NUTRITIONAL STATUS AND PREVALENCE OF ANEMIA AMONG 6 - 59 MONTHS CHILDREN IN *THARU* COMMUNITY OF DURUWA VDC, DANG

by

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A dissertation submitted to the Department of Nutrition and Dietetics Central Campus of Technology, Tribhuvan University, in the partial fulfillment of the requirements for the degree of B.Sc. Nutrition & Dietetics.

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Approval Letter

This *dissertation* entitled *Nutritional status and prevalence of anemia among 6 -59 months children in Tharu community of Duruwa VDC, Dang* presented by Basudev Bhattarai has been accepted as the partial fulfillment of the requirements for the Bachelor of Science in Nutrition and Dietetics.

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(Basudev Bhattarai)

Abstract

A cross-sectional study was conducted to assess the factors associated with nutritional status of 6 – 59 months *Tharu* children in Duruwa VDC of Dang District with sample of 189 children were selected by using random sampling technique; anthropometric measurements (weight, height, MUAC) were performed to find the nutritional status of children and Hemocue was used to determine anemia. A pre-coded questionnaire was used to collect information and was administered to caretaker. WHO Anthro version 3.2.2 and SPSS version 20 were used to analyze data. Chi- square test was used to analyze the factors associated with nutritional status of child.

Prevalence of wasting, stunting and underweight are 13.2%, 27%, and 21.2% respectively while 60.4% of the children were anemic (N=48). Male population who were anemic was 45.5% whereas 73.1% of females were anemic. Chi- square test revealed that IDDS ($P<0.05$) was significantly associated with stunting, wasting and underweight. Food frequency ($P<0.05$) was significantly associated with stunting and underweight. Child age ($P<0.05$), Annual income ($P<0.05$), Birth order ($P<0.05$) was significantly associated with wasting, stunting and underweight respectively. Hence the nutrition intervention programs focusing these risk factors should be launched immediately to overcome the problems.

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Abbreviations

Abbreviations	Full form
FAO	Food and Agriculture Organization
FANTA	Food and Nutrition Technical Assistance
FCHV	Female Community Health Volunteer
HAZ	Height for Age Z Score
HFA	Height for Age
IDA	Iron Deficiency Anemia
IDD	Iodine Deficiency Disorder
IDDS	Individual Dietary Diversity Score
I/NGO	International /Non – Governmental Organization
LBW	Low Birth Weight
MDG	Millennium Development Goal
MoHP	Ministry of Health and Population
MUAC	Mid – Upper Arm Circumference
NDHS	Nepal Demographic Health Survey
PEM	Protein Energy Malnutrition
RDA	Recommended Daily Allowance
SAM	Severe Acute Malnutrition
UN	United Nations
UNICEF	United Nations International Child Emergency Fund
UNSCN	United Nation Standing Committee of Nutrition
VDC	Village Development Committee
WAZ	Weight for Age Z Score
WFA	Weight for Age
WFH	Weight For Height
WFP	World Food Program
WHO	World Health Organization
WHZ	Weight for Height Z Score

Part I

Introduction

1.1 Background

Adequate nutrition is essential in early childhood for the ensure of healthy growth, proper organ formation and function, a strong immune system, and neurological and cognitive development (UNICEF *et al.*, 2012). The burden of malnutrition in Nepal is very high. Malnutrition is not just a stark manifestation of poverty, it is also the non-income face of poverty and it helps perpetuate poverty (WorldBank., 2012). Ignoring this disease malnutrition will lead to heavy loss for the nation. Malnutrition is poor nutrition due to an insufficient, poorly balanced diet, faulty digestion or poor utilization of foods. Malnutrition is not only insufficient intake of nutrients. It can occur when an individual is getting excessive nutrients as well. Nutritional status is defined as the condition of the body resulting from the intake, absorption and utilization of food. It is determined by a complex interaction between internal/constitutional factors and external environmental factors: Internal or constitutional factors like: age, sex, nutrition, behavior, physical activity and diseases. External environmental factors like: food safety, cultural, social and economic circumstances (Ensminger and Ensminger, 1993).

Around half of under-five mortality (54 per 1000 live births) in Nepal is associated with malnutrition (UNICEF *et al.*, 2012). Ignoring their eating habits and eating to fulfill their hunger only leads to deficient of nutrients which means malnutrition. Protein energy malnutrition, marasmus, kwashiorkor is that important cause that should be noted for the cause of childhood mortality. Many of them are also suffering from Anemia. Malnutrition can also lead to permanent impairment of physical and mental growth in those children who were able to survive if proper food was supplied to them. It occurs when requirement of nutrient are not met by diet because of increased demand or decreased intake. The nutritional status of children is directly related to their health condition and both in turn are key determinants of the human and social development of communities around the world. Improvement of nutrition and health increase the chances of child survival and is a precondition for economic development. Malnutrition in early age causes irreparable damage to the cognitive function of a person (Liang *et al.*, 1967).

41 % of children under five in Nepal are stunted, 11 % are wasted and 29% are underweight (MoHP, 2012). It also shows that rural population is most affected by stunting, wasting, and underweight whereas stunting is major problem in mountain area. 46% of children under five in Nepal are anemic (MoHP, 2012). In the study of children 6-59 months, the prevalence of anemia is highest in the terai (50%), followed by the mountains (48%) and the hills (41%). Children in rural areas are more affected (47%) compared to their counterparts from the urban areas (41%) (MoHP, 2012).

