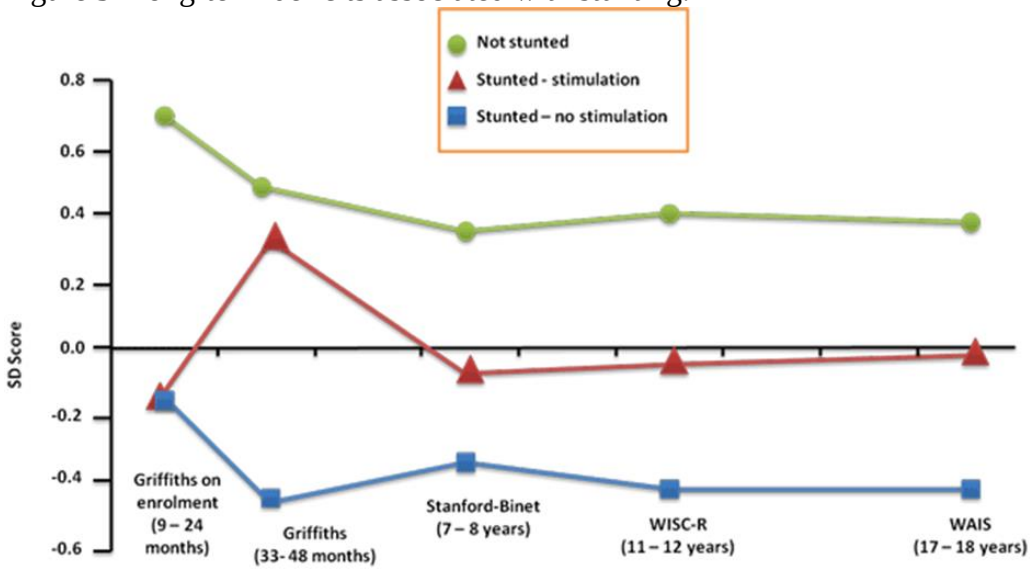
Due to the high prevalence of stunting among children in Nepal as reported by the NDHS 2011 a part of this literature review section deals with stunting and the effect it has on educational outcomes. The 2008 Lancet series on Maternal and Child Under-nutrition found that stunting in the first two years of life was associated with lower levels of school attainment and reduced economic productivity in adult life. Stunting between 12 and 36 months was associated with poor cognitive performance and/or lower grades in school. Overall, the study concluded that poor fetal growth or stunting in the first 2 years of life was linked to shorter adult height, lower attained schooling and reduced adult income(28).

Controlling for socio-economic covariates, prospective cohort studies consistently show significant associations between stunting by age 2 or 3 years and later cognitive deficits, school achievement, and dropout. The presence of cognitive and educational deficits in stunted children is a consistent and robust finding, although

the size of the deficit varies across studies. Long term cognitive deficits as assessed by Development Quotient or Intelligence Quotient scores of Jamaican children aged 9 - 24 months to 17 - 18 years associated with stunting is displayed in Figure 3. The red line shows the benefits of a home-visiting program providing early childhood stimulation to stunted children. Early childhood stimulation has been shown to reduce the negative impact of stunting on cognitive outcomes, with lasting effects(29).

Early childhood stimulation techniques can be applied at home and school. Some of them are using expressive facial gestures when talking, encouraging sign language and mimicking actions, reading bedtime stories, helping the child mingle with other children and making sure the child takes part in physical activity which includes sports and games. Other suggestions were to get children to read, ask questions, clarify meanings by putting things in their own words and consider alternative explanations and solutions(30).

Figure 3 Long-term deficits associated with stunting.



CHAPTER III
RESEARCH METHODOLOGY

3.1 Study Design

The study was a cross-sectional study conducted over a period of 2 months (July – August 2014)

3.2 Study area

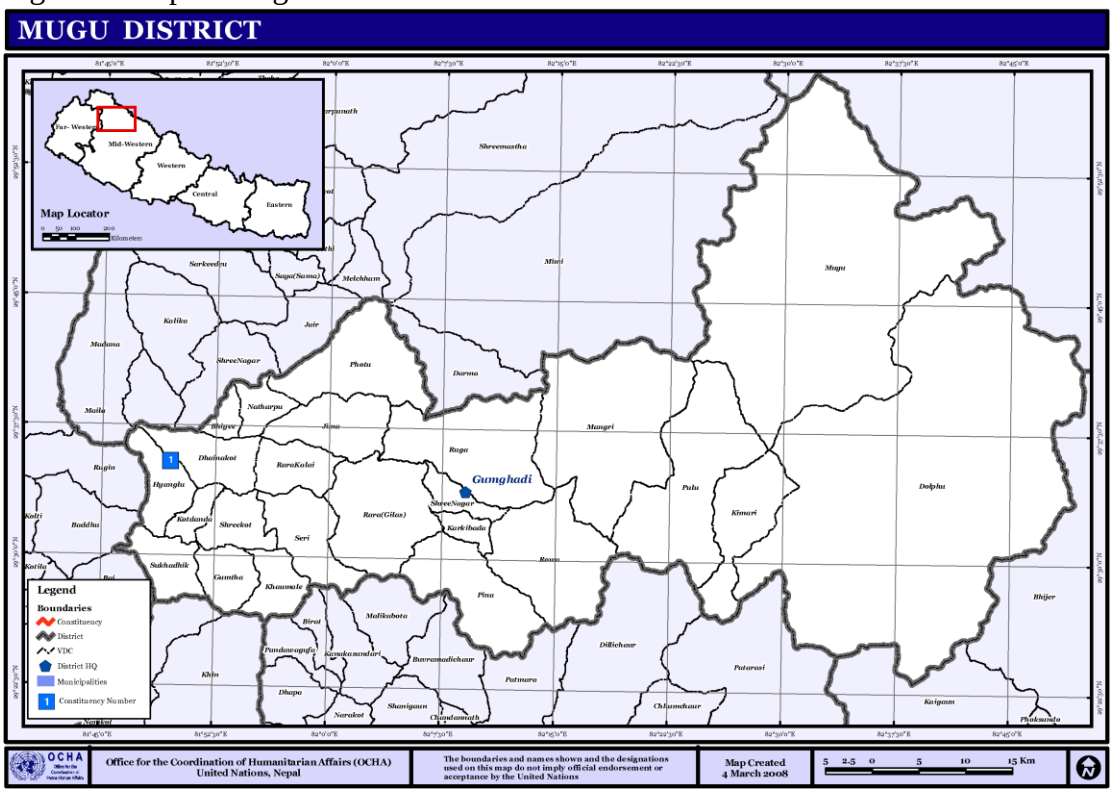
Mugu District, lies in the Mid Western Development Region, a part of Karnali Zone, is one of the seventy-five districts of Nepal. The district, with Gamgadhi as its district headquarters, covers an area of 3,535 km² and has a population (2012) of 55,286. Mugu is known for being both the most remote district in Nepal, as well as the least developed(31).

The Mid Western Region is remote and developmentally challenged. Some 46.5 % of people in the Mid Western Region live below the poverty line. Mugu District comprises 24 Village Development Committees (VDCs), and a single electoral constituency, with its District Headquarters (DHQ) in the town of Gamgadhi in Shree Nagar VDC(31).

The lack of physical infrastructure presents a major challenge to accessibility and service delivery; the only transportation options are limited and unreliable flights which are beyond the means of most people. Talcha airport is located 5km from Gamgadhi. However, a road to the airport from DHQ and Karnali Highway that connects Nagma and Sinja VDCs with Gamgadi is still under construction. Within the district, narrow mule trails that are difficult to use during the monsoon season raise the cost of transporting food and other goods to up to four times above normal

levels. Of the 21 suspension bridges in the district, only 11 are in good condition and the rest are either in poor condition or not in use. Bridges that were destroyed during the conflict have not been reconstructed and make travel within the district difficult(31).

Figure 4 Map of Mugu District



3.3 Study Population

Children aged 0-59 months residing in wards with at least 80 households in the 2 selected VDCs of Mugu district.

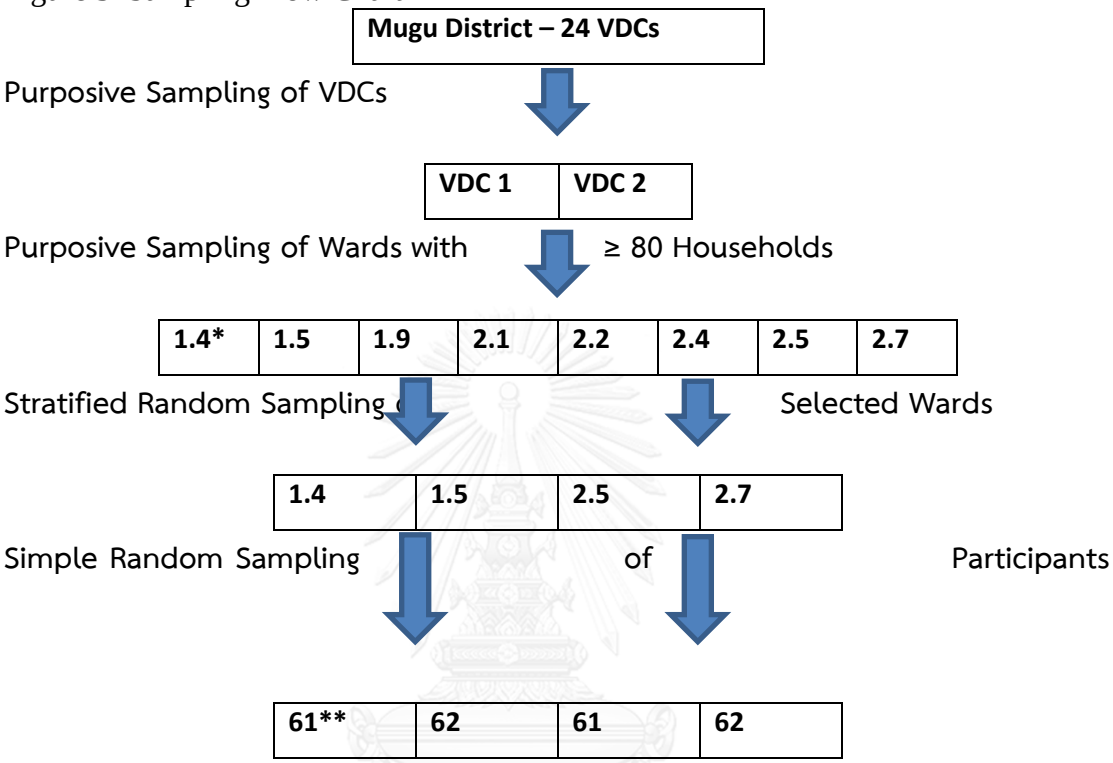
3.4 Sampling Technique

Multistage sampling method was used to select subjects of this study. In the first stage, out of 24 VDCs in the district, 2 VDCs were selected purposively according to highest population density (as reported by the National Population and Housing Census 2011) and easiest geographical access. In the second stage, out of 9 wards in each of the selected VDCs, wards with a minimum of 80 households (as reported by the National Population and Housing Census 2011) were selected purposively. VDC 1 (Shreenagar) had 3 wards and VDC 2 (Karkibada) had 5 wards with a minimum of 80 households. In the third stage, among the 8 selected wards (3 in VDC 1 and 5 in VDC 2), 2 wards were chosen from each selected VDC based on a stratified sampling method. Therefore, 2 wards each belonging to VDC 1 and 2 were sampled bringing the total number of sampled wards to 4.

In the fourth and final stage, random households with children aged 0-59 months were selected from each of the wards based on lists maintained by FCHV (Female and Child Health Volunteers) responsible for the ward selected. This random selection was achieved by a lottery method of simple random sampling without replacement in order not to select the same household twice. Each household in a ward was assigned a number which was recorded on a piece of paper. All the pieces were placed in a box. The chits that were drawn represented the households that would participate in the study. In case households had more than one child aged 0-59 months, all of them were selected and the drawing of chits was concluded when the number of selected children in the ward reached 61 or 62. Mothers from the selected households were pre-informed to gather with their children aged 0-59 months at an important landmark in the ward (school or temple) which was

convenient for anthropometric measurement and interviewing on the day of the survey.

Figure 5 Sampling Flow Chart



VDC 1- Shreenagar, VDC 2 – Karkibada *1.4 – Ward Number 4 belonging to VDC 1
**61 – Number of children selected from each ward

3.5 Inclusion & Exclusion criteria

3.5.1 Inclusion Criteria

Children aged 0-59 months.

Children resident in the selected VDCs with wards having ≥ 80 households in Mugu District.

3.5.2 Exclusion Criteria

Physical or mental disability interfering with nutrition.

Twins or Triplets

Respondents that provided incomplete data for analysis.

3.6 Sample and Sample size

The association between the Under 5 child under-nutrition and various factors was determined by using the formula for sample size calculation of population in a cross-sectional study in a condition of known prevalence. For the purposes of this study the prevalence of under-nutrition was taken at 22.5% as reported by DoHS (Department of Health Services), Annual Report 2066/67 (2009/2010).(32)

The formula was chosen based on Suresh, K. P., & Chandrashekara, S. (2012)(32) and is explained in detail as put down below:

$$N = \frac{Z^2_{\alpha/2} * P * (1-p) * D}{E^2}$$

N= Sample size

P= Prevalence

$Z_{\alpha/2}$= normal deviate for two-tailed alternative hypothesis at a level of significance

D = design effect reflects the sampling design used in the survey type of study. This is 1 for simple random sampling and higher than 1 for other methods. I used a design effect value of 1.5.

E ²= the margin of error

N= $(1.96)^2 \times 0.225 \times (1-0.225) \times 1.5 / (0.07)^2$

Sample Size = **205**

Giving a 20% non-response rate and non-completion rate, allowance was made to add to the sampling figures.