1.2 Statement of the problem and justification

Malnutrition remains a serious obstacle to child survival, growth and development in Nepal. Malnutrition remains a serious obstacle to child survival, growth and development in Nepal. Prevalence of malnutrition among under five children is high with 48.6% in the country. Protein-energy malnutrition (PEM) and micronutrient deficiency are most common types of malnutrition (Acharya and Khanal, 2015). In Nepal, 11% of children are wasted and 3% are severely wasted. Children whose weight-for-age is below minus two standard deviations from the median of the reference population are considered underweight. The measure reflects the effects of both acute and chronic under nutrition. Nearly three in ten children (29%) are underweight and 8% are severely underweight (MoHP, 2012). Anemia is a serious public health problem, which affects the mental and physical development, as well as health maintenance and work performance. About 2 billion people suffer from varying degrees of anemia in developing countries (Kotecha, 2011).

Children under five years of age are very vulnerable to the malnutrition. The children from the low income family are not breastfed properly and complementary foods are also not provided sufficiently so there is high chance of malnutrition (De Onis and Blössner, 2003).

Dang district is located in the Mid-Western Region of Nepal, which occupies the area of 2,955 km2. Headquarter of Dang district is Ghorahi. The major cities of Dang district are Ghorahi, Thulsipur, and lamahi. It has the population of 552,583 (CBoS, 2012). It is the second largest inner Terai valley in south East Asia.

The climate of Dang district is tropical. *Tharu*s are one of the indigenous people of Nepal. Before 1983, most of the *Tharu* boys and girls were working for landlords instead

of schooling; for repaying back their parents' loan. *Tharu*s were discriminated by so called high caste, to the attempts of social, economic, and political exploitation. *Tharu* is the under prevalent ethnic group, who are living in the Western Terai districts of Nepal from the ancient period. Over the last fifty-five years, *Tharu*s have an experience and encroachment of land they traditionally inhabited. After The eradication of malaria and some development initiatives, there was an influx of hill people in these areas. In the process of hill to terai migration many *Tharu*s lost their land. Due to which they had to pay the loan, which they hadn't borrowed before, they were force to work for their whole life period in the house of so called high-class people without wage or in a very minimum wage to return back the loan and to make their daily expenses to run their miserable life. This brought about socio-economic consequences to unequal inter caste and inter class relations that affected *Tharu*s more negatively. Exploitation, poor health, unclaimed right to natural resources, weak voice in government decision, poor access to market, lack of credit for their work and many other associated factors increases poverty among *Tharu*s and other deprived community people of western Nepal as well. So-called high-class people blamed and not accepted to uplift the economic growth of Thaurs and addressed their views on the reason on *Tharu*s for being backwardness. They blamed that Social and culture factors are the main reason, which made *Tharu*s less cleaver and incapable of managing their lives in standard way (BASE, 2016).

The study place, Duruwa VDC lies in mid-western development region of Nepal. The prevalence of undernutrition is still high in Mid-western terai i.e. 43.5% stunting, 13.9% wasting and 32.1% underweight. Duruwa V.D.C is still underdeveloped and no any study was conducted before to assess the nutritional status. Thus, there was need for determining the current nutritional status of Duruwa VDC. Therefore, this study is designed to assess the prevalence of malnutrition and associated factors among children aged 6-59 months which can be used as a reference in priority setting and designing effective nutritional programs at *Tharu* community of Duruwa VDC, Dang.

1.3 Significance of the study

Good nutrition is of prime importance in the attainment of normal growth and development and maintenance of health throughout the life. The will find the actual nutritional status of *Tharu* children and their real condition which is affecting their livelihood. This study will assess the prevalence of malnutrition and associated factors among children aged 6-59

months which can be used as a reference in priority setting and designing effective nutritional programs at *Tharu* community of Duruwa VDC, Dang. The result of the survey will have following implications.

a) The study will serve as a guide for conducting nutrition intervention program in the studied VDC.
b) Provide information to the government as well as volunteer organizations to initiate action solve the problem of malnutrition.
c) Make people aware about the current real situation of nutritional status in their surroundings.
d) Encourage people for the improvement of their present status by uplifting their feeding behavior of their children and by maintaining hygienic condition.

1.4 Objectives

1.4.1 General objective

To find Nutritional status and prevalence of anemia among 6 months to 59 months children in *Tharu* community of Duruwa VDC Dang

1.4.2 Specific objectives

i. To conduct anthropometric measurement for assessing the nutritional situation of *Tharu* children residing in Duruwa VDC
ii. To identify associated factors of malnutrition among *Tharu* children aged 6-59 months in Duruwa VDC of Dang district.
iii. To conduct biochemical test for assessing the prevelance of anemia in *Tharu* children aged 6 – 59 months of Duruwa VDC by using hemocue kit.

1.5 Research questions

a) Is the problem of malnutrition is existing in 6 - 59 months *Tharu* children in Duruwa VDC?
b) Is there association of factors with the nutritional status of 6 – 59 month children of *Tharu* community of Duruwa VDC?

1.6 Limitation of the study

i. The type of anemia could not be studied due to unavailability of the specific equipment.

ii. The responses regarding age, hygiene and sanitation, dietary practice given by respondents may not be precise due to memory bias and shy nature.

iii. Quantity of food consumed was not taken in account while measuring IDDS and food frequency.

Part II

Literature Review

2.1 Malnutrition

Malnutrition has been defined as a pathological state resulting from relative or absolute deficiency of one or more nutrients. This state is clinically manifested or detected only by biochemical, anthropometric or physiological tests (Jelliffe, 1997). Malnutrition is a broad term commonly used as an alternative to undernutrition but technically it also refers to overnutrition. People are malnourished if their diet does not provide adequate calories and protein for growth and maintenance or they are unable to fully utilize the food they eat due to illness (undernutrition). They are also malnourished if they consume too many calories (overnutrition) (UNICEF, 2008).