An increase of 20% was calculated to a final sample size of **246.**

3.7 Research Instrument

Anthropometric Measurements

The weight of children aged 0-59 months and their mothers was measured using Seca weighing scales with digital screens designed and manufactured under the authority of the United Nations Children's Fund (UNICEF). The scale measured weight to a 0.1 kg precision. Calibration of the weighing scale was done at the beginning of each day of the survey using a standard weight of 1 kg. After ensuring that the weighing scale was placed on a flat, hard and even surface we asked the participants to remove their shoes, any heavy items of clothing and accessories like watches and ornaments. The participant was then asked to step on the scales and stand still with

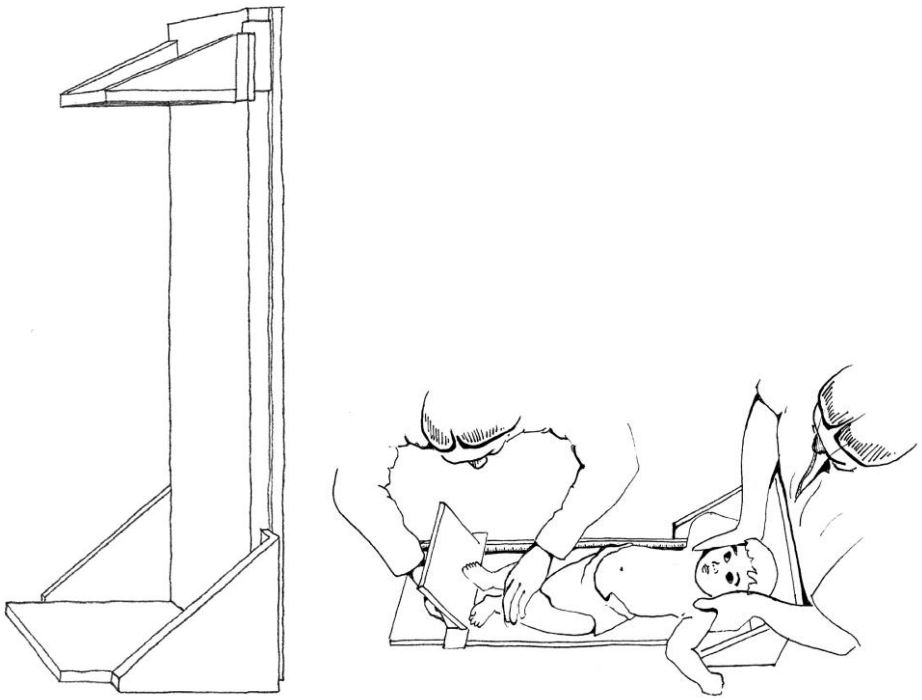
feet slightly apart and weight was recorded. In case the child was unable to stand on the scale, the mother was asked to step onto the scale, after recording the mother's weight the scale was tared by covering the solar panel for a second and when the screen displayed the digits 0.0 and the figure of a mother and baby the child was handed to the mother. When the child's weight was displayed on the screen it was recorded.

Figure 6 Measuring Weight

Height/length of the participants was measured using measuring boards specially produced by Shorr Productions for use in survey settings. The portable measuring board was lightweight and compact with a footboard for accurate measurement. It

had a measurement range of 0-190 cm and could measure to a 0.1 cm precision. It could be used vertically as a stadiometer to measure height for children and adults, or horizontally, to measure recumbent length for infants. For height measurement the board was mounted at a right angle between a level floor and against a straight, vertical surface such as a wall or pillar and for length measurement it was placed on a flat, stable surface. Height/length was measured immediately after weighing the participants after ensuring that the shoes, braids and hair ornaments which could interfere with measurement were removed. Children under age 2 or less than 85 cm were measured lying down on the board (recumbent length), and standing height was measured for all other participants. If a child less than 2 years old could not lie down for measurement of length, standing height was measured and 0.7 cm added to convert it to length. If a child aged 2 years or older could not stand, recumbent length was measured and 0.7 cm subtracted to convert it to height.

Figure 7 Measuring Height/Length



While measuring length the child was laid straight, on his back, with his head against the fixed headboard, legs straight, toes pointing upward, looking straight ahead and without arching his spine. While measuring height the participant was made to stand on the baseboard feet slightly apart with back of the head, shoulder blades, buttocks, calves, and heels all touching the vertical board and looking straight ahead.

Questionnaire

An interviewer administered structured questionnaire based on the NDHS 2011 questionnaire (see appendix a) was developed and the official Nepalese version (see appendix b) of the questionnaire was used in the field(8). The first section of the questionnaire was for purposes of identification and recorded the household address (VDC and Ward and Household Number), names of the Respondent and the Household Head. The date of interview was also recorded in this section and the participant was assigned a serial number. The following section dealt with informed consent explaining the purpose of the survey, identity of the interviewer, confidentiality of the information collected and voluntary participation. In the next

section anthropometric measurements of children and their mothers was recorded. Questions 1 to 6 dealt with Religion, Caste, Maternal Educational, Maternal Age, Child's Age and Child's Sex. Questions 7 to 12 required information regarding Child Size at Birth, Birth weight, Gestational Duration, Birth Interval and whether child was Exclusively Breastfed and fed Colostrum. Questions 13 to 17 dealt with child's History of Acute Illness (Fever and Diarrhoea), Immunization Status (see operational definitions for categories used) and Growth Monitoring Visits and ANC visits by mother during pregnancy (see operational definitions for categories used).

Question 18 was regarding the diet of the child on the day preceding the interview. Based on recall the mother had to respond with a yes or no as the interviewer listed out 21 various food item groups and liquids which could have been consumed by the child. The mother also had to recall how many times the child had eaten or drunk over the day. Dietary Diversity was scored by giving a point for each of the major nutritionally important types of food the child may have eaten. A point was given if the child had eaten 1 or more of the food items and 0 if the child had not eaten any of the food items listed in the categories numbered 1-7. It is important to note that even if a child had eaten more than 1 of the food items listed in a category only 1 point was given.

1. Starchy staples – two items combined: Foods made from grain and Foods made from roots or tubers
2. Food made from legumes
3. Dairy – two items combined: Milk other than breast-milk and Cheese or yogurt
4. Meat, poultry, fish or eggs
5. Vitamin A-rich fruits and vegetables – three items combined: Pumpkin, red or

yellow yams or squash, carrots, or red sweet potatoes, Green leafy vegetables and Mango, papaya, or other local vitamin A rich fruits

6. Other fruits and vegetables, or fruit juice – two items combined

7. Foods made with oil, fat or butter

The maximum possible score was 7; a score of 0-2 was Low, 2-4 was Middle and 5-7 was High Dietary Diversity Score.

Questions 19-20 were regarding Food Security of a household. Question 19 dealt with limitation in variety of foods consumed and question 20 addressed lack of food to eat in the household over the past 12 months. To both Questions 19 and 20 a response of never was given a score of 1, rarely a score of 2, sometimes a score of 3 and often a score of 4. Households could be given a minimum score of 2, indicating high levels of food security, to a maximum score of 8, indicating high levels of food insecurity. It is important to note the reverse coding; the higher the Food Security Score of a household the greater the food insecurity. A score of 2-3 was High, 4-6 was Middle and 7-8 was Low Food Security Group for households.

3.8 Data Analysis

The data was analyzed using the Statistical Package for the Social Sciences, version 17.0 (SPSS Inc., Chicago, IL, USA).

Descriptive statistics were calculated in terms of frequency and percentage as both the independent and dependent variables were categorical.

The prevalence of stunting, wasting and underweight in the sample population was described in terms of frequency and percentage as displayed in Table 2. These three

indices were expressed in standard deviation units from the Multicenter Growth Reference Study median of the WHO reference population.

Table 2 Dummy Frequency and Percentage of Dependent Variables

	Z Score ≥ -2 S.D. **Frequency/Percentage**	**Z score < -2 S.D.** **Frequency/Percentage**	**Z score < -3 S.D.** **Frequency/Percentage**
Stunting (ht/age)	Normal	Stunted	Severely Stunted
Wasting (wt/ht)	Normal	Wasted	Severely Wasted
Underwt (wt/age)	Normal	Underweight	Severely Underwt

The significance of association between each independent variable and dependent variable was tested using Chi Squared test or Fishers Exact test as displayed in Table 3.

Table 3 Dummy Bi-variate Analysis Table

Ind. Variable	**Stunting** Frequency Percentage	**$\chi 2$** P value	**Wasting** Frequency Percentage	**$\chi 2$** P value	**Underweight** Frequency Percentage	**$\chi 2$** P value
Maternal Factors						
Child Related Factors						

Bi-variate logistic regression analysis was conducted to examine the relationships between various independent variables and the three dependent variables separately. The dependent variables were converted into dichotomous variables by merging the < -2SD and < -3SD columns into one, as such combining them, resulting in two columns which were Z Score ≥ -2SD (Normal) and Z Score < -2SD (Undernourished). This gave the unadjusted Odds ratio with a 95% Confidence Interval and the statistical significance of the association (p value).

Finally, Multivariable logistic regression analysis was conducted in one model including all the relevant independent variables together. Results were considered statistically significant at a 5% ($P < 0.05$) significance level. Those independent variables in the Bi-variate analysis which showed a p value of $p \leq 0.2$ were included in the Multivariable analysis. This gave an adjusted Odds ratio with a 95% Confidence Interval along and the statistical significance of the association (p value). Three multivariable logistic regression models were constructed using the dependent variables;

Model 1. Dependent Variable- Stunting

Model 2. Dependent Variable- Wasting

Model 3. Dependent Variable- Underweight

The logistic model was specified as:

$\text{Log } (P/1-P) = A + B_1X_1 + B_2X_2 + \ldots\ldots + B_NX_N$,where X_{1-N} are the various independent variables included in the model as shown in the conceptual framework.

3.9 Ethical Consideration

Approval from National Health Research Council, Ethical Review Board (Registration Number 107/2014, 1 July 2014) and permission from the District Public Health Officer in Mugu was obtained in order to conduct the study (see appendix d and e).

The thesis proposal and measurement tools were reviewed and approved by Nepal Health Research Council (NHRC), Ministry of Health and Population (MoHP). The objective and the purpose of the study were explained to the respondents before administering the questionnaire and taking anthropometric measurements. Informed written consent was taken from all the participants in the study. The data was presented in aggregated tables so there is no way to link any specific participant with the result. All the questionnaires were coded by the principal researcher making it impossible to relate the questionnaire's participant code with the name of the participant in questionnaire as the list relating participant's name with the code was only available to the principal researcher, this will be destroyed after the completion of the research. No one was forced to participate in this study; the participation was voluntary. The data collected will be used for the purpose of research work only for the partial fulfilment of MPH degree. A copy of the thesis will be submitted to the relevant department of Ministry of Health and Population (MoHP), Nepal; highlighting the key finding and recommendations for policy purposes.

3.10 Limitations

Since the study is conducted in only 1 district and furthermore included only 2 VDCs it is not representative of the national population.

Many factors which have been shown to be related indirectly to under-nutrition among children like access to clean drinking water, proper toilet facilities could not be studied because of the limitation in time and resources.

Factors such as access to household income or wealth, health care and dietary practices could only be measured by proxy indicators such as Number of antenatal care visits, growth monitoring visits, dietary diversity and food security score which may not provide a clear picture.

We did not taking into account the signs of marasmus and kwashiorkor which could tell us more about the child's nutritional status.

Birth weight could not be used as a factor because a lot of women did not have a birth certificate for their child.

Many of the factors being studied like child size at birth, gestational duration, number of ANC visits during pregnancy and birth interval were dependant on the mothers recall and therefore subject to bias.

Inclusion of more than 1 child from a household significantly increased cluster effect in the study.

Recall bias, sampling bias, measurement bias and selection bias is common in these types of studies.

CHAPTER IV
RESULTS

This chapter presents the findings from the statistical analysis of the data collected during the survey.

4.1 Descriptive Analysis

This section includes descriptive statistics in terms of frequency and percentage of the various independent variables under the headings Maternal factors and Child related factors. Socio-demographic characteristics of the respondents as well as the other independent variables being studied are included.

The prevalence of stunting, wasting and underweight in the studied population is also described in terms of frequency and percentage. These three indices are expressed in standard deviation units from the Multicenter Growth Reference Study median of the WHO reference population.

As shown in Table 4, the participants of the study were from the two selected VDCs in Mugu. Each VDC contributed half (50%) of the total number of participants (n=246). The majority of the participants, 98.8%, were Hindu by religion. By combining the ‘so called’ higher caste/ethnic groups together and the remaining ethnicities in another group we see that most of the participants, 72.8%, belonged to the higher ethnic groups.

Most of the mothers participating in the study, 73.2%, belonged to the age group of 20-29 years. A large proportion, 55.3%, of mothers belonged to the age group 20-29

years at the birth of their child while a significant proportion, 34.6%, were below 20 years. A majority of the mothers, 71.1%, had BMI within the normal range and 10.1% were overweight.

Table 4 Descriptive Analysis – Maternal Factors 1

Independent Variable	Frequency	Percentage	Cumulative Percentage
Residence: VDC/Ward			
Karkibada/5	62	25.2	25.2
Karkibada/7	61	24.8	50.0
Shreenagar/4	61	24.8	74.8
Shreenagar/5	62	25.2	100.0
Religion			
Hindu	243	98.8	98.8
Buddhist	3	1.2	100.0
Ethnicity			
0	67	27.2	27.2
1	179	72.8	100.0
Ethnicity 0= Dalit, Tamang and Raut. 1= Chettri, Thakuri and Hill Brahmin.			
Maternal Age Group in Years*			
<20 years	18	7.3	7.3
20-29 years	180	73.2	80.5
30-34 years	27	11.0	91.5
≥35 years	20	8.1	99.6
Missing	1	0.4	100.0
Maternal Age Group at Birth			
<20 years	85	34.6	34.6
20-29 years	136	55.3	89.9
30-34 years	14	5.7	95.6
≥35 years	10	4.1	99.7
Missing**	1	0.4	100.0
Maternal BMI			

Moderately Obese	8	3.3	3.3
Overweight- At Risk	19	7.7	11.0
Normal Range	175	71.1	82.1
Low	43	17.5	99.6
Missing	1	0.4	100.0
Moderately Obese (BMI 25-29.9) Overweight- At Risk (BMI 23-24.9) Normal Range (BMI 18.5-22.9) Low (BMI<18.5)			

* Maternal Age group is divided along the same lines as the NDHS 2011
** In the study one of the participants did not have a mother and interview was administered to a caretaker. Therefore, the missing data regarding certain Maternal Factors.

Table 5 shows that a majority of the mothers, 61%, were uneducated although, 26.1% of them had completed high school or more. In the study, 38.2% of the children were first born, while 37% had a 24-47 months age difference compared to their elder sibling. Among the participants, 65.7% had a Food Security score of 4 or less. A majority of the mothers, 85.8%, reported term delivery of their child when asked about the gestational age of their child at birth. A majority of mothers, 82.1%, reported they had made 3 or more Antenatal Care visits during pregnancy but 11% said they had not visited a health facility at all.

Table 6 shows 51.6% of the children selected were male and 48.4% female. A large proportion of the children selected, 43.9%, fell between the ages of 36 - 59 months, whereas a minority of children, 4.5%, fell between the ages of 0-8 months. Most mothers, 66.7%, perceived their child's size at birth to be average while a minority, 1.6%, perceived their child to be very large at birth. A majority of the children, 89.8%, were exclusively breastfed during the first 6 months of life. A majority of the children, 95.1%, were fed colostrum. Only 26.4% of the children in the study suffered from diarrhoea in the past 2 weeks and 31.7% of the children experienced fever in the

past 2 weeks as reported by their mothers. In the study, 75.6% of mothers had not taken their child to a health facility for growth monitoring/ anthropometric measurement in the past 2 months.

Table 5 Descriptive Analysis – Maternal Factors 2

Independent Variable	Frequency	Percentage	Cumulative Percentage
Maternal Education			
No Formal Edu	150	61.0	61.0
≤ Grade 5	24	9.8	70.8
≥ Grade 6	18	7.3	78.1
≥ Grade10	53	21.5	99.6
Missing	1	0.4	100.0
No Edu= Uneducated. ≤ Grade 5= Primary School. ≥ Grade 6= Some Secondary School. ≥ Grade10= Graduated High School			
Birth Interval			
First Born	94	38.2	38.2
<24 Months	33	13.4	51.6
24-47 Months	91	37.0	88.6
≥48 Months	28	11.4	100.0
Food Security Score (2-8)			
2	78	31.7	31.7
3	3	1.2	32.9
4	85	34.6	67.5
5	55	22.4	89.8
6	17	6.9	96.7
7	3	1.2	98.0
8	5	2.0	100.0
Food Security Group			
High 2-3	81	32.9	32.9
Middle 4-6	157	63.8	96.7
Low 7-8	8	3.3	100
Gestational Duration			
Pre-term	33	13.4	13.4
Term	211	85.8	99.2
Post-term	2	.8	100.0
Number of ANC Visits During Pregnancy			
0	27	11.0	11.0
1	7	2.8	13.8
2	10	4.1	17.9
≥3	202	82.1	100.0

Table 6 Descriptive Analysis – Child Related Factors 1

Independent Variable	Frequency	Percentage	Cumulative Percentage
Child Gender			
Male	127	51.6	51.6
Female	119	48.4	100.0
Child Age Group in Months*			
< 6	3	1.2	1.2
6-8	8	3.3	4.5
9-11	11	4.5	8.9
12-17	34	13.8	22.8
18-23	34	13.8	36.6
24-35	48	19.5	56.1
36-47	55	22.4	78.5
48-59	53	21.5	100.0
Child Size at Birth			
Very Large	4	1.6	1.6
Larger than Average	46	18.7	20.3
Average	164	66.7	87.0
Smaller than Average	27	11.0	98.0
Very Small	5	2.0	100.0
Exclusively Breastfed Child (first 6 months of life)			
Yes	221	89.8	89.8
No	25	10.2	100.0
Colostrum Fed Child			
Yes	234	95.1	95.1
No	12	4.9	100.0
History of Fever in the Past 2 Weeks			
Yes	78	31.7	31.7
No	168	68.3	100.0
History of Diarrhoea in the Past 2 Weeks			
Yes	65	26.4	26.4
No	181	73.6	100.0
Number of Growth Monitoring Visits During Last 2 Months			
0	186	75.6	75.6
≤2	46	18.7	94.3
>2	14	5.7	100.0

* Child Age group is divided along the same lines as the NDHS 2011

Table 7 shows a majority of the children in the study, 97.6%, had been immunized as per the National Immunization Program schedule. A majority of the participants, 66.3%, scored 3-4 which is a moderate Dietary Diversity Score.

Table 7 Descriptive Analysis – Child Related Factors 2

Independent Variable	Frequency	Percentage	Cumulative Percentage
Immunized as per the National Immunization Program Schedule			
Yes	240	97.6	97.6
No	6	2.4	100.0
Dietary Diversity Score			
0-2 Low	30	12.2	12.2
3-4 Middle	163	66.3	66.3
5-7 High	53	21.5	21.5

Table 8 displays the prevalence of wasting, stunting and underweight among the children participating in the study. These three indices are expressed in standard deviation units from the Multicenter Growth Reference Study median. In terms of Weight for height, 85.4% of the children were found to be normal and the remaining 14.1% were moderately or severely wasted. In terms of Height for age, 25.2% were moderately stunted and 36.6% were severely stunted. In terms of Weight for age, 30.5% were moderately underweight and 18.3% were severely underweight.

Table 8 Prevalence of Wasting, Stunting and Underweight

Indicator	Level	Frequency	Percentage (%)
Weight for Height (Wasting)	Normal (≥ -2 SD)	210	85.4
	Wasted (<-2SD & ≥ -3SD)	21	8.5
	Severely Wasted (< -3SD)	15	6.1
	Total	246	100
Height for Age (Stunting)	Normal (≥ -2 SD)	94	38.2
	Stunted (<-2SD & ≥ -3SD)	62	25.2
	Severely Stunted (< -3SD)	90	36.6
	Total	246	100
Weight for Age (Underweight)	Normal (≥ -2 SD)	126	51.2
	Underwt. (<-2SD & ≥ -3SD)	75	30.5
	Severely Underwt. (< -3SD)	45	18.3
	Total	246	100

4.2 Bivariate Analysis

This section shows the association of the various Independent variables (Maternal and Child related Factors) with the Dependent variables (Weight for Height, Height for Age and Weight for Age) using Chi-square Test or Fisher's exact test where applicable (when any of the cells had an observed cell count less than 5).

For the purposes of bivariate analysis some of the Independent variables were re-categorized by merging formerly separate categories as presented in the descriptive analysis. This new categorization was maintained throughout the bivariate and multivariate analysis. Child Age Group in Months, was re-categorised into 3 groups (0-11 months, 12-35 months and 36-59 months) from the previous 8 groups. Food Security Score was re-categorised into 3 groups (High=2-3, Middle=4-6 and Low=7-8) from the previous 7 groups. Child Size at Birth was re-categorized into 3 groups (Large=V. Large + >Average, Average and Small= V. Small + <Average) from the previous 5 groups. Maternal BMI was re-categorized into 3 groups (Overweight ≥ 23,

Normal = 18.5-22.9 and Low < 18.5) from the previous 5 groups. Gestational Duration was re-categorized into 2 groups (Pre-term and ≥Term) from the previous 3 groups. Number of ANC Visits During Pregnancy was re-categorized into 2 groups (≤1 visit and ≥2 visits) from the previous 4 groups.

4.2.1 Bivariate Analysis: Weight for Height

This section presents the association between the various Independent variables (Maternal and Child related Factors) with the Dependent variable: Weight for Height. The following sections will present the association of the various Independent variables (Maternal and Child related Factors) with the Dependent variables: Height for Age and Weight for Age respectively.

Table 9 lists the association between the Dependent variable: Weight for Height and the Independent variables categorised under Maternal Factors- Residence: VDC/Ward, Religion, Ethnicity, Maternal Age Group in Years, Maternal Age Group at Birth, Maternal BMI and Maternal Education.

Weight for Height was seen to be not significantly associated with any of the Independent variables mentioned above as displayed in Table 9.

Table 10 lists the association between the Dependent variable: Weight for Height and the remaining Independent variables categorised under Maternal Factors- Birth Interval, Food Security Score, Gestational Duration and Number of ANC Visits During Pregnancy.

Weight for Height was seen to be not significantly associated with any of the Independent variables mentioned above as displayed in Table 10.

Table 9 Bivariate Analysis: Weight for Height with Maternal Factors 1

Independent Variable	Weight for Height Z Score n (%)			Total n (%)	Chi Square	p value
	Normal	Wasted	S.Wasted			
Residence: VDC/Ward						
Karkibada/5	50 (80.6)	5 (8.1)	7 (11.3)	62(100)	8.677	0.176*
Karkibada/7	51 (83.6)	5 (8.2)	5 (8.2)	61 (100)		
Shreenagar/4	52 (85.2)	6 (9.8)	3 (4.9)	61 (100)		
Shreenagar/5	57 (91.9)	5 (8.1)	0 (0)	62 (100)		
Religion						
Hindu	207(85.2)	21 (8.6)	15 (6.2)	243(100)	0.521	1.000*
Buddhist	3 (100)	0 (0)	0 (0)	3 (100)		
Ethnicity						
0	55 (82.1)	7 (10.4)	5 (7.5)	67 (100)	0.791	0.715
1	155(86.6)	14 (7.8)	10 (5.6)	179(100)		
Ethnicity 0= Dalit, Tamang and Raut. 1= Chettri, Thakuri and Hill Brahmin.						
Maternal Age Group in Years						
<20 years	15 (83.3)	2 (11.1)	1 (5.6)	18 (100)	1.804	0.952*
20-29 years	153 (85)	15 (8.3)	12 (6.7)	180(100)		
30-34 years	23 (85.2)	2 (7.4)	2 (7.4)	27 (100)		
≥35 years	18 (90)	2 (10)	0 (0)	20 (100)		
Maternal Age Group at Birth						
<20 years	70 (82.4)	8 (9.4)	7 (8.2)	85 (100)	2.622	0.822*
20-29 years	118(86.8)	10 (7.4)	8 (5.9)	136(100)		
30-34 years	12 (85.7)	2 (14.3)	0 (0)	14 (100)		
≥35 years	9 (90)	1 (10)	0 (0)	10 (100)		
Maternal BMI						
Overweight	25 (92.6)	2 (7.4)	0 (0)	27 (100)	4.604	0.298*
Normal Range	151(86.3)	14 (8)	10 (5.7)	175 (100)		
Low	33 (76.7)	5 (11.6)	5 (11.6)	43 (100)		
Overweight (BMI ≥23) Normal Range (BMI 18.5-22.9) Low (BMI<18.5)						
Maternal Education						
No Edu	124(82.7)	16 (10.7)	10 (6.7)	150(100)	5.402	0.437*
≤ Grade 5	24 (100)	0 (0)	0 (0)	24 (100)		
≥ Grade 6	15 (83.3)	2 (11.1)	1 (5.6)	18 (100)		
≥ Grade10	46 (86.8)	3 (5.7)	4 (7.5)	53 (100)		

*Fisher's Exact Test Value.

Table 10 Bivariate Analysis: Weight for Height with Maternal Factors 2

Independent Variable	Weight for Height Z Score n (%)			Total n (%)	Chi Square	p value
	Normal	Wasted	S.Wasted			
Birth Interval						
First Born	79 (84)	9 (9.6)	6 (6.4)	94 (100)	1.002	0.993*
<24 Months	29 (87.9)	2 (6.1)	2 (6.1)	33 (100)		
24-47 Months	78 (85.7)	7 (7.7)	6 (6.6)	91 (100)		
≥48 Months	24 (85.7)	3 (10.7)	1 (3.6)	28 (100)		
Food Security Group						
High (2-3)	73 (90.1)	3(3.7)	5 (6.2)	78 (100)	4.199	0.313*
Middle (4-6)	130(82.8)	17(10.8)	10 (6.4)	157 (100)		
Low (7-8)	7 (87.5)	1(12.5)	0 (0)	8 (100)		
Gestational Duration						
Pre-term	30 (90.9)	3 (9.1)	0 (0)	33 (100)	2.239	0.366*
≥ Term	180(84.5)	18 (8.5)	15 (7)	211(100)		
Number of ANC Visits During Pregnancy						
≤ 1	26 (76.5)	3 (8.8)	5 (14.7)	34 (100)	4.705	0.075*
≥ 2	184(86.8)	18(8.5)	10 (4.7)	212 (100)		

*Fisher's Exact Test Value.

Table 11 lists the association between the Dependent variable: Weight for Height and the Independent variables categorised under Child Related Factors- Child Gender, Child Age Group in Months, Child Size at Birth, Exclusively Breastfed Child, Colostrum Fed Child, History of Fever, History of Diarrhoea and Number of Growth Monitoring Visits.

Weight for Height was seen to be significantly associated with Child Gender (p=0.011) with a slightly higher prevalence of overall wasting among male children (15.7%), Child Age Group in Months (p=0.007), Child Size at Birth (p=0.001) with a significantly higher prevalence of wasting among children perceived to be small at birth (40.6%), Exclusively Breastfed Child (p=0.007) had a protective effect against wasting with a significantly higher prevalence among children not exclusively breastfed (36%), History of Fever (p=0.010) and History of Diarrhoea (p=0.007) were positively

associated with wasting with higher prevalence among children who had suffered an episode of diarrhoea (26.1%) and fever (24.4%).

Table 11 Bivariate Analysis: Weight for Height with Child Related Factors 1

Independent Variable	Weight for Height Z Score n (%)			Total n (%)	Chi Square	p value
	Normal	Wasted	S.Wasted			
Child Gender						
Male	107(84.3)	16 (12.6)	4 (3.1)	127(100)	8.791	**0.011***
Female	103(86.6)	5 (4.2)	11 (9.2)	119 (100)		
Child Age Group in Months						
≤ 11	17 (77.3)	4 (18.2)	1 (4.5)	22 (100)	13.001	**0.007***
12-35	92 (79.3)	12 (10.3)	12(10.3)	116 (100)		
36-59	101(93.5)	5 (4.6)	2 (1.9)	108 (100)		
Child Size at Birth						
Large	46 (92)	1 (2)	3 (6)	50 (100)	18.253	**0.001***
Average	145(88.4)	12 (7.3)	7 (4.3)	164 (100)		
Small	19 (59.4)	8 (25)	5 (15.6)	32 (100)		
Exclusively Breastfed Child (first 6 months of life)						
Yes	194(87.8)	16 (7.2)	11 (5)	221 (100)	9.381	**0.007***
No	16 (64)	5 (20)	4 (16)	25 (100)		
Colostrum Fed Child						
Yes	202(86.3)	18 (7.7)	14 (6)	234 (100)	4.603	0.068*
No	8 (66.7)	3 (25)	1 (8.3)	12 (100)		
History of Fever in the Past 2 Weeks						
Yes	59 (75.6)	12(15.4)	7 (9)	78 (100)	9.090	**0.010**
No	151(89.9)	9 (5.4)	8 (4.8)	168 (100)		
History of Diarrhoea in the Past 2 Weeks						
Yes	48 (73.8)	9 (13.8)	8 (12.3)	65 (100)	9.878	**0.007**
No	162(89.5)	12 (6.6)	7 (3.9)	181 (100)		
Number of Growth Monitoring Visits During Last 2 Months						
0	161(86.6)	13 (7)	12 (6.5)	186 (100)	3.496	0.412*
≤2	37 (80.4)	7 (15.2)	2 (4.3)	46 (100)		
>2	12 (85.7)	1 (7.1)	1 (7.1)	14 (100)		

*Fisher's Exact Test Value.

Table 12 lists the association between the Dependent variable: Weight for Height and the remaining Independent variables categorised under Child Related Factors-Immunized as per the National Immunization Program Schedule and Dietary Diversity Score.

Weight for Height was seen to be not significantly associated with any of the Independent variables mentioned above as displayed in Table 12.

Table 12 Bivariate Analysis: Weight for Height with Child Related Factors 2

Independent Variable	Weight for Height Z Score n (%)			Total n (%)	Chi Square	p value
	Normal	Wasted	S.Wasted			
Immunized as per the National Immunization Program Schedule						
Yes	206(85.8)	20 (8.3)	14 (5.8)	240(100)	3.121	0.214*
No	4 (66.7)	1 (16.7)	1 (16.7)	6 (100)		
Dietary Diversity Score						
0-2 Low	23 (76.7)	2 (6.7)	5 (16.7)	30 (100)	7.658	0.082*
3-4 Middle	144(88.3)	13 (8)	6 (3.7)	163 (100)		
5-7 High	43 (81.1)	6 (11.3)	4 (7.5)	53 (100)		

*Fisher's Exact Test Value.

4.2.2 Bivariate Analysis: Height for Age

This section presents the association between the various Independent variables (Maternal and Child related Factors) with the Dependent variable: Height for Age.

Table 13 lists the association between the Dependent variable: Height for Age and the Independent variables categorised under Maternal Factors- Residence: VDC/Ward, Religion, Ethnicity, Maternal Age Group in Years, Maternal Age Group at Birth, Maternal BMI and Maternal Education.

Height for Age was seen to be significantly associated with the Independent variables Maternal Age Group in Years ($p<0.001$) with the highest prevalence of stunting among children with mothers less than 20 years old (83.3%) and Maternal BMI ($p=0.010$) with a significantly higher prevalence of stunting among children whose mothers had

low BMI (74.4%) as displayed in Table 13. The remaining variables mentioned above showed no significant association with Height for Age.