Many factors can cause malnutrition, most of which relate to poor diet or severe and repeated infections, particularly in underprivileged populations. Inadequate diet and disease, in turn, are closely linked to the general standard of living, the environmental conditions, and whether a population is able to meet its basic needs such as food, housing and health care. Malnutrition is thus a health outcome as well as a risk factor for disease and exacerbated malnutrition and it can increase the risk both of morbidity and mortality. Although it is rarely the direct cause of death (except in extreme situations, such as famine), child malnutrition was associated with 54% of child deaths (10.8 million children) in developing countries in 2001 (Blössner M. and Onis D.M., 2005).

2.2 Causes of malnutrition

The UNICEF conceptual framework, developed in the 1990s and shown below in Fig 2.1 summarizes the causes of malnutrition.

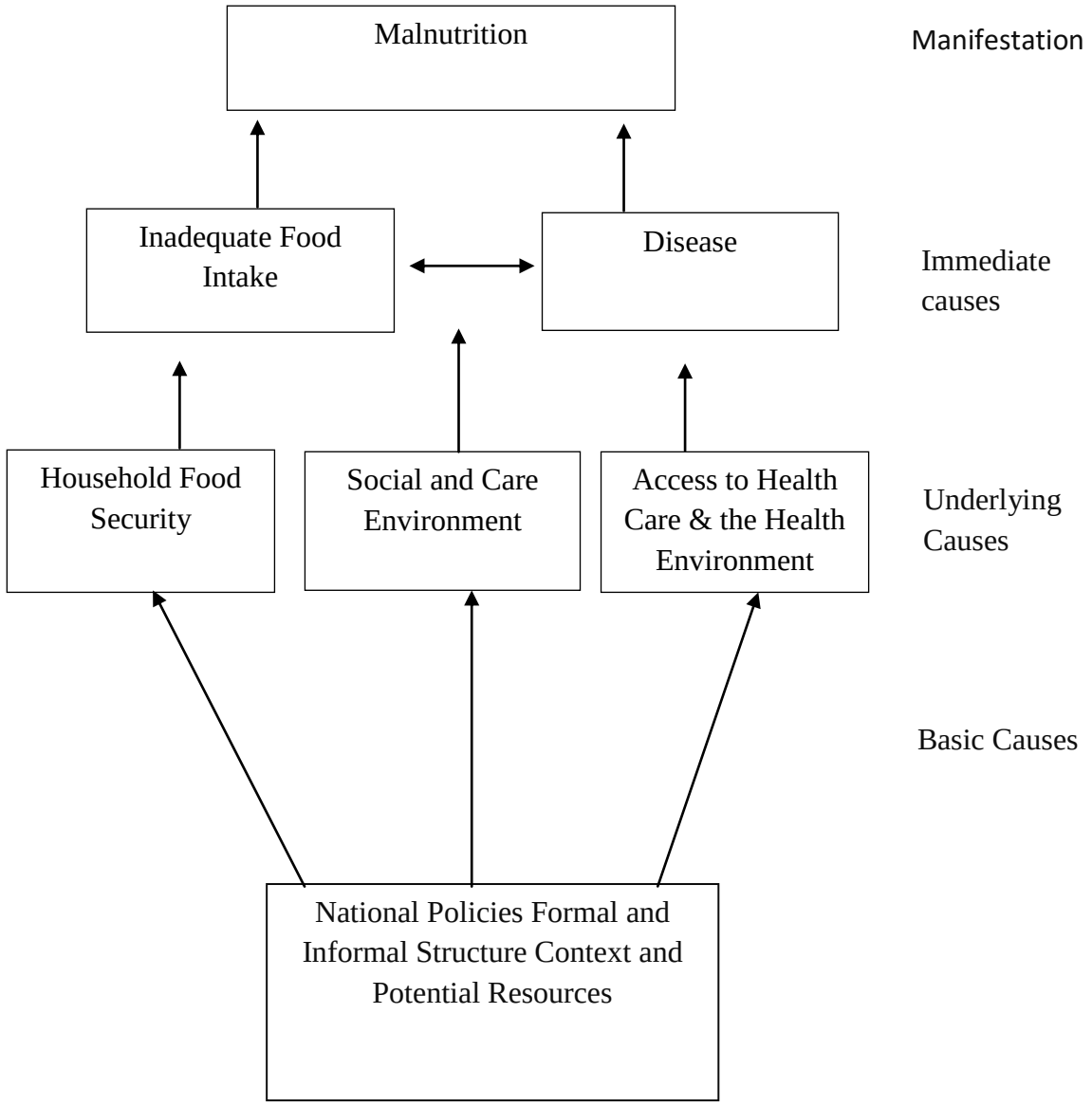

Fig 2.1 UNICEF conceptual framework (UNICEF, 2015)

2.2.1 Immediate causes of malnutrition

Lack of food intake and disease are immediate cause of malnutrition and create a vicious cycle in which disease and malnutrition exacerbate each other. It is known as the Malnutrition Infection Complex. Thus, lack of food intake and disease must both be addressed to support recovery from malnutrition (Reinhardt K. and Franzo J., 2014).

2.2.2 Underlying causes of malnutrition

Three major underlying causes of malnutrition include (Veghari, 2013):

- Food: Inadequate household food security (limited access or availability of food).
- Health: Limited access to adequate health services and/or inadequate environmental health conditions.
- Care: Inadequate social and care environment in the household and local community, especially with regard to women and children.

2.2.3 Basic causes of malnutrition

The basic causes of malnutrition in a community originate at the regional and national level, where strategies and policies that affect the allocation of resources (human, economic, political and cultural) influence what happens at community level. Geographical isolation and lack of access to markets due to poor infrastructure can have a huge negative impact on food security. When conducting an assessment to determine the causes of malnutrition in a community, it is important to research the actions at each level and how these actions, or inactions, influence malnutrition rates (Gillespie and Haddad, 2003).

2.3 Forms of malnutrition

There are different forms of malnutrition. As defined by World health organization (WHO, 1996) there are four forms of malnutrition which are described as follows.

2.3.1 Under nutrition

Under nutrition is defined as the condition which results when insufficient food is eaten over an extended period of time. In extreme cases, it is called starvation (Jelliffe D., 1996).

2.3.2 Over nutrition

This is the pathological state resulting from the consumption of excessive quantity of food over an extended period of time. Over nutrition is often related to obese and overweight (Jelliffe D., 1996).

2.3.3 Specific deficiency

It is defined as the pathological state resulting from a relative or absolute lack of an individual nutrient (Jelliffe D., 1996).

2.3.4 Imbalance

It is the pathological state resulting from a disproportion among essential nutrient with or without the absolute deficiency of any nutrient (Jelliffe D., 1996)**.**

2.4 Categories of malnutrition

There are two categories of malnutrition: Acute Malnutrition and Chronic Malnutrition.

2.4.1 Acute malnutrition

Children can have a combination of both acute and chronic. Acute malnutrition is categorized into Moderate Acute Malnutrition (MAM) and Severe Acute Malnutrition (SAM), determined by the patient's degree of wasting. All cases of bi-lateral edema are categorized as SAM. These guidelines address management and treatment of acute malnutrition (Collins *et al.*, 2006).

2.4.2 Chronic malnutrition

Chronic malnutrition is determined by a patient's degree of stunting, i.e. when a child has not reached his or her expected height for a given age. To treat a patient with chronic malnutrition requires a long-term focus that considers household food insecurity in the long run; home care practices (feeding and hygiene practices); and issues related to public health. SAM is further classified into two categories: Marasmus and Kwashiorkor. Patients may present with a combination, known as Marasmic Kwashiorkor. Patients diagnosed with Kwashiorkor are extremely malnourished and at great risk of death (Brock, 1954).

2.5 The most common prevalent forms of malnutrition

2.5.1 Protein-energy malnutrition

PEM results when the body's needs for energy and protein or both cannot be satisfied by the diet. It has a wide spectrum of manifestations, and its severity ranges from weight loss to growth retardation to distinct clinical syndromes, frequently associated with deficiencies of vitamins and minerals (e.g. vitamin A, iron and zinc). The most severe clinical manifestations of PEM are kwashiorkor and marasmus (FAO, 1997).

Symptoms of marasmus include (FAO, 1997):

i. Apathy, growth failure.
ii. With weight below 60 percent of expected weight for age.
iii. Wasted muscles (muscles that are visibly thinner and less developed than normal) and very little fat under the skin.
iv. Diarrhea

Marasmus is commonly seen in babies whose mothers had inadequate breast milk and occurs most clearly during the child's first year. It may also occur when there is too long a reliance on breast milk without complementary solid foods. Improper use of bottle-feeding is closely associated with marasmus, especially in urban areas (FAO, 1997).

Characteristics of symptoms of Kwashiorkor are growth failure, edema, muscle wasting, moon face, apathy and peevishness, crazy pavement dermatitis and fatty liver (Swaminathan M., 1991).Symptoms of kwashiorkor include:

i. Fine, reddish-brown, lusterless hair with loose curls,
ii. Apathy; growth failure,
iii. With weight usually below 60 percent of expected weight for age, but this depends on the degree of edema
iv. Edema (excess fluid under the skin, causing puffiness)
v. Blotchy skin
vi. Prominent stomach
vii. Diarrhea
viii. Wasted muscles.

Kwashiorkor usually occurs later than marasmus and is uncommon under one year of age.

It occurs most frequently when children are taken off a diet of breast milk and have to rely only on the starchy staple. On the same kind of diet and in the same household, one child may develop marasmus and kwashiorkor. The causes of kwashiorkor are still not fully known; however, it has often been found to occur in association with diarrhoeal infections, which indicates that the causes go beyond nutritional factors (FAO, 1997).

Marasmic-kwashiorkor is said when the incidence of PEM is high. A large number of cases show same symptoms of marasmus and Kwashiorkor (Swaminathan M., 1991).

Infants and young children are the most severely affected by PEM because of their high energy and protein needs relative to body weight and their particular vulnerability to infection. Children's health is most in danger from about three months of age until they can feed themselves, perhaps at about three years of age. During this period several weaning practices can have an adverse effect on child nutrition. One factor is the age at which food supplements are introduced into the child's diet; others include the method of food preparation, the frequency of feeding and the energy density of weaning foods. In all circumstances, but especially during illness, young children need to be fed frequently during the day. Mothers may have difficulty in feeding children often enough if they are working in the fields; thus the limited time available to mothers may be an important constraint on children's food intake (FAO, 1997).

2.5.2 Micronutrient deficiencies

Several micronutrients are required for adequate growth of children. However, it has been unclear as to which nutrient deficiencies contribute most often to growth faltering in populations at risk for poor nutrition and poor growth (Rivera *et al.*, 2003).

2.5.2.1 Iron deficiency

It is the most prevalent form of malnutrition worldwide, affecting millions of people. Iron forms the molecules that carry oxygen in the blood, so symptoms of a deficiency include tiredness and lethargy. Lack of iron in large segments of the population severely damages a country's productivity (WFP, 2016). Iron deficiency also impedes cognitive development, affecting 40-60 percent of children aged 6-24 months in developing countries (UNICEF, 2010).