Table 14 lists the association between the Dependent variable: Height for Age and the remaining Independent variables categorised under Maternal Factors- Birth Interval, Food Security, Gestational Duration and Number of ANC Visits During Pregnancy.

Height for Age was seen to be significantly associated with the Independent variables Birth Interval (p=0.004) with the highest prevalence of stunting among children with a birth interval less than 24 months (81.9%), Food Security Score (p=0.004) and Number of ANC Visits During Pregnancy (p=0.037) with a higher prevalence of stunting among children of mothers who made 1 or less ANC visits during pregnancy (70.6%).

Table 13 Bivariate Analysis: Height for Age with Maternal Factors 1

Independent Variable	**Height for Age Z Score n (%)**			**Total n (%)**	**Chi Square**	**p value**
	Normal	**Stunted**	**S.Stunted**			
Residence: VDC/Ward						
Karkibada/5	23(37.1)	16(25.8)	23(37.1)	62(100)	2.471	0.875
Karkibada/7	26(42.6)	11 (18)	24(39.3)	61(100)		
Shreenagar/4	22(36.1)	17(27.9)	22(36.1)	61(100)		
Shreenagar/5	23(37.1)	18 (29)	21(33.9)	62(100)		
Religion						
Hindu	92 (37.9)	61 (25.1)	90 (37)	243(100)	1.902	0.472*
Buddhist	2 (66.7)	1 (33.3)	0 (0)	3 (100)		
Ethnicity						
0	30 (44.8)	17 (25.4)	20 (29.9)	67 (100)	2.181	0.330
1	64 (35.8)	45 (25.1)	70 (39.1)	179(100)		
Ethnicity 0= Dalit, Tamang and Raut. 1= Chettri, Thakuri and Hill Brahmin.						
Maternal Age Group in Years						
<20 years	3 (16.7)	9 (50)	6 (33.3)	18 (100)	24.962	**<0.001***
20-29 years	68 (37.8)	40 (22.2)	72 (40)	180(100)		
30-34 years	9 (33.3)	13 (48.1)	5 (18.5)	27 (100)		
≥35 years	13 (65)	0 (0)	7 (35)	20 (100)		
Maternal Age Group at Birth						
<20 years	24 (28.2)	26 (30.6)	35 (41.2)	85 (100)	11.865	0.055*
20-29 years	55 (40.4)	34 (25)	47 (34.6)	136(100)		

30-34 years	6 (42.9)	2 (14.3)	6 (42.9)	14 (100)		
≥35 years	8 (80)	0 (0)	2 (20)	10 (100)		
Maternal BMI						
Overweight	17 (63)	7 (25.9)	3 (11.1)	27 (100)	13.038	**0.010***
Normal Range	65 (37.1)	43 (24.6)	67 (38.3)	175 (100)		
Low	11 (25.6)	12 (27.9)	20 (46.5)	43 (100)		
Overweight (BMI ≥23) Normal Range (BMI 18.5-22.9) Low (BMI<18.5)						
Maternal Education						
No Edu	56 (37.3)	36 (24)	58 (38.7)	150(100)	8.381	0.206*
≤ Grade 5	8 (33.3)	6 (25)	10 (41.7)	24 (100)		
≥ Grade 6	10 (55.6)	1 (5.6)	7 (38.9)	18 (100)		
≥ Grade10	19 (35.8)	19 (35.8)	15 (28.3)	53 (100)		

*Fisher's Exact Test Value.

Table 14 Bivariate Analysis: Height for Age with Maternal Factors 2

Independent Variable	**Height for Age Z Score n (%)**			**Total n (%)**	**Chi Square**	**p value**
	Normal	**Stunted**	**S. Stunted**			
Birth Interval						
First Born	33 (35.1)	30(31.9)	31 (33)	94 (100)	18.712	**0.004***
<24 Months	6 (18.2)	12(36.4)	15 (45.5)	33 (100)		
24-47 Months	37 (40.7)	16(17.6)	38 (41.8)	91 (100)		
≥48 Months	18 (64.3)	4 (14.3)	6 (21.4)	28 (100)		
Food Security Group						
High 2-3	39 (48.1)	25(30.9)	17 (21)	81 (100)	14.154	**0.004***
Middle 4-6	51 (32.5)	36(22.9)	70 (44.6)	157 (100)		
Low 7-8	4 (50)	1 (12.5)	3 (37.5)	8 (100)		
Gestational Duration						
Pre-term	15 (45.5)	8 (24.2)	10(30.3)	33 (100)	0.948	0.645
≥ Term	79 (37.1)	54 (25.4)	80 (37.6)	213(100)		
Number of ANC Visits During Pregnancy						
≤ 1	10 (29.4)	5 (14.7)	19 (55.9)	34 (100)	6.540	**0.037**
≥ 2	84 (39.6)	57(26.9)	71 (33.5)	212 (100)		

*Fisher's Exact Test Value.

Table 15 lists the association between the Dependent variable: Height for Age and the Independent variables categorised under Child Related Factors- Child Gender, Child Age Group in Months, Child Size at Birth, Exclusively Breastfed Child, Colostrum Fed Child, History of Fever, History of Diarrhoea and Number of Growth Monitoring Visits.

Height for Age was seen to be significantly associated with the Independent variables Child Size at Birth (p=0.034) with the highest prevalence of stunting among children perceived to be small at birth (68.7%) and Number of Growth Monitoring Visits (p= 0.037) with the highest prevalence among children never taken for growth monitoring (66.1%). The remaining variables showed no significant association with Height for Age as shown in Table 15.

Table 15 Bivariate Analysis: Height for Age with Child Related Factors 1

Independent Variable	**Height for Age Z Score n (%)**			**Total n (%)**	**Chi Square**	**p value**
	Normal	**Stunted**	**S. Stunted**			
Child Gender						
Male	48 (37.8)	33 (26)	46 (36.2)	127(100)	0.085	0.973
Female	46 (38.7)	29 (24.4)	44 (37)	119 (100)		
Child Age Group in Months						
≤ 11	11 (50)	6 (27.3)	5 (22.7)	22 (100)	7.623	0.102
12-35	35 (30.2)	30 (25.9)	51 (44)	116 (100)		
36-59	48 (44.4)	26 (24.1)	34 (31.5)	108 (100)		
Child Size at Birth						
Large	25 (50)	15 (30)	10 (20)	50 (100)	10.373	**0.034**
Average	59 (36)	42 (25.6)	63 (38.4)	164 (100)		
Small	10 (31.2)	5 (15.6)	17 (53.1)	32 (100)		
Exclusively Breastfed Child (first 6 months of life)						
Yes	85 (38.5)	57 (25.8)	79 (31.7)	221 (100)	0.753	0.692
No	9 (36)	5 (20)	11 (44)	25 (100)		
Colostrum Fed Child						
Yes	91 (38.9)	58 (24.8)	85 (36.3)	234 (100)	1.136	0.564*

No	3 (25)	4 (33.3)	5 (41.7)	12 (100)		
History of Fever in the Past 2 Weeks						
Yes	31 (39.7)	18 (23.1)	29 (37.2)	78 (100)	0.286	0.868
No	63 (37.5)	44 (26.2)	61 (36.3)	168 (100)		
History of Diarrhoea in the Past 2 Weeks						
Yes	21 (32.3)	17 (26.2)	27 (41.5)	65 (100)	1.430	0.513
No	73 (40.3)	45 (24.9)	63 (34.8)	181 (100)		
Number of Growth Monitoring Visits During Last 2 Months						
0	63 (33.9)	47 (25.3)	76 (40.9)	186 (100)	9.928	**0.037***
≤2	21 (45.7)	13 (28.3)	12 (26.1)	46 (100)		
>2	10 (71.4)	2 (14.3)	2 (14.3)	14 (100)		

*Fisher's Exact Test Value.

Table 16 lists the association between the Dependent variable: Height for Age and the remaining Independent variables categorised under Child Related Factors-Immunized as per the National Immunization Program Schedule and Dietary Diversity Score.

Height for Age was seen to be significantly associated with the Independent variable Dietary Diversity Score (p=0.001) although no significant association was seen with the remaining Independent variable Immunized as per the National Immunization Program Schedule as displayed in Table 16.

Table 16 Bivariate Analysis: Height for Age with Child Related Factors 2

Independent Variable	**Height for Age Z Score n (%)**			**Total n (%)**	**Chi Square**	**p value**
	Normal	**Stunted**	**S. Stunted**			
Immunized as per the National Immunization Program Schedule						
Yes	92 (38.3)	62(25.8)	86 (35.8)	240(100)	2.646	0.202*
No	2 (33.3)	0 (0)	4 (66.7)	6 (100)		
Dietary Diversity Score						
0-2 Low	12 (40)	9 (30)	9 (30)	30 (100)	19.351	**0.001**
3-4 Middle	52 (31.9)	37 (22.7)	74 (45.4)	163 (100)		
5-7 High	30 (56.6)	16 (30.2)	7 (13.2)	53 (100)		

*Fisher's Exact Test Value.

4.2.3 Bivariate Analysis: Weight for Age

This section presents the association between the various Independent variables (Maternal and Child related Factors) with the Dependent variable: Weight for Age.

Table 17 lists the association between the Dependent variable: Weight for Age and the Independent variables categorised under Maternal Factors- Residence: VDC/Ward, Religion, Ethnicity, Maternal Age Group in Years, Maternal Age Group at Birth, Maternal BMI and Maternal Education.

Weight for Age was seen to be significantly associated with the Independent variable Maternal BMI ($p<0.001$) with a significantly higher prevalence of underweight among children whose mothers had low BMI (69.8%) as displayed in Table 17. The remaining variables mentioned above showed no significant association with Weight for Age.

Table 18 lists the association between the Dependent variable: Weight for Age and the remaining Independent variables categorised under Maternal Factors- Birth Interval, Food Security, Gestational Duration and Number of ANC Visits During Pregnancy.

Weight for Age was seen to be significantly associated with the Independent variable Food Security Group ($p=0.030$). The remaining variables mentioned above showed no significant association with Weight for Age as shown in Table 18

Table 17 Bivariate Analysis: Weight for Age with Maternal Factors 1

Independent Variable	**Weight for Age Z Score n (%)**			**Total n (%)**	**Chi Square**	**p value**
	Normal	**Underwt**	**S.Underwt**			
Residence: VDC/Ward						
Karkibada/5	30 (48.4)	16 (25.8)	16 (25.8)	62(100)	12.363	0.054
Karkibada/7	32 (52.5)	16 (26.2)	13 (21.3)	61 (100)		

Shreenagar/4	25 (41)	27 (44.3)	9 (14.8)	61 (100)		
Shreenagar/5	39 (62.9)	16 (25.8)	7 (11.3)	62 (100)		
Religion						
Hindu	123(50.6)	75 (30.9)	45 (18.5)	243(100)	1.745	0.298*
Buddhist	3 (100)	0 (0)	0 (0)	3 (100)		
Ethnicity						
0	36 (53.7)	17 (25.4)	14 (20.9)	67 (100)	1.245	0.564
1	90 (50.3)	58 (32.4)	31 (17.3)	179(100)		
Ethnicity 0= Dalit, Tamang and Raut. 1= Chettri, Thakuri and Hill Brahmin.						
Maternal Age Group in Years						
<20 years	8 (44.4)	7 (38.9)	3 (16.7)	18 (100)	5.489	0.479*
20-29 years	88 (48.9)	56 (31.1)	36 (20)	180(100)		
30-34 years	17 (63)	5 (18.5)	5 (18.5)	27 (100)		
≥35 years	12 (60)	7 (35)	1 (5)	20 (100)		
Maternal Age Group at Birth						
<20 years	39 (45.9)	26 (30.6)	20 (23.5)	85 (100)	5.324	0.496*
20-29 years	71 (52.2)	42 (30.9)	23 (16.9)	136(100)		
30-34 years	7 (50)	5 (35.7)	2 (14.3)	14 (100)		
≥35 years	8 (80)	2 (20)	0 (0)	10 (100)		
Maternal BMI						
Overweight	21 (77.8)	6 (22.2)	0 (0)	27 (100)	19.555	**<0.001***
Normal Range	91 (52)	53 (30.3)	31 (17.7)	175(100)		
Low	13 (30.2)	16 (37.2)	14 (32.6)	43 (100)		
Overweight (BMI ≥23) Normal Range (BMI 18.5-22.9) Low (BMI<18.5)						
Maternal Education						
No Edu	75 (50)	44 (29.3)	31 (20.7)	150(100)	4.255	0.646*
≤ Grade 5	12 (50)	7 (29.2)	5 (20.8)	24 (100)		
≥ Grade 6	8 (44.4)	6 (33.3)	4 (22.2)	18 (100)		
≥ Grade10	30 (56.6)	18 (34)	5 (9.4)	53 (100)		

*Fisher's Exact Test Value.

Table 18 Bivariate Analysis: Weight for Age with Maternal Factors 2

Independent Variable	**Weight for Age Z Score n (%)**			**Total n (%)**	**Chi Square**	**p value**
	Normal	**Underwt**	**S.Underwt**			
Birth Interval						
First Born	49 (52.1)	29 (30.9)	16 (17.0)	94(100)	4.018	0.680
<24 Months	13 (39.4)	11 (33.3)	9 (27.3)	33 (100)		
24-47 Months	47 (51.6)	29 (31.9)	15 (16.5)	91 (100)		
≥48 Months	17 (60.7)	6 (21.4)	5 (17.9)	28 (100)		
Food Security Group						

High	50 (61.7)	23 (28.4)	8 (9.9)	81 (100)	10.002	**0.030***
Middle	70 (44.6)	51 (32.5)	36 (22.9)	157(100)		
Low	6 (75)	1 (12.5)	1 (12.5)	8 (100)		
Gestational Period						
Pre-term	21 (63.6)	9 (27.3)	3 (9.1)	33 (100)	2.856	0.228
≥ Term	105(49.3)	66 (31)	42 (19.7)	213(100)		
Number of ANC Visits During Pregnancy						
≤ 1	13 (38.2)	11 (32.4)	10 (29.4)	34 (100)	4.010	0.139
≥ 2	113(53.3)	64 (30.2)	35 (16.5)	212(100)		

*Fisher's Exact Test Value.

Table 19 lists the association between the Dependent variable: Weight for Age and the Independent variables categorised under Child Related Factors- Child Gender, Child Age Group in Months, Child Size at Birth, Exclusively Breastfed Child, Colostrum Fed Child, History of Fever, History of Diarrhoea and Number of Growth Monitoring Visits.

Weight for Age was seen to be significantly associated with the Independent variables Child Age Group in Months (p=0.001) with a slightly higher prevalence of underweight among children belonging to the age group 12-35 months (60.3%), Child Size at Birth (p=0.007) with a significantly higher prevalence among children perceived to be small at birth (68.6%) and History of Diarrhoea (p=0.001) which showed a positive association with underweight as children who had suffered from diarrhoea had higher prevalence of underweight (67.7%). The remaining variables showed no significant association with Weight for Age as shown in Table 19.