2.5.2.2 Vitamin A deficiency

The deficiency of Vitamin A weakens the immune systems of a large proportion of under-fives in poor countries, increasing their vulnerability to disease. A deficiency in vitamin A, for example, increases the risk of dying from diarrhea, measles and malaria by 20-24 percent (UNICEF, 2010). Affecting 140 million preschool children in 118 countries and more than seven million pregnant women, it is also a leading cause of child blindness across developing countries (WFP, 2016).

2.5.2.3 Iodine deficiency

Globally iodine deficiency affects 780 million people. The most common symptom is a swelling of the thyroid gland called a goiter. But the most serious impact is on the brain, which cannot develop properly without iodine. According to UN research, some 20 million children are born mentally impaired because their mothers did not consume enough iodine (UNICEF, 2010). Iodine deficiency is estimated to have lowered the intellectual capacity of almost all of the nations reviewed by as much as 10 to 15 percentage points (UNICEF, 2010). The worst-hit suffer cretinism, associated with severe mental retardation and physical stunting (WFP, 2016).

2.5.2.4 Zinc deficiency

The deficiency of zinc leads to growth failure and weakened immunity in young children. It is linked to a higher risk of diarrhea and pneumonia, resulting in nearly 800,000 deaths per year (WFP, 2016).

2.6 Nutritional status of children below 5 years in Nepal

Children's nutritional status is a reflection of their overall health. When children have access to an adequate and nutritious food supply, are not exposed to repeated illness, and are well cared for, they reach their growth potential and are considered well nourished. Undernutrition is associated with more than half of all child deaths worldwide. Under-nourished children are more likely to die from common childhood disorders, and for those who survive, have recurring sicknesses and faltering growth. Three-quarters of children who die from causes related to malnutrition were only mildly or moderately malnourished showing no outward sign of their vulnerability. The MDG target is to reduce by half the proportion of people who suffer from hunger between 1990 and 2015. A reduction in the

prevalence of malnutrition will also assist in the goal to reduce child mortality (CBS, 2015).

60 percent of newborns were weighed at birth. For all births, 24 percent of infants were estimated to weigh less than 2.5 kilograms. There was some regional variation, ranging from 20 percent in the Eastern Terai to 33 percent in the Mid-Western Mountains (CBS, 2015).

Study indicated that on increase in age, risk of stunting also increases. Socioeconomic status was most important factors associated with stunting, underweight and wasting. Meeting the minimum dietary diversity, minimum meal frequency and minimum acceptable diet was associated with better nutritional status of children (Ruwali, 2012). Children in rural areas were more likely than those in urban areas to be underweight, stunted or wasted. Those children whose mother has secondary or higher education were the least likely to be underweight, stunted or wasted compared to children of mothers with no education. Older children were more likely than younger children to be underweight and/or stunted but less likely to be wasted (CBS, 2015).

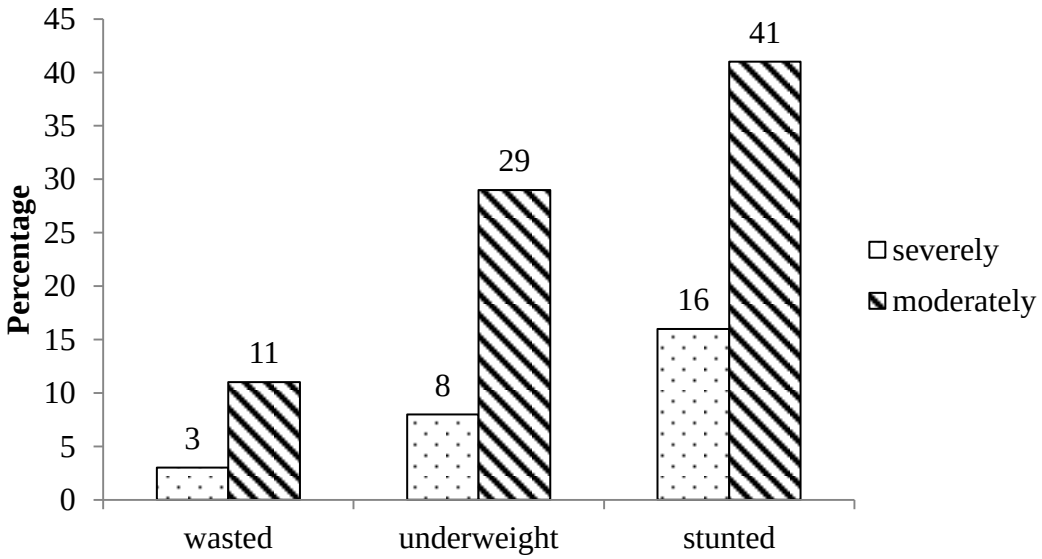

Fig. 2.2 Prevalence of different forms of malnutrition in Nepal Source: (MoHP, 2012)

According to Nepal Demographic and Health Survey 2011, 41% of under five children are stunted and 16% are severely stunted, 11% are wasted and 3% are severely wasted and

29% are underweight and 8% are severely underweight which is shown in above figure Fig.2.2 (MoHP, 2012).

Analysis of NDHS data by age shows that stunting is highest (53%) in children age 36 – 47 months and lowest (14%) in 9 – 11 months, wasting is found to be highest (25%) in children age 9 – 11 months and lowest (7%) in children age 36 – 47 months and proportion of underweight children is highest (37%) among age 18 – 23 months and lowest (18%) among under 6 months children. Male children are more likely to be stunted, wasted and underweight as compared to female children (MoHP, 2012).