Table 19 Bivariate Analysis: Weight for Age with Child Related Factors 1

Independent	Weight for Age Z Score n (%)	Total	Chi	p

Variable	Normal	Underwt	S.Underwt	n (%)	Square	value
Child Gender						
Male	64 (50.4)	40 (31.5)	23 (18.1)	127(100)	0.127	0.941
Female	62 (52.1)	35 (29.4)	22 (18.5)	119(100)		
Child Age Group in Months						
≤ 11	10 (45.5)	10 (45.5)	2 (9.1)	22 (100)	17.522	**0.001***
12-35	46 (39.7)	44 (37.9)	26 (22.4)	116(100)		
36-59	70 (64.8)	21 (19.4)	17 (15.7)	108(100)		
Child Size at Birth						
Large	35 (70)	8 (16)	7 (14)	50 (100)	14.074	**0.007**
Average	81 (49.4)	55 (33.5)	28 (17.1)	164(100)		
Small	10 (31.2)	12 (37.5)	10 (31.2)	32 (100)		
Exclusively Breastfed Child (first 6 months of life)						
Yes	116(52.5)	68 (30.8)	37 (16.7)	221(100)	3.599	0.164
No	10 (40)	7 (28)	8 (32)	25 (100)		
Colostrum Fed Child						
Yes	121(51.7)	72 (30.8)	41 (17.5)	234(100)	1.927	0.440*
No	5 (41.7)	3 (25)	4 (33.3)	12 (100)		
History of Fever in the Past 2 Weeks						
Yes	33 (42.3)	29 (37.2)	16 (20.5)	78 (100)	3.756	0.155
No	93 (55.4)	46 (27.4)	29 (17.3)	168(100)		
History of Diarrhoea in the Past 2 Weeks						
Yes	21 (32.3)	25 (38.5)	19 (29.2)	65 (100)	13.789	**0.001**
No	105 (58)	50 (27.6)	26 (14.4)	181(100)		
Number of Growth Monitoring Visits During Last 2 Months						
0	95 (51.1)	56 (30.1)	35 (18.8)	186(100)	1.486	0.844*
≤2	22 (47.8)	15 (32.6)	9 (19.6)	46 (100)		
>2	9 (64.3)	4 (28.6)	1 (7.1)	14 (100)		

*Fisher's Exact Test Value.

Table 20 lists the association between the Dependent variable: Weight for Age and the remaining Independent variables categorised under Child Related Factors-Immunized as per the National Immunization Program Schedule and Dietary Diversity Score.

Weight for Age was seen to be significantly associated with the Independent variable Dietary Diversity Score (p=0.006) although no significant association was seen with the

remaining Independent variable Immunized as per the National Immunization Program Schedule as displayed in Table 20.

Table 20 Bivariate Analysis: Weight for Age with Child Related Factors 2

Independent Variable	Weight for Age Z Score n (%)			Total n (%)	Chi Square	p value
	Normal	Underwt	S.Underwt			
Immunized as per the National Immunization Program Schedule						
Yes	125(52.1)	72 (30)	43 (17.9)	240(100)	3.420	0.162*
No	1 (16.7)	3 (50)	2 (33.3)	6 (100)		
Dietary Diversity Score						
0-2 Low	10 (33.3)	16 (53.3)	4 (13.3)	30 (100)	14.129	**0.006***
3-4 Middle	84 (51.5)	42 (25.8)	37 (22.7)	163(100)		
5-7 High	32 (60.4)	17 (32.1)	4 (7.5)	53 (100)		

*Fisher's Exact Test Value.

4.3 Multivariable Analysis

In this section bivariate logistic regression was used to see the association between each of the Independent variables (Maternal and Child related Factors) with the Dependent variables (Weight for Height, Height for Age and Weight for Age) separately and the results obtained from the bivariate logistic regression analysis were used to construct 3 separate models for each Dependent variable for multivariable Analysis. These multivariable models included all the Independent variables for which p-value was less than or equal to 0.20 in bivariate logistic regression analysis. All the Independent variables with p-value less than or equal to 0.20 were included in the initial multivariable models but in a stepwise process, final multivariable models for each Dependent variable were created by removing those Independent variables with p-value more than 0.20 from the initial models.

4.3.1 Multivariable Analysis: Weight for Height

This section presents the association between the various Independent variables (Maternal and Child related Factors) which had a p-value less than or equal to 0.20 in binary logistic regression analysis with the Dependent variable: Weight for Height.

Binary logistic regression showed the following Independent variables- Maternal BMI (p=0.164), Number of ANC Visits During Pregnancy (p=0.12), Child Age Group in Months (p=0.010), Child Size at Birth (p<0.001), Exclusively Breastfed Child (p=0.003), Colostrum Fed Child (p=0.073), History of Fever (p=0.004), History of Diarrhoea (p=0.003) and Dietary Diversity Score (p=0.163) were to be included in the initial multivariable model.

As displayed in Table 21, after stepwise exclusion of Independent variables with p-value greater than 0.20 from the initial multivariable model, a final multivariable model was created which showed that the Independent variables- Child Size at Birth (p=0.002), Exclusively Breastfed Child (p=0.009) and History of Diarrhoea (p=0.020) remained significantly associated with Weight for Height. Being perceived as small at birth had an increased likelihood of wasting, Odds Ratio of 5.366. Not being exclusively breastfed resulted in an increased chance of being wasted, Odds Ratio of 4.126. Children who had not suffering from an acute episode of diarrhoea were less likely to be wasted, Odds Ratio of 0.371.

Table 21 Multivariable Analysis: Weight for Height

Independent Variable	Coefficient (B)	Standard Error (SE)	p value	Odds Ratio (OR)	95% Confidence Interval
Child Size at Birth			**0.002**		
Large				1.00	
Average	0.054	0.609	0.930	1.055	0.320 - 3.480

Small	1.680	0.687	0.014	5.366	1.397 -20.619
Child Age Group in Months			0.063		
≤ 11				1.00	
12-35	0.118	0.623	0.849	1.125	0.332 – 3.813
36-59	-1.046	0.713	0.142	0.351	0.087 – 1.421
Exclusively Breastfed Child			**0.009**		
Yes				1.00	
No	1.417	0.541	0.009	4.126	1.429 -11.913
History of Diarrhoea in the Past 2 Weeks			**0.020**		
Yes				1.00	
No	-0.991	0.427	0.020	0.371	0.161 – 0.856
Dietary Diversity Score			0.167		
0-2 Low				1.00	
3-4 Middle	-0.382	0.566	0.500	0.682	0.225 – 2.071
5-7 High	0.511	0.631	0.418	1.667	0.494 - 5.740

4.3.2 Multivariable Analysis: Height for Age

This section presents the association between the various Independent variables (Maternal and Child related Factors) which had a p-value less than or equal to 0.20 in binary logistic regression analysis with the Dependent variable: Height for Age.

Binary logistic regression showed the following Independent variables- Ethnicity (p=0.196), Maternal Age Group (p=0.030), Maternal Age Group at Birth (p=0.023), Maternal BMI (p=0.009), Birth Interval (p=0.004), Food Security (p=0.051), Child Age Group (p=0.046), Child Size at Birth (p=0.143), Number of Growth Monitoring Visits (p=0.017) and Dietary Diversity Score (p=0.007) were to be included in the initial multivariable model.

As displayed in Table 22, after stepwise exclusion of Independent variables with p-value greater than 0.20 from the initial multivariable model, a final multivariable model was created which showed that the Independent variables- Maternal BMI (p=0.037), Birth Interval (p=0.001), Child Age Group (p=0.010), Number of Growth Monitoring Visits (p=0.022) and Dietary Diversity Score (p=0.008) remained significantly associated with Height for Age. An increased likelihood of stunting among children whose mothers had low BMI was observe, Odds Ratio of 4.36. The protective influence against stunting of a birth interval greater than or equal to 48 months could be seen, Odds ratio of 0.08. The protective effects of more than 2 growth monitoring visits against stunting were observed with an Odds ratio of 0.188.

Table 22 Multivariable Analysis: Height for Age

Independent Variable	Coefficient (B)	Standard Error (SE)	p value	Odds Ratio (OR)	95% Confidence Interval
Maternal BMI		**0.037**			
Overweight				1.00	
Normal Range	0.941	0.467	0.044	2.562	1.026 - 6.399
Low	1.473	0.579	0.011	4.360	1.401 -13.567
Birth Interval		**0.001**			
<24 Months				1.00	
24-47 Months	-1.386	0.549	0.012	0.250	0.085 – 0.734
≥48 Months	-2.531	0.665	0.000*	0.080	0.022 – 0.293
First Born	-1.025	0.547	0.061	0.359	0.123 – 1.048
Child Age Group in Months		**0.010**			
≤ 11				1.00	
12-35	0.771	0.552	0.162	2.163	0.733 – 6.379
36-59	-0.184	0.567	0.746	0.832	0.274 – 2.529
Number of Growth Monitoring Visits		**0.022**			
0				1.00	
≤2	-0.668	0.376	0.076	0.513	0.245 – 1.072
>2	-1.674	0.709	0.018	0.188	0.047 – 0.753
Dietary Diversity Score		**0.008**			
0-2 Low				1.00	

3-4 Middle	0.568	0.474	0.231	1.765	0.697 – 4.470
5-7 High	-0.568	0.530	0.284	0.567	0.201 – 1.601

* p value < 0.001

4.3.3 Multivariable Analysis: Weight for Age

This section presents the association between the various Independent variables (Maternal and Child related Factors) which had a p-value less than or equal to 0.20 in binary logistic regression analysis with the Dependent variable: Weight for Age.

Binary logistic regression showed the following Independent variables- Residence: VDC/Ward (p=0.108), Maternal Age (p=0.038), Maternal BMI (p=0.164), Number of ANC Visits During Pregnancy (p=0.12), Child Age Group (p=0.010), Child Size at Birth (p<0.001), History of Fever (p=0.058), History of Diarrhoea (p<0.001) and Dietary Diversity Score (p=0.066) were to be included in the initial multivariable model.

As displayed in Table 23, after stepwise exclusion of Independent variables with p-value greater than 0.20 from the initial multivariable model, a final multivariable model was created which showed that the Independent variables- Child Age Group 36-59 months (p=0.036) and Child Size at Birth (p<0.001) remained significantly associated with Weight for Age. Children aged 36-59 months were less likely to be underweight, Odds ratio of 0.206. Children perceived to be small at birth were much more likely to be underweight, Odds ratio of 7.124.

Table 23 Multivariable Analysis: Weight for Age

Independent Variable	Coefficient (B)	Standard Error (SE)	p value	Odds Ratio (OR)	95% Confidence Interval
VDC/Ward Number		0.094			
Karkibada/5				1.00	
Karkibada/7	-0.485	0.566	0.392	0.616	0.203 – 1.868
Shreenagar/4	-1.372	0.621	0.027	0.254	0.075 – 0.857
Shreenagar/5	-1.185	0.623	0.057	0.306	0.090 – 1.037
Child Age Group in Months		0.056			
≤ 11				1.00	
12-35	-0.553	0.657	0.400	0.575	0.159 – 2.086

36-59	-1.580	0.753	0.036	0.206	0.047 – 0.901
Child Size at Birth			**0.000***		
Large				1.00	
Average	0.151	0.614	0.805	1.163	0.349 – 3.877
Small	1.963	0.686	0.004	7.124	1.856 -27.338
History of Diarrhoea in the Past 2 Weeks			0.081		
Yes				1.00	
No	-0.757	0.434	0.081	0.469	0.200 – 1.099
History of Fever in the Past 2 Weeks			0.072		
Yes				1.00	
No	-0.793	0.440	0.072	0.452	0.191 – 1.072
Number of ANC Visits During Pregnancy			0.283		
≤ 1				1.00	
≥ 2	-0.582	0.542	0.283	0.559	0.193 – 1.616

* p value < 0.001

Table 24 Summary Table of Results: Bivariate and Multivariate Analysis

Independent Variable	Weight for Height		Height for Age		Weight for Age	
	Bi*	Multi**	Bi	Multi	Bi	Multi
Residence						
Religion						
Ethnicity						
Maternal Age Group			✓			
Mat. Age Grp at Birth						
Maternal BMI			✓	✓	✓	
Maternal Education						
Birth Interval			✓	✓		
Food Security Group			✓		✓	
Gestational Duration						
No. of ANC Visits			✓			
Child Gender	✓					
Child Age Group	✓			✓	✓	✓
Child Size at Birth	✓	✓	✓		✓	✓
Exclusively Breastfed	✓	✓				
Colostrum Fed						

History of Fever	✓					
History of Diarrhoea	✓	✓			✓	
No. of GM Visits***			✓	✓		
Immunized****						
Dietary Div. Score			✓	✓	✓	

*Bivariate Analysis **Multivariate Analysis *** Number of Growth Monitoring Visits

****Immunized as per the National Immunization Program Schedule

✓ Significantly associated with the dependent variable

CHAPTER V
DISCUSSION, CONCLUSION AND RECOMMENDATIONS

The main objectives of this thesis were to determine the prevalence of under-nutrition, to describe the socio-demographics of under-nutrition and to find the association between various factors and under-nutrition among children aged 0-59 months in Mugu District.

After extensive Literature review, the following Independent Variables were selected- Residence, Religion, Ethnicity, Maternal Age, Maternal BMI, Maternal Education, Birth Interval, Food Security, Gestational Duration, Number of ANC Visits, Child Gender, Child Age, Child Size at Birth, Exclusively Breastfed Child, Colostrum Fed Child, History of Fever, History of Diarrhea, Number of Growth Monitoring Visits, Immunization History and Dietary Diversity, in the belief that they had the potential to influence the presence of under-nutrition among children aged 0-59 months.

This Chapter is divided into five sections:

5.1 General Discussion on characteristics of study population

5.2 General Discussion on the key findings of the study

5.3 Benefits from the study

5.4 Conclusions

5.5 Recommendations

5.1 General Discussion on Characteristics of study population

The participants of the study were from the two selected VDCs in Mugu. Each VDC contributed half (50%) of the total number of participants (n=246). The majority of the participants, 98.8%, were Hindu by religion compared to the NDHS 2011 report which states that 84% of the population between the ages of 15-49 years is Hindu(8). As 98.8% of the participants were Hindu it was not possible to find any association between religion and the dependent variables (homogeneity of data). Among the participants 72.8% belonged to the higher ethnic groups consisting of Hill Chhetris and Brahmins compared to the NDHS 2011 which states that among women Hill Chhetris and Brahmins together comprise 33.4% of the total population between the ages of 15-49 years(8). This study was conducted in a mountain district with a more homogenous population comprising of 91% Hindus by religion and 66% belonging to the Chhetri and Brahmin ethnic groups according to the Central Bureau of Statistics, National Population and Housing Census 2001(33).

Most of the mothers participating in the study, 73.2%, belonged to the age group of 20-29 years which is consistent with the NDHS 2011 report which states that, nationally, the largest proportion of women between the ages of 15-49 years, 34.7%, fall in the 20-29 age group(8). A larger proportion of mothers, 34.6%, were below 20 years at the birth of their child compared to the NDHS 2011 which reports 17% of women aged 15-19 years are already mothers or pregnant with their first child(8). This could be explained by the lower levels of education, marriage at a younger age or lack of awareness or access to family planning services among the study population. This is confirmed by data from the Central Bureau of Statistics, National Population and Housing Census 2001 which states that 72% of girls and women in Mugu are

married as adolescents(33). The Annual Report 2011/2012, District Health Office, Mugu states that of the 196 sanctioned health professional posts, 26 are vacant, some in key positions and coverage by outreach clinics is also only 40% along with a Contraceptive Prevalence Rate of only 30%, which is below the national average(34). This could explain the lack of awareness and access to family planning services. As all the participants are mothers with children under 5 years of age, the bulk of them would fall in the 20-29 age-group. A majority of the mothers, 71.1%, had BMI within the normal range but 17.5% had low BMI in the study population which resembled the NDHS 2011 which reported that 18% of women had low BMI(8). A majority of the mothers, 61%, were uneducated compared to NDHS 2011 which reports 39.8% women between the ages of 15-49 years were uneducated although a similar proportion of women had completed high school or more; 26.1% women in the study population and 18.4% women in the NDHS 2011 report(8). The low levels of education reflect Mugu's status as one of the least developed districts in Nepal. Mugu was ranked last (75^{th}) among all districts according to the Overall Composite Index which is an indicator of development according to a report titled 'Districts of Nepal, Indicators of Development, Update 2003' prepared jointly by International Centre for Integrated Mountain Development and Central Bureau of Statistics, Nepal(35). In the study 38.2% of the children were first born, 37% had a 24-47 months age difference compared to their elder sibling and 13.4% had less than 24 months age difference compared to the NDHS 2011 which reports half of births, 50%, occur within 3 years of a previous birth with 21% occurring within 24 months(8). In this study 65.7% of the respondents had a Food Security score of 4 or less which indicates that they enjoy a moderate to high level of food security but the NDHS

2011 reports that nationally only 49% of households are food secure(8). The study area included the district headquarter and surrounding areas which are reported to have relatively more food secure households as stated by the Nepal Khadya Surakshya Anugaman Pranali supported by WFP and Nepal and Ministry of Agriculture Development(31). The large percentage of food secure households in the study could also be due to bias created by the respondent's tendency to give a socially acceptable answer. A majority of the mothers, 85.8%, reported term delivery of their child when asked about the gestational age of their child at birth. A majority of mothers, 82.1%, reported they had made 3 or more Antenatal Care visits during pregnancy but 11% said they had not visited a health facility at all compared to the NDHS 2011 which reports 50% of women make 4 or more Antenatal Care visits during pregnancy(8). This indicates that a large proportion of women understand the importance of Antenatal care during pregnancy and actively seek it although the tendency of the respondents to give a socially acceptable response could have created bias, especially as no documented evidence of ANC visits was required. Another reason for increased awareness and practice of attending Antenatal clinics is because the government has offered a financial incentive.

In the study 51.6% of the children selected were male and 48.4% female compared to a nutrition anthropometric survey carried out in Mugu district by ACF Nepal during May/June 2008 which surveyed 901 children aged 6 to 59 months which reported 47.8% were male and 52.2% were female(15). The largest proportion of the children selected, 43.9%, fell between the ages of 36-59 months similar to Nutrition anthropometric survey carried out in Mugu district by ACF Nepal which reported 46% of the children to be aged between 30-59 months(15). Most mothers, 87%,

perceived their child's size at birth to be average or larger while a minority, 13%, perceived their child to be small or very small at birth similar to the NDHS 2011 which reports 84% were perceived to be average or larger in size and 12% were perceived to be smaller than average(8). A larger proportion of children, 89.8%, were exclusively breastfed during the first 6 months of life compared to the NDHS 2011 which reports 70% of children were exclusively breastfed during the first 6 months(8). The very high percentage of exclusively breastfed children in the study population could be because of the tendency among the respondents to give a socially acceptable response leading to a bias in the results. A majority of the children, 95.1%, were fed colostrum. Among children in the study 26.4% suffered from diarrhea in the past 2 weeks compared to 14% children in the NDHS 2011(8). The higher incidence of diarrhea in the study population could be one of the causes for the higher rates of under-nutrition and also points to poor levels of hygiene and sanitary practices among the study population. A Knowledge Attitude and Practice survey titled "Clean water, improved sanitation and hygiene promotion in rural villages of Humla and Mugu, Mid-West Nepal" carried out in 2009 involving 320 households reported only 19% of the respondents had access to a latrine and only 36% women were aware that they have to wash their hands after defecation(36). Among children in the study 31.7% experienced fever in the past 2 weeks compared to 19% children in the NDHS 2011 which could also be one of the causes for higher rates of under-nutrition(8). In the study 75.6% of mothers had not taken their child to a health facility for growth monitoring/ anthropometric measurement in the past 2 months although it is recommended by the Health Ministry and WHO for all children under 5 years of age. This finding could be an indicator of poor levels of access to

health facilities or a general lack of awareness among the study population. A majority of the children in the study, 97.6%, had been fully immunized according to their age, as per the National Immunization Program schedule compared to 87% children as reported by NDHS 2011(8). This reflects a high level of vaccination coverage in the study population. A majority of the participants, 66.3%, scored 3-4 which is a moderate Dietary Diversity Score in keeping with the recommended IYCF (Infant and young Child Feeding) practice which requires children to be fed at least 3 different food groups. The NDHS 2011 reports that 44% of children are fed in accordance with the recommended IYCF practices(8). The high percentage of children fed in accordance with IYCF practices in the study could be explained by the tendency of the respondents to give a socially acceptable response creating a bias which inflates the actual percentage.

5.2 General Discussion on the key findings of the study

The study found that in terms of Weight for height, 8.5% of the children were wasted and 6.1% were severely wasted in comparison to the NDHS 2011 which reports 11% to be wasted and 3% to be severely wasted(8). The overall prevalence of wasting are the same in the study and NDHS 2011 report but the prevalence of severe wasting is higher among children in the study. This indicates a higher level of severe acute under-nutrition among children in the study which could be due to acute illness in the period preceding the study which is reflected by the higher levels of diarrhoea and fever among children in the study compared to the NDHS 2011.

The study found that in terms of Height for age, 25.2% of the children were stunted and 36.6% were severely stunted in comparison to the NDHS 2011 which reports 41% to be stunted and 16% to be severely stunted(8). The overall prevalence of stunting is higher in the study, 61.8%, compared to the NDHS 2011 report of 57% and the prevalence of severe stunting is much higher among children in the study reiterating the fact that Mugu district has the highest levels of under-nutrition in the country(8, 14). Stunting is an indicator of chronic under-nutrition which is caused by inadequate dietary intake over a long period along with recurrent and chronic illness.

Keeping in mind the high prevalence of stunting in the study population it is important to discuss some of the consequences it has. The 2008 Lancet series on Maternal and Child Under-nutrition found that stunting in the first two years of life was associated with lower levels of school attainment and reduced economic productivity in adult life. Stunting between 12 and 36 months was associated with poor cognitive performance and/or lower grades in school(28). Controlling for socio-economic covariates, prospective cohort studies consistently show significant associations between stunting by age 2 or 3 years and later cognitive deficits, school achievement, and dropout. Early childhood stimulation has been shown to reduce the negative impact of stunting on cognitive outcomes, with lasting effects(29).

The study found that in terms of Weight for age, 30.5% of the children were underweight and 18.3% were severely underweight in comparison to the NDHS 2011 which reports 29% to be underweight and 8% to be severely underweight(8). The overall prevalence of being underweight is higher in the study mainly because of the significantly higher share of severely underweight children. Weight for age is an indicator of both acute and chronic under-nutrition and the high level of

underweight children in the group further highlights the problem of acute and chronic under-nutrition among children in Mugu district.

5.2.1 Factors associated with Weight for Height

In the bivariate analysis the following independent variables: Child Gender, Child Age Group, Child Size at Birth, Exclusively Breastfed Child, History of Fever and History of Diarrhoea were found to be significantly associated with Wasting among children.

Among the above listed variables, Child Size at Birth, Exclusively Breastfed Child and History of Diarrhoea retained their significance of association in the final multivariable model.

In the study, children perceived to be small at birth had positive association with wasting; Odds Ratio of 5.366. Similar results were found in a study where Child Size at Birth was found to be associated with wasting with an Odds ratio of 2.4 for term babies who were small for gestational age and 4.5 for preterm babies who were small gestational age(37). The NDHS 2011 also reports that children perceived to be small at birth were more likely to be wasted(8).

The association between Child Gender and Child Age Group with wasting found in the study with a slightly larger percentage of wasting among male children and slightly larger percentage of wasting among children less than 11 months of age is similar to results from the NDHS 2011 which found wasting to be higher among male children and highest in the 9-11 month age group(8).

The association between Exclusive breastfeeding and wasting was also seen in a study conducted in Nairobi, Kenya which found that bottle fed babies and children discontinuing breastfeeding were more likely to be wasted; Odds ratio of 1.6(22). The association was also seen in a case control study conducted in Bangladesh which found wasting more prevalent among children who had stopped exclusive breastfeeding before 4 months of age(23).

The positive association between acute episode of fever or diarrhoea and wasting among children was also seen in a study conducted among Malawian children aged 6-18 months which found greater duration of fever or diarrhea resulted in greater levels of wasting(24). Similar results were seen in a cross sectional study conducted in India among children aged 2-5 years which found a significant association ($p<0.01$) between diarrhoea and wasting(38).

5.2.2 Factors associated with Height for Age

In the bivariate analysis the following independent variables: Maternal Age Group, Maternal BMI, Birth Interval, Food Security Score, Number of ANC Visits During Pregnancy, Child Size at Birth, Number of Growth Monitoring Visits and Dietary Diversity Score were found to be significantly associated with Stunting among children.

Among the above listed variables, Maternal BMI, Birth Interval, Number of Growth Monitoring Visits and Dietary Diversity Score retained their significance of association in the final multivariable model. Child Age Group which showed no significant

association in the bivariate analysis proved to be significantly associated with Stunting in the final multivariable model.

The association between low Maternal Age and stunting was also seen in a cross sectional analysis of nationally representative household samples from 55 countries which found that mothers below the age of 27 had elevated risk of stunting in their children(39). Another study conducted among squatters in Brazil found that the prevalence of stunting among children of adolescent mothers was twice as high compared to mothers who were 20 years or more(40).

The association between low Maternal BMI and stunting was similar to the NDHS 2011 which reported mothers with poor nutritional status (BMI < 18.5) have children with the highest levels of stunting(8).

The association between Birth Interval (<24 months) and stunting was also seen in a longitudinal study conducted in the Philippines among 18,544 children younger than 30 months which found a short previous birth interval (<24 months) was one among the two most important risk factors for stunting(41).

Low Food Security Score was found to be associated with higher levels of stunting in a study which surveyed 800 households in 8 countries, including Nepal, among children aged between 24 to 60 months(42).

The protective influence of Growth Monitoring Visits against stunting and under-nutrition as a whole was also seen in a study which evaluated 16 projects which involved Growth Monitoring and Growth Monitoring Promotion impact over the past 3 decades. The study reported a significant reduction in rates of stunting(25).

The association between low Dietary Diversity Score and stunting was also seen in a study which analyzed data from DHS surveys of 11 countries including Nepal. The study reported significant associations between low Dietary Diversity Scores and stunting in 9 out of the 11 countries(26). Similarly, the Nepal Thematic Report on Food Security and Nutrition 2013 showed children with a score of less than 4 had a higher prevalence of stunting (76.2%) and stated that there was a significant association between Dietary Diversity Score and stunting among children(27).

The association between maternal ANC visits during pregnancy and stunting was also seen in a study which analyzed the role of ANC programs in determining the level and distribution of child stunting in three Andean countries which found that, overall the use of ANC is associated with a reduction in the level of child stunting(43).

The prevalence of stunting was highest among children in the age group of 12-35 months (69.9%) in the study but the NDHS 2011 reported stunting to be highest among children of the age group of 36-47 months (53%)(8).

In the study, children perceived to be small at birth had the highest prevalence of stunting (68.7%). The NDHS 2011 also reports that more than half of children whose size at birth was very small or small were stunted(11).

5.2.3 Factors associated with Weight for Age

In the bivariate analysis the following independent variables: Maternal BMI, Food Security Score, Child Age Group, Child Size at Birth, History of Diarrhoea and Dietary

Diversity Score were found to be significantly associated with Underweight among children.

Among the above listed variables, Child Age Group (36-59 months) and Child Size at Birth retained their significance of association in the final multivariable model.

The prevalence of underweight children was highest (69.8%) among mothers with low BMI (<18.5) in the study. The NDHS 2011 also reported the highest prevalence of underweight children (52.8%) among mothers with low BMI(8).

The relationship between food insecure households and underweight children was also seen in the NDHS 2011 which reported the highest prevalence of underweight children (50%) in severely food insecure households(8).

In the study the prevalence of underweight was highest among children belonging to the age group 12-35 months (60.3%) which is similar to the NDHS 2011 which reports highest levels of underweight among children of the age group 18-23 months (37%)(8).

In the study children perceived to be small or very small at birth had a higher prevalence (66.6% and 80% respectively) of being underweight. The odds of a child perceived to be small at birth to be underweight was 7.124 compared to a child perceived to be large at birth. This was similar to the NDHS 2011 findings which stated that babies perceived by mothers as very small and small at birth are much more likely to also be underweight later in life (43 percent and 45 percent, respectively) than those perceived as average or large at birth (25 percent)(8).

In the study children who had suffered from an episode of diarrhoea had a higher prevalence of underweight (67.7%) among them. The positive association between acute episode of diarrhoea and underweight among children was also seen in a study conducted among Malawian children aged 6-18 months which found greater duration of fever or diarrhea resulted in greater levels of underweight(24).

In the study a Dietary Diversity Score of 3-4 and 0-2 was associated with a higher prevalence of underweight children (48.5% and 66.6% respectively) which is similar to the Nepal Thematic Report on Food Security and Nutrition 2013 which showed children with a score of less than 4 had a higher prevalence of underweight (55.7%) and stated that there was a significant association between Dietary Diversity Score and underweight among children(27).

5.3 Benefits from the study

The participants in the study gained knowledge regarding correct infant and young child feeding practices, the importance of immunization and growth monitoring of children and good reproductive health practices like ANC visits during pregnancy and appropriate birth spacing as the interviewer counselled the participants about the topics mentioned above at the end of the session.

The results from the study further highlight the high prevalence of under-nutrition in Mugu district which should serve as an indicator to national policy makers to step up interventions to combat both acute and chronic under-nutrition.

The study offers some insights into factors which are associated with child under-nutrition and future interventions could be designed accordingly.

Findings from this study can be utilized to generate hypothesis for future research.

5.4 Conclusion

A cross-sectional study was conducted in July 2014 involving 246 children aged 0-59 months residing in selected 2 VDCs in Mugu district. Anthropometric measurements were conducted on the children participating in the study along with their mothers. A structured questionnaire was then administered to the mothers. Data collected was recorded on site. Data analysis was done using SPSS version 17.0; Chi Squared test or Fishers Exact test was used for bivariate analysis and a final multivariable model was created using Logistic Regression with statistical significance of each analysis accepted at a p value < 0.05.