2.7 Breastfeeding status of Nepal

In Nepal, every year 57,000 under-five children lose their lives, among which 54 percent of death occurs within the first month of life. Twenty-two percent of newborn deaths can be prevented through breastfeeding within the first hour of birth (UNICEF, 2016). The World Health Organization recommends initiating breastfeeding within the first hour of birth (Edmond *et al.*, 2006).

Almost all (97 percent) newborns in Nepal were breastfed at some point after birth. However, only 49 percent started breastfeeding at the recommended time (i.e., within one hour of birth). 57 percent of infants below six months of age were exclusively breastfed and 75 percent received breast milk as the predominant source of nourishment during the day prior to the survey. Boys were more likely than girls to be exclusively breastfed. A cultural dimension partially explains this difference, as boys are usually introduced to semi-solid food at six months as compared to girls at five months (CBS, 2015).

Mother's education level was negatively associated with exclusive breastfeeding. Some 94 percent of children aged 12–15 months and 87 percent of children aged 20–23 months were still being breastfed. Approximately 79 percent of all children aged 0–23 months were receiving age-appropriate breastfeeding. Some 12 percent of children aged 0–23 months in Nepal were fed using a bottle with a nipple. Urban children were much more likely than rural children to be bottle fed, and bottle feeding was positively correlated with mother's education level and household wealth status (CBS, 2015).

Maternal education was associated with a higher likelihood of early initiation of breastfeeding in each survey. Pooled data analysis revealed higher odds of early initiation

of breastfeeding among the mothers with primary education and secondary or higher education. As the association between a mother's educational status and her likelihood of early initiation of breastfeeding increases, long-term approaches to prioritizing education for women and girls should be explored. In the short term, uneducated mothers should be targeted with breastfeeding promotion strategies such as counseling and peer education (Acharya and Khanal, 2015).

2.8 Weaning and complementary feeding status

After six months, complementary food should be introduced and it is important to continue breastfeeding the children at least up to the age of two years (UNICEF, 2016). Overall, 74 percent of infants aged 6–8 months had received solid, semi-solid or soft foods at least once during the previous day. Boys were more likely than girls to receive solid, semi-solid or soft foods. Of children aged 6–23 months, 74 percent had adequate meal frequency and 37 percent had adequate dietary diversity. Overall, 32 percent received a minimum acceptable diet (CBS, 2015). Undesirable cultural practices such as giving prelacteal feeds, late initiation of breastfeeding after birth, delay in introduction of weaning foods and avoiding exclusive breastfeeding are still prevalent among the mothers. The maternal knowledge towards breast feeding was inadequate and there was a big gap between actual and desired practices (Chaudhary *et al.*, 2011).

2.9 Use of iodized salt

Adequately iodized salt, defined as containing 15 or more parts per million (15+ ppm), is used in 82 percent of households, with considerably higher consumption in urban areas (96 %) and among the richest households (98%) than in rural areas (78%) and among the poorest households (64%). Use of iodized salt was lowest in the Far Western Hills (54%) and highest in the Central Hills (92%) (CBS, 2015).

A study done in topic "Iodized Salt Use and Salt Iodine Content among Household Salts from Six Districts of Eastern Nepal" showed that 85% of Nepalese households were found to use iodized salt whereas 15% used non iodized crystal salt. The mean iodine content in iodized and crystal salt was 40.8±12.35 ppm and 18.43±11.49 ppm respectively (Khatiwada *et al.*, 2014)

2.10 Assessment of nutritional status

The assessment of the Nutritional status of an individual member of a community is accomplished by carrying out clinical biochemical anthropometric and biophysical examination (WHO, 1963). The nutritional assessment may require encompassing nations, communities, vulnerable segments of communities or individuals. It may be done as a part of an exercise to document current status as compared with post status or as specific attempt to evaluate the, impact of an intervention program.

The assessment of nutritional status can be done using the following information (WHO and Fund, 2009).

a) Direct method: Deals with the individual and measures objective criteria. Eg. Anthropometric, Clinical examination, Biochemical and Bio- physical parameters.

b) Indirect method: Use community indices that reflect the community nutritional status or need. Eg. Dietary intake, morbidity and mortality rates, as specific mortality and vital statistics.

c) Ecological factors: Eg. Socio-economic status, housing and environmental hygiene, health and education services conditioning infection.

2.11 Indicator in nutritional status

A variety of indicators, which can be used for the purpose of assessing nutritional status, are currently available. Of the many possible indicators of nutritional status only few are suitable for the evaluation of field program. The only indicator of nutritional status that are applicable in a large scale and for which a suitable experience if available are those based on anthropometric indicators are best applicable in the evaluation of nutritional status (Keller, 1982).

A report by WHO in 1976 listed the lowering nutritional status indicators based on body dimensions, birth weight, weight for height, height for age , weight for age, arm circumference. The measurement of weight and height is relatively simple and reliable and their changes and distribution over ages are well documented for healthy well-nourished reference populations. The simplest of those indicators is weight for age (Keller, 1982). It is widely used for both the assessment of child population and the monitoring of individual development.

Weight is the measure of total body mass but gives no indication of its structure; a tall thin child may have same mass as a short, well-proportioned one, a fact that introduces a considerable error in to the classification of malnutrition by weight for age particularly in the categories of “mild” and “moderate” malnutrition. Therefore, a refinement that has long been used by anthropologist was introduced into the nutritional anthropometry of children (Scoane and Lathan, 1971). By relating the weight to the attained height a distinction was made between chronic and acute malnutrition (Scoane and Lathan, 1971) or between “stunting” (low-height-for-age), and “wasting” (low-weight-for –height), (Waterlow and Rutishauser, 1974). The three indicators weight-for-age , height-for-age, and weight-for-height have since found wide acceptance and application and probably more is known today about these indicators in different population and different health situations than any of other indicators that have been prepared in the past (Keller, 1982).

An essential component of these indicators and their use is the reference population. It provide the indicator value of the population that are considered normal i.e, healthy and without significant deficiencies, and against which measured indicator value are compared while the indicator weight-for-height is apparently independent of age during childhood (Waterlow and Rutishauser, 1974). In the case of dependent indicators weight-for-age and height-for age, it has been argued the major difference in growth potential between ethnic groups would require local references population. It has however, been shown (Bondal, 1996) that with few exception growth of different ethnic groups under favourable conditions is almost identical (Hiernaux, 1964).

2.11.1 Anthropometric assessment

It is the physical measurement of the human body and is commonly used to estimate the nutritional status of children. Anthropometry measures have been extensively used for identification and classification of children suffering from protein-energy malnutrition (PEM). Different anthropometric measurements are combined as ratios or indices such as weight-for-age, weight for height and height for age (Pietsch, 2000).

Height-for-Age (HFA)

HFA is an indicator of past or chronic malnutrition. HFA cannot be used to measure short term changes in malnutrition. Deficits in HFA are signs of stunting. Stunting, usually results from extended periods of inadequate food intake, disease or a combination of both,

especially during the periods of greatest growth for children when the slowing of skeletal growth results in reduced stature or length (Pietsch, 2000). Stunting begins in *utero*; therefore, the pro-pregnancy health and nutritional status of women and the nutrition and health of mothers during pregnancy is critical. Stunting is a result of a process over time; most of the damage occurs before 2 years of age. Emphasis should be on prevention.

Children whose height for age Z – score is below minus two standard deviations (-2SD) from the median of the WHO reference population are considered short for age (stunted), or chronically malnourished. Children who are below minus three standard deviations (-3SD) are considered severely stunted (De Onis and Blössner, 2003).

Stunted growth is a reduced growth rate in human development. It is a primary manifestation of malnutrition in early childhood, including malnutrition during fetal development brought on by the malnourished mother. In developing countries, stunted growth is a common problem affecting a large percentage of children. Once established, stunting and its effects typically become permanent. Stunted children may never regain the height lost as a result of stunting, and most children will never gain the corresponding body weight. It also leads to premature death later in life because vital organs never fully developed during childhood (Badrialaily, 2008).

Weight-for-Height (WFH)

Weight-for-Height (WFH) helps to identify children suffering from current or acute malnutrition. It is used to examine short term effects, i.e. recent rapid weight loss associated with a period of starvation and/or severe disease (Chase and Martin, 1970).

Children with Z – scores below minus two standard deviations (-2SD) are considered thin (wasted) or acutely malnourished. Children with weight for height index below minus three standard deviations (-3SD) are considered severely wasted and children with more than two standard deviations (+2SD) above the median weight for height are considered overweight or obese (De Onis and Blössner, 2003).

Wasting results from weight falling significantly below the weight expected of a child of the same length or height. Wasting indicates current acute malnutrition resulting from feeding practices, diseases and infection, or, more frequently, a combination of these factors. Wasting in individual children and population groups can change rapidly and

shows marked seasonal patterns associated with change in food availability or disease prevalence (Smith and Haddad, 2000).

WHO and UNICEF recommend the use of a cut-off for weight-for height of below -3 standard deviations (SD) of the WHO standards to identify infants and children as having SAM. The reasons for the choice of this cut-off are as follows:

1) Children below this cut-off have a highly elevated risk of death compared to those who are above
2) These children have a higher weight gain when receiving a therapeutic diet compared to other diets, which results in faster recovery;
3) In a well-nourished population there are virtually no children below -3 SD (<1%).
4) There are no known risks or negative effects associated with therapeutic feeding of these children applying recommended protocols and appropriate therapeutic foods (WHO and Fund, 2009).

Weight-for-Age (WFA)

Low weight-for-age identifies the condition of being underweight at a specific age. WFA may reflect both past (chronic) and present (acute) under nutrition; however, it is unable to distinguish between the two (Smith and Haddad, 2000).

Children whose weight for age Z – score is below minus two standard deviations (-2SD) are classified as underweight while children whose weight for age Z – score is below minus three standard deviation (-3SD) are considered severely underweight (De Onis and Blössner, 2003).

W/A is used to identify the nutritional condition underweight, which is a composite measure of stunting and wasting. Just over 15% of the study children were severely malnourished, having a z score ≤ -3 standard deviations (SD) for any index (TD, 2005).

Mid-Upper-Arm Circumference (MUAC)

Measurement of the mid-upper arm appears to be most useful in practice. This reason is easily accessible, even with a young child sitting in front of the examiner on his mother‘s lap. The arm circumference is measured to the nearest 0.1 cm with a flexible steel or fibre-tape, which must be placed gently, but firmly, round the limb to avoid compression of the

soft tissue. MUAC should then be measured on the left upper arm while the arm is hanging down the side of the body and relaxed (UNICEF. and ENN, 2010).