The overall prevalence of wasting are the same in the study and NDHS 2011 report but the prevalence of severe wasting is higher among children in the study indicating a higher level of severe acute under-nutrition. The overall prevalence of stunting is higher in the study compared to the NDHS 2011 and the prevalence of severe stunting is much higher among children in the study reiterating the fact that Mugu district has the highest levels of chronic under-nutrition in the country. The overall prevalence of being underweight is higher in the study compared to the NDHS 2011 mainly because of the significantly higher share of severely underweight children highlighting the problem of both acute and chronic under-nutrition in the district.

Wasting was associated with Child Gender, Child Age Group, Child Size at Birth, Exclusively Breastfed Child, History of Fever and History of Diarrhoea. Small size at birth, not exclusively breastfed and history of diarrhoea had a positive association with wasting among children.

Stunting was associated with Maternal Age Group, Maternal BMI, Birth Interval, Number of ANC Visits During Pregnancy, Child Size at Birth, Food Security Score, Number of Growth Monitoring Visits, Dietary Diversity Score and Child Age Group. A birth interval less than 24 months, poor dietary diversity and child age group of 12-35 months had a positive association whereas more than 2 growth monitoring visits had a negative association with stunting among children.

Underweight was associated with Maternal BMI, Food Security Score, Child Age Group, Child Size at Birth, History of Diarrhoea and Dietary Diversity Score. Low maternal BMI (<18.5), child age group of 12-35 months, small size at birth and history of diarrhoea had a positive association with underweight among children.

In conclusion, prevalence of under-nutrition among children aged 0-59 months in Mugu district is high as reflected by the indices of wasting, stunting and underweight. The situation regarding factors such as dietary diversity and food security which were linked to more than 1 indicator of under-nutrition needs to be resolved through infrastructure development and intervention programs. Factors such as birth spacing, growth monitoring visits, high levels of fever and diarrhoea among children can be resolved through adequately staffed health facilities and outreach programs with a special focus on health education and promotion.

5.5 Recommendations

5.5.1 Recommendations for Policy Makers

1. A bi-annual Food security and Dietary diversity survey should be conducted every 5 years by the Government in the district reflecting seasonal variation and the impact of food crises; this will also help in creating a meaningful food security and nutrition profile of the district.

2. Anthropometric survey of children could be conducted alongside the above mentioned survey to track the trends in child nutritional status and it could also be a measure of the impact of interventions or programs to combat under-nutrition in the district.

3. Financial incentives could be offered to improve attendance of children to health care facilities for regular growth monitoring visits.

4. Financial incentives and opportunities of further study or promotion should be provided to Government health personnel serving in backward districts like Mugu in order to ensure adequately staffed health care facilities.

5. Implementation of a Health Insurance scheme could ensure increased utilization of the available health care services and reduce some of the economic burden of out of pocket expenditure on health care.

6. Financial incentives could be offered to improve attendance of children to health care facilities for growth monitoring visits.

7. Focus on health promotion and education through group counselling, pamphlets, print and electronic media could improve awareness among the population regarding

a broad range of issues like proper nutrition, recommended infant and young child feeding practices and reproductive health.

8. A nutritional rehabilitation center for chronic and severely undernourished children should be established in the district hospital.

9. Teachers in schools in the district should be trained regarding early childhood stimulation techniques that can be applied at school in order to improve cognitive thinking and IQ levels with a special focus on stunted children.

10. Focus group discussions should be conducted with parents of stunted children when they bring their child to a health care facility for growth monitoring regarding early childhood stimulation techniques that can be applied at home in order to improve cognitive thinking and IQ levels.

5.5.2 Recommendations for Future Research

1. Household anthropometric survey which takes into account additional factors like household wealth, access to clean drinking water and toilets, proper hygienic practices and intestinal parasitic infestations in Mugu District could be conducted and to minimize cluster effect not more than one child should be selected from a household.

2. Research on micronutrient intake deficiencies among children like Iron, Vitamin A and Iodine could be conducted in Mugu District.

3. Knowledge, attitude and practice study could be conducted among mothers regarding infant and young child feeding in Mugu district.

4. Knowledge, attitude and practice study could be conducted regarding hygiene and sanitation in Mugu District.

5. Studies on the effectiveness of the Community based Management of Acute Malnutrition (CMAM) program in Mugu district.

6. Research could be conducted on the IQ levels and educational achievements of stunted children as compared to healthy children.

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APPENDIX

Appendix a English Questionnaire

Questionnaire

IDENTIFICATION
SERIAL NUMBER.....
NAME OF VILLAGE DEVELOPMENT COMMITTEE.....
WARD NUMBER . . . . . .
. . . . . .
HOUSEHOLD NUMBER . . . . . .
. . . . . .
NAME OF HOUSEHOLD HEAD.....
NAME OF RESPONDENT.....
DATE OF INTERVIEW.....

INTRODUCTION AND CONSENT
Hello. My name is _____. I am a student at Chulalongkorn University in Thailand. I am conducting a survey along with my co-researcher about child undernutrition in Mugu District. Your household was selected for the survey. I would like to ask you some questions about your household. The questions usually take about 10-15 minutes. All of the answers you give will be confidential and will not be shared with anyone other than members of our survey team. No part of this interview is being recorded in tape or video. You don't have to be in the survey, but we hope you will agree to answer the questions since your views are important. If I ask you any question you don't want to answer, just let me know and I will go on to the next question or you can stop the interview at any time. Do you have any questions?
May I begin the interview now?

SIGNATURE OF INTERVIEWER:..... DATE:.....

CHILD
WEIGHT IN KILOGRAMS..... HEIGHT IN CENTIMETERS.....
MOTHER

WEIGHT IN KILOGRAMS..... HEIGHT IN CENTIMETERS.....

1. What is your religion? Hindu. . . Buddhist . . . Other. . .

2. What is your caste/ethnicity? .....

3. Have you ever attended school? No education..... Primary School.....(≤ Grade 5) Some Secondary School(≥ Grade 6)..... Graduated high school or more.....

4. How old were you at your last birthday? Age in completed years.....

5. What is the age of the target child in completed years and months?.....

6. What is the sex of the child? Male..... Female.....

7. When child was born, was he/she very large, larger than average, average, smaller than average, or very small? Very Large.... Larger than Average.... Average.... Smaller than Average.... Very Small.... Don't Know....

8. How much did child weigh at birth? Record weight in kilograms from health card, if available..... Don't Know.....

9. Mothers Gestational Age at childbirth? Term birth: gestational age ≥ 37 completed weeks (259 days) and < 42 completed weeks (294 days)**.....** Preterm < 37 weeks..... Post Term or Post Dated > 42 weeks.....Don't know.....

10. If the child has an elder sibling, the number of months differing between the birth of the child and elder sibling? 1st born..... < 24 months..... 24-47 months..... ≥ 48 months.....

11. Was the child exclusively breastfed upto 6 months of age? Yes.....No.....

12. Was the child fed colostrum, the orange to yellow, thick and sticky secretions from the breast produced during the first few days after birth?

13. Has the child suffered from diarrhea over the past 2 weeks? Yes.....No.....Don't know

14. Has the child suffered from fever with rapid or uncomfortable breathing and/or cough over the past 2 weeks? Yes.....No.....Don't know

15. How many times did you receive antenatal care during this pregnancy? 0..... 1.....2.....≥3.....

16. How many times have you taken you child for growth monitoring at the health facility over the past 2 months? 0.....≤2.....>2

17. Has child been immunized as per the schedule of the Expanded Program on Immunization? Do you have a card where the child's vaccinations are written down? If yes copy dates from the card.

BCG- Bacillus Calmette–Guérin Vaccine agains Tuberculosis.....

OPV- Oral Polio Vaccine 1.....2.....3.....

DPT- Vaccine against Diptheria, Pertusis and Tetanus 1.....2.....3.....

Hep B- Vaccine against Hepatitis B 1.....2.....3.....

JE- Vaccine against Japanese Encephalitis.....

Immunization Schedule		
Type of Vaccine	Number of Doses	Recommended Age
BCG	1	At birth or on first contact
OPV	3	6, 10, and 14 weeks of age
DPT - Hep B	3	6, 10, and 14 weeks of age
Measles	1	9 months of age
TT	2	Pregnant women
JE	1	12-23 months (proposed)

18. Now I would like to ask you about liquids or foods that your child had yesterday during the day or at night. I am interested in whether your child had the item I mention even if it was combined with other foods. You are to answer Yes, No or Don't know.

Did child (drink/eat): Yes

No Don't Know

18.1 Plain water?

18.2 Juice or juice drinks?

18.3 Soup?

18.4 Milk such as tinned, powdered, or fresh animal milk?

IF YES: How many times did child drink milk?.....

18.5 Infant formula like Lactogen?

IF YES: How many times did child drink infant formula?.....

18.6 Any other liquids?

18.7 Yogurt?

IF YES: How many times did child eat yogurt?.....

18.8 Any fortified baby food like Cerelac, Nestum, Champion etc?

18.9 Roti, rice, maize, millet, noodles, porridge, or other foods made from grains?

18.10 Pumpkin, carrots, squash or sweet potatoes that are yellow or orange inside?

18.11 White potatoes, white yams, colocasia, or any other foods made from roots?

18.12 Any dark green, leafy vegetables like spinach, amaranth leaves, mustard leaves?

18.13 Ripe mangoes, papayas or apricot?

18.14 Any other fruits or vegetables?

18.15 Liver, kidney, heart or other organ meats?

18.16 Any meat, such as pork, buff, lamb, goat, chicken, or duck?

18.17 Eggs?

18.18 Fresh or dried fish or shellfish?

18.19 Any foods made from beans, peas, lentils, or nuts?

18.20 Cheese or other food made from milk?

18.21 Any other solid, semi-solid, or soft food (jaulo, lito, sarbottam pitho etc.)?

How many times did child eat solid, semisolid, or soft foods yesterday during the day or at night?.....

Food groups in dietary diversity score- score included a point for each of the major nutritionally important types of food the child may have eaten, while providing some balance between plant foods and animal-source foods.

1. Starchy staples – two questionnaire items combined:

Foods made from grain

Foods made from roots or tubers

2. Food made from legumes

3. Dairy – two items combined:

Milk other than breastmilk

Cheese or yogurt

4. Meat, poultry, fish or eggs

5. Vitamin A-rich fruits and vegetables – three items combined:

Pumpkin, red or yellow yams or squash, carrots, or red sweet potatoes

Green leafy vegetables

Mango, papaya, or other local vitamin A rich fruits

6. Other fruits and vegetables, or fruit juice – two items combined

7. Foods made with oil, fat or butter

19. In the past 12 months, how often did you or any household member have to eat a limited variety of foods due to a lack of resources?

NEVER . . . . . 1 RARELY 2
SOMETIMES 3OFTEN 4

20. In the past 12 months, how often was there with no food to eat of any kind in your household because of lack of resources to get food?

NEVER . . . . . 1 RARELY 2
SOMETIMES 3OFTEN 4

Appendix b Nepali Questionnaire

प्रश्नावली

परिचयात्मक विवरण

धारावाहिक संख्या .....

गा.वि.स./नगरपालिकाको नाम र नम्बर .....

वडा नम्बर .....

घरपरिवार नम्बर .....

घरमुलीको नाम .....

प्रतिवादी को नाम .....

अन्तवार्ता मिति .....

सुचित मञ्जुरी

नमस्ते ! मेरो नाम..... हो । म पाल्पाण्डको चुलातंगकर्ने विश्वविद्यालयमा अध्ययनरत सार्वजनिक स्वास्थ्यमा मास्टर्स विद्यार्थी हुँ। म मुगु जिल्लामा बच्चा न्यूनपोषण बारेमा मेरो सह-शोधकर्ता साथ सर्वेक्षणमा छु। यस सर्वेक्षणको लागि तपाईको घर छनौटमा परेको छ । म तपाईलाई केही प्रश्न सोध्न चाहन्छु। सर्वेक्षणको लागि लगभग 10 देखि 15 मिनेट समय लाग्नेछ । तपाईले दिनु भएका सम्पूर्ण जानकारीहरु गोप्य राखिने छन् र सर्वेक्षण टोली बाहेक अन्य कसैलाई पनि देखाईने छैन । यस अन्तरवार्तालाई टेपमा रेकर्ड गर्ने वा फोटो खिच्ने कार्य गरिने छैन ।

यो सर्वेक्षणमा सहभागि हुने वा नहुने तपाईको स्वेच्छाको कुरा हो । तथापी, मलाई आशा छ, तपाई सर्वेक्षणमा सहभागि हुनुहुनेछ किनकी तपाईका विचारहरु महत्वपूर्ण छन् । यदि मैले तपाईलाई जवाफ दिन मन नलाग्ने कुनै प्रश्न सोधें भने त्यति नै बेला मलाई भन्नुहोला, म उक्त प्रश्न नसोधी अर्को प्रश्न सोध्नेछु, वा तपाईले चाहनु भयो भने त्यति नै बेला अन्तरवार्ता टुंग्याउन सक्नु हुनेछ ।

के तपाई सर्वेक्षण सम्बन्धी कुनै कुरा सोध्न चाहनु हुन्छ ?

के म अब अन्तरवार्ता लिन शुरु गरौं ?

प्रश्नकर्ताको सही : _____ मिति: _____

बच्चा

वजन किलोग्राम मा ..... सेन्टिमिटर उँचाई .....

आमा

वजन किलोग्राम मा ..... सेन्टिमिटर उँचाई .....

१ तपाई कुनधर्म मान्नु हुन्छ ?
हिन्दु बौद्ध मुस्लिम किरांत क्रिश्चयन अन्य

२ तपाईको जात/जातियता के हो ?
.....

३ के तपाईले कहिल्यै स्कूलमा पढनु भएको थियो/छ ?
छैन/छैन ≤ कक्षा ५ ≥ कक्षा ६ माध्यमिक विद्यालय स्नातक

४ तपाईको शुद्ध घरेलू आय रुपैयामा कति छ ?.....

५ तपाई कति वर्ष पुरा हुनुभयो ?.....

६ बच्चा कुन महिना र सालमा जन्मेको हो ? पुरा भएको वर्ष र महिना लेख्ने ।.....

७ छोरा हुन् कि छोरी ?.....

८ बच्चा जन्मँदा कती थियो वा कती थिइन: धेरै तूलो, औसत भन्दा ठूलो, ठिक्कको, औसत भन्दा सानो वा धेरै सानो?
.....

९ बच्चा को जन्मेका बेलामा तौल कति थियो ? (हेल्थ कार्ड उपलब्ध भए त्यसबाट तौल किलोग्राममा लेख्ने ।)
.....

१० बच्चा जन्मेका बेलाको गर्भावधि ?. <३७ पुरा हप्ता र >४२ पुरा हप्ता..... <३७ पुरा हप्ता..... >४२ पुरा हप्ता.....

११ बच्चाको दाइ वा दीदी छ भने, बच्चा र दाइ वा दीदी को जन्म बीच कतक महिना को संख्या? पहिलो जन्म ..... <२४ महिना ..... २४-४७ महिना ..... ≥ ४८ महिना .....