MUAC-for-age show that in a well-nourished population there are very few children aged 6–60 months with a MUAC less than 115 mm. Children with a MUAC less than 115 mm have a highly elevated risk of death compared to those who are above. Thus it is recommended to increase the cut-off point from 110 to 115 mm to define SAM with MUAC. When using the WHO child growth standards to identify the severely malnourished among 6–60 month old children, the below -3SD cut-off for weight-for-height classifies two to four times as many children compared with the NCHS reference. The prevalence of SAM, i.e. numbers of children with SAM, based on weight-for height below -3 SD of the WHO standards and those based on a MUAC cut-off of 115 mm, are very similar. The shift from NCHS to WHO child growth standards or the adoption of the new cut-off for MUAC will therefore sharply increase case loads. This has programmatic implications (WHO and Fund, 2009)

2.11.2 Biochemical assessment

To further assess health and nutritional status beyond anthropometric measurements, biochemical measurements are often used. These involve laboratory analysis of a biological sample, such as blood or urine. In some cases, the sample is analyzed for a specific nutrient. For example, blood, calcium levels can be measured to determine calcium status. In other laboratory tests, the sample is analyzed for an indicator that reflects the nutrient's function; this indicator is called a biological marker or biomarker. For example, the hemoglobin content of blood is often measured as a biological (McGuire M. and Beerman A.K., 2011).

Body composition means components of the body such as fat, lean mass (muscle), water, and minerals. Biochemical measurement means laboratory analysis of biological samples, such as blood and urine, used in nutritional assessment. Biological marker (biomarker), a measurement in a biological samples such as blood or urine that reflects a nutrient's function (Gibson, 2005).

It may be the marker of iron status or other nutrient deficiency that causes decrease hemoglobin concentration in blood. This is because hemoglobin levels decrease during

iron deficiency. Biochemical measurements are powerful because they can help diagnose a specific nutrient deficiency or excess (McGuire M. and Beerman A.K., 2011).

2.11.3 Dietary assessment

Dietary assessment encompasses food supply and production at the national level, food purchases at the household level, and food consumption at the individual level (Ferruzzi M. *et al.*, 2013). The choice of method in each case should be guided by the purpose of the monitoring, the need for data accuracy and the availability of resources. Dietary assessment methods should also be adapted to the target population and be culturally sensitive. Dietary intake data may be collected at the national, household or the individual level (FAO, 2009).

2.11.3.1 Household survey

The principle methods of assessment at the household level are: food accounts, inventories and household recall. Data generated by these methods are useful for comparing food availability among different communities, geographic areas and socioeconomic groups, and for tracking dietary changes in the total population and within population subgroups. However, these data do not provide information on the distribution of foods among individual members of the household (FAO, 2009).

a. Food account and inventory method

In food account method household members keep a detailed record of the quantities of food entering the household, including purchases, home produced food, gifts, and from other sources. No account of stock of foods is taken before or after the study period. Inventory method is similar to the food account method. The additional element is that an inventory of stored food is made at the beginning and end of the survey period. One main weakness of these methods is that data are restricted to food brought into the home and does not include food consumed outside home (FAO, 2009).

b. Household record method

In the household record method, the foods presented for consumption to household members are weighed or estimated in household measures. Preparation waste and waste after eating are deducted, as well as the food consumed by visitors should also be deducted. This method may be well suited to populations in which a substantial proportion

of the diet is home produced rather than purchased (FAO, 2009).

2.11.3.2 Individual survey

Main methods for assessing present or recent diet as individual survey include food records, 24-hours (or 48-hours) recall, and food frequency questionnaires. In order to quantify the intake of foods, some estimate of the weight of consumed food is required. To convert food intake into nutrient intake, the availability of a food composition database/food table is essential. By combining the information of dietary intake and food composition databases/tables one can determine whether the diet is nutritionally adequate or not (FAO, 2009).

a. Food record method

In the food record method food intake is measured at the time of eating. Food intake is quantified by weighing and using household measures. Household members themselves usually record their food intake, although a field worker might keep the record. The data collection and processing are time consuming and expensive. These methods require a high degree of cooperation from the subjects, which can lead to poor response rates. Also, the need to weigh and record food, or the act of being observed, may alter the intake (FAO, 2009).

b. 24-Hour dietary recall method

In the 24-hour dietary recall, the respondent is asked to remember and report all the foods and beverages consumed in the preceding 24 hours or in the preceding day. The recall typically is conducted by interview, in person or by telephone, either computer assisted or using a paper-and-pencil form, although self-administered electronic administration has recently become available. Ideally, interviewers would be dietitians with education in foods and nutrition; however, non-nutritionists who have been trained in the use of a standardized instrument can be effective. All interviewers should be knowledgeable about foods available in the marketplace and about preparation practices, including prevalent regional or ethnic foods (Thompson F.E. and Subar A. F., 2013). It is a much used dietary assessment method because it is simple, quick and inexpensive, but it is prone to reporting errors, including biased or inaccurate recalls of food intake and portion sizes. It requires a good methodological knowledge in order to transform the interview data of the dietary

intake to nutrients. Applied once, it yields no information on day-to-day variation on food or nutrient intake (FAO, 2009).

c. Food frequency method

For food frequency method there are a set of questions, these questionnaires provide information about how often certain foods or foods from given food groups, were eaten during a time interval in the past, usually day, by either the household or an individual. The questionnaire can be self-administered or be administered through a short personal interview. The food list may range from a few questions to capture intake of selected foods and nutrients, to a comprehensive list to assess the total diet. The frequency responses can be open-ended or multiple choice, ranging from several times per day to number of times per year, depending on the type of food (FAO, 2009). The appropriateness of the food list is crucial in the food frequency method. The entire breadth of an individual's diet, which includes many different foods, brands, and preparation practices, cannot be fully captured with a finite food list. Frequency instruments designed to assess total diet generally list more than 100 individual line items, many with additional portion size questions, requiring 30-60 minutes to complete (Thompson F.E. and Subar A. F., 2013).

2.11.3.3 Dietary diversity

Dietary diversity is related to nutrient adequacy and to diet variety/balance, which are two of the main components of diet quality. Dietary diversity, is considered an outcome measure of food security mainly at the level of individual or household food access, but also can provide information about food availability in the community and reflect seasonal