१२ बच्चा जन्मे पछि ६ महिना सम्म आफ्नो स्तन देखि दुध मात्र खुवाउनु भयो ? खुवाएं खुवाइन

१३ बच्चालाई जन्म पछिको केहि दिन को समयमा स्तन देखि उत्पादन भएको , पहेलो बाक्लो र च्यापच्याप खाव खुवाउनु भयो ?
खुवाएं खुवाइन

१४ गत २ हप्ता भित्रमा के बच्चालाई झाडापखाला लागेको थियो ? थियो थिएन थाहा छैन

१५ विगत २ हप्ता भित्रमा के बच्चालाई खाई कुनै बेला ज्वरो आएको थियो र खोकी लागेको थियो वा के उनले साधारण अवस्था भन्दा छोटो छोटो र छिटो छिटो सास फेर्ने वा सास फेर्न कठिनाई हुने भएको थियो ? थियो थिएन थाहा छैन

१६ तपाईले यो गर्भावस्थामा कति पटक गर्भवती सेवा लिनुभयो ? ०..... १..... २.....≥३.....

१७ गत २ महिनामा तपाई आफ्नो बच्चाको **उचाइ र तौल** नापतौलको लागि स्वास्थ्य संस्थामा कति पटक जानु भएको थियो ?

०.....≤ १.....>२.....

१८ बच्चाको **खोप मा विस्तारित कार्यक्रम को अनुसूची अनुसार खोप गरिएको छ** ? तपाईसंग बच्चाको को खोपको कार्ड छ ? प्रत्येक खोपको खोप लगाएको मिति कार्डबाट सार्ने ।

	सबैभन्दा पछि जन्मेको							
	गते		महिना		साल			
बिसिजी								
पोलियो 1								
पोलियो 2								
पोलियो 3								
डिपीटी 1/हिप् B1								
डिपीटी 2/हिप् B2								
डिपीटी 3/हिप् B3								
दादुरा								
जापानीज इन्सेफलाइटिस								

१९ अब म तपाईसंग बच्चाले हिजो दिनभरी र राती खाएका अन्य झोल तथा ठोस खानेकुराहरूका बारेमा सोध्न चाहन्छु । म तपाईको बच्चाले यी खानेकुराहरु अन्य खानेकुरा संग मिसाएर खाएको भए पनि जान्न इच्छुक छु ।

के बच्चाले यी खानेकुराहरु पिउनु/खानु भएको थियो ?

			थियो	थिएन	थाहा छैन
a) सादा पानी ?		a)	1	2	8
b) दुध ?		b)	1	2	8
c) सुप ?		c)	1	2	8
d) दुध जस्तै: टिनको दुध, पाउडर दुध वा गाई वस्तुको दुध ? यदि थियो भने: (नाम) ले कति पटक दुध पिए ?		d)	1	2	8
		दुध खाएको पटक..... ☐			

(सात भन्दा बढी पटक भए '7' लेख्ने ।)					
e) *शिशु आहार जस्तै: ल्याक्टोजिन ?*		e)	1	2	8
यदि छियो भने: (नाम) ले कति पटक शिशु आहार खाए ? (सात भन्दा बढी पटक खाए '7' लेख्ने ।)		खाएको पटक..... ☐			
f) *अन्य भकोल खानेकुरा ?*		f)	1	2	8
g) *दही ?*		g)	1	2	8
यदि छियो भने: (नाम) ले कति पटक दही खाए ? (सात भन्दा बढी पटक भए '7' लेख्ने ।)		दही खाएको पटक..... ☐			
h) *कुनै पोषिलो शिशु आहार जस्तै: सेरेल्याक, नेस्टम, क्याम्पिडन, आदी ?*		h)	1	2	8
i) *चामल, कोदो, गहुं, मकै, जौ आदी बाट निर्मित भात, चाउचाउ वा रोटी ?*		I)	1	2	8
j) *फर्सी, गाजर, सक्कर खण्ड आदि जस्को भित्री भागमा पहेंलो वा सुनाले रंग हुन्छ ?*		j)	1	2	8
k) *आलु, तरुल, पिंडालु वा अन्य जरामा फल्ने कन्दमुल वा सो बाट बनेका खानेकुरा ?*		k)	1	2	8
l) *अन्य गाढा हरियो सागसब्जी जस्तै: सिंहानुको पात, पालुंगो, केरे, तोरीको साग, सिस्नु साग ?*		I)	1	2	8
m) *आँप, मेवा, सुर्पाली, हलुवाबेर ?*		m)	1	2	8
n) *अन्य फलफुल वा तरकारी जस्तै: केरा, स्याउ, अम्बा, अमला, सुन्तला, टमाटर ?*		n)	1	2	8
o) *कलेजो, मुटुलिर, मुटु, फोक्सो आदि ?*		o)	1	2	8
p) *कुखुरा, खसी, बोका, राँगा, सुगुर/बंगुर, हाँस वा अन्य मासु ?*		p)	1	2	8
q) *अण्डा ?*		q)	1	2	8
r) *ताजा (आलो) वा सुकाएको माछा वा सिपी ?*		r)	1	2	8
s) *सिमी, बोडी, दाल, बदाम जस्ता गेडागुडीबाट बनाइएका खानेकुरा ?*		s)	1	2	8
t) *पीज वा दुधबाट बनेका अन्य खानेकुरा ?*		t)	1	2	8
u) *माथि उल्लेख नगरिएका बाहेक अन्य कुनै ठोस वा पिलो खानेकुरा (सिटो) ?*		u)	1	2	8

२१ बच्चाले हिजो दिनभरी र/वा राती कुनै ठोस, गिलो वा झोल खानेकुरा कति पटक खाएका थिए/खाएकि थिइन् ?

पटक थाहा छैन

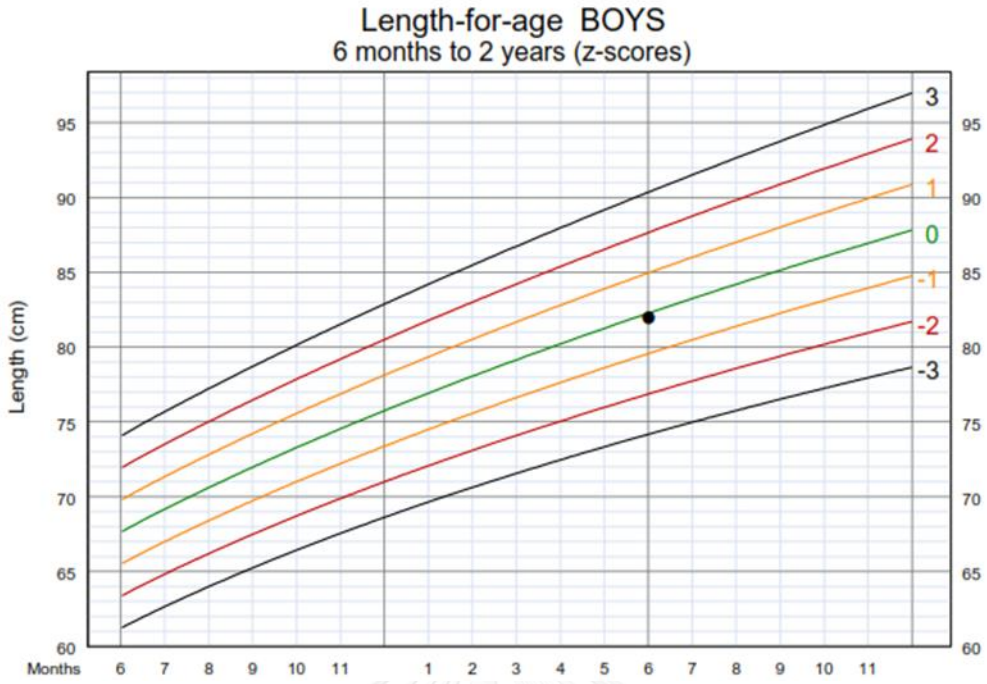
२२ विगत १२ महिनामा तपाई वा तपाईको घरपरिवारका कुनै सदस्यले आर्थिक अभावका कारणले गर्दा कति पटक खानेको जस्तो खानेकुरा सान नपाएको थियो ?

कहिल्यै परेन १ एकदमै कम २
कहिले काही ३ प्राय जसो ४

२३ विगत १२ महिनामा तपाईको घरपरिवारमा आर्थिक अभावका कारणले गर्दा कति पटक कुनै पनि किसिमका खाने कुरा नभएको अवस्था भोल्नु परेको थियो ?

कहिल्यै परेन १ एकदमै कम २
कहिले काही ३ प्राय जसो ४

Appendix c Growth Charts



Appendix d Ethical Approval

Nepal Health Research Council

Estd. 1991

Ref. No.: 1552

01 July 2014

Dr. Salil Rana
Principal Investigator
College of Public Health Sciences
Chulalongkon University,
Thailand

Ref: **Approval of Research Proposal** entitled **Prevalence & factors associated with under nutrition among children aged 0-59 months in Mugu district, Nepal**

Dear Dr. Rana ,

It is my pleasure to inform you that the above-mentioned proposal submitted on 2 June 2014 (**Reg. no.107/2014**please use this Reg. No. during further correspondence) has been approved by NHRC Ethical Review Board on 30 June 2014 (2071-3-16).

As per NHRC rules and regulations, the investigator has to strictly follow the protocol stipulated in the proposal. Any change in objective(s), problem statement, research question or hypothesis, methodology, implementation procedure, data management and budget that may be necessary in course of the implementation of the research proposal can only be made so and implemented after prior approval from this council. Thus, it is compulsory to submit the detail of such changes intended or desired with justification prior to actual change in the protocol.

If the researcher requires transfer of the bio samples to other countries, the investigator should apply to the NHRC for the permission.

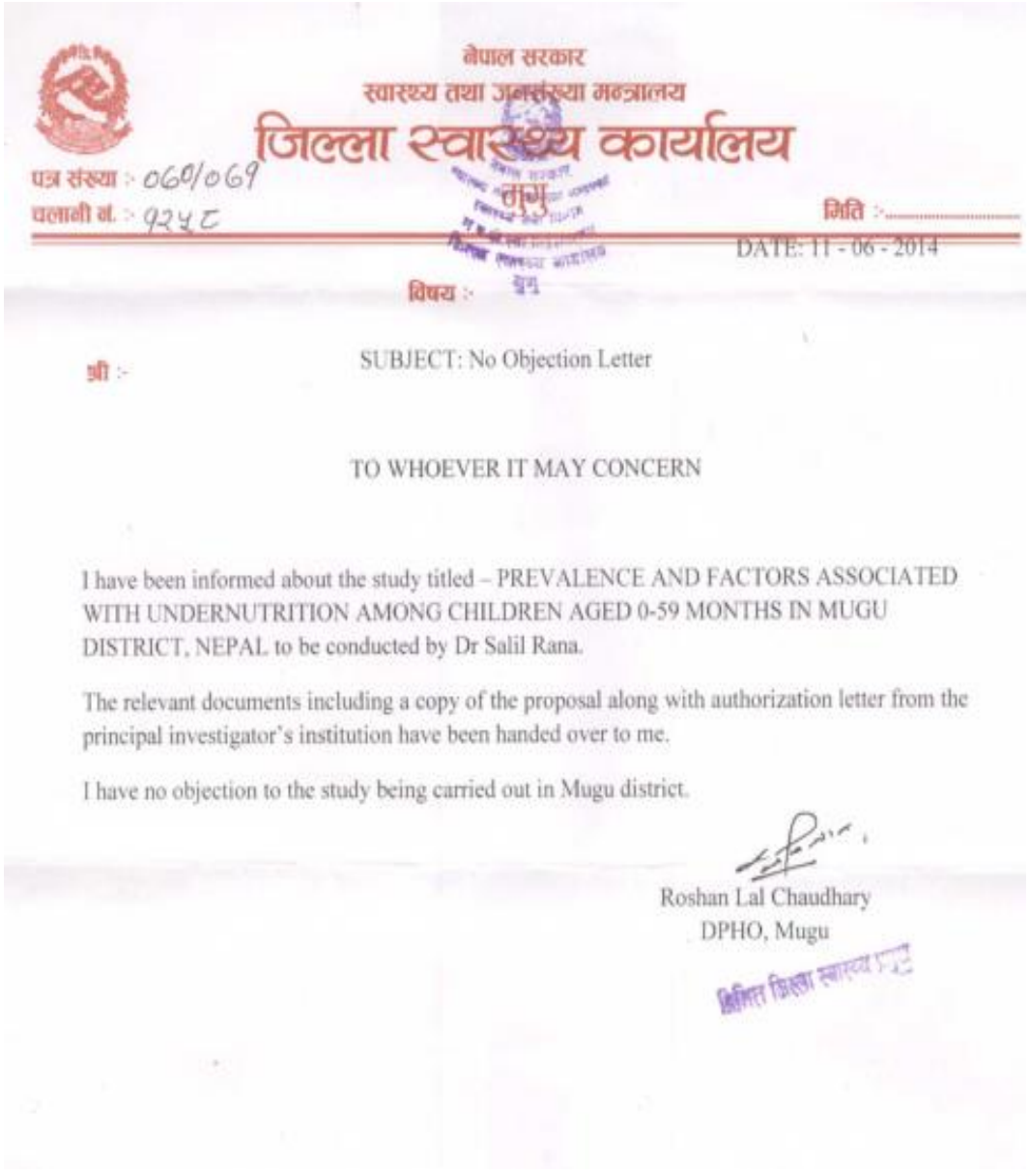
Further, the researchers are directed to strictly abide by the National Ethical Guidelines published by NHRC during the implementation of their research proposal and submit progress report and full or summary report upon completion.

As per your research proposal, the total research amount is **Self-funded** and accordingly the processing fee amounts to **NRs- 9,490.00**. It is acknowledged that the above-mentioned processing fee has been received at NHRC.

If you have any questions, please contact the research section of NHRC.

Thanking you.

Appendix e DPHO Permission



नेपाल सरकार
स्वास्थ्य तथा जनसंख्या मन्त्रालय
जिल्ला स्वास्थ्य कार्यालय
मुगु

पत्र संख्या :- 060/069
चलानी नं. :- 925

मिति :-
DATE: 11 - 06 - 2014

विषय :-

श्री :-

SUBJECT: No Objection Letter

TO WHOEVER IT MAY CONCERN

I have been informed about the study titled – PREVALENCE AND FACTORS ASSOCIATED WITH UNDERNUTRITION AMONG CHILDREN AGED 0-59 MONTHS IN MUGU DISTRICT, NEPAL to be conducted by Dr Salil Rana.

The relevant documents including a copy of the proposal along with authorization letter from the principal investigator's institution have been handed over to me.

I have no objection to the study being carried out in Mugu district.

Roshan Lal Chaudhary
DPHO, Mugu

जिल्ला स्वास्थ्य

VITA

Full Name Dr Salil Rana

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PO BOX 3034,

Kathmandu, Nepal

Phone 0967548058

Email drsalilrana@gmail.com

Nationality Nepali

Sex Male

Education

School Leaving Certificate from Budhanilkantha School, Kathmandu - January 1989 to January 1996

All India Senior School Certificate from Kendriya Vidyalaya, Kathmandu - June 1997 to June 1999

MBBS Degree from B. P. Koirala Institute of Health Sciences, Dharan - August 1999 to August 2005

Employment

Medical Officer at Q&Q Hospital, Damak – January 2008 to July 2009

Camp Medical Officer at AMDA Primary Health Care Program for Bhutanese Refugees – February 2011 to February 2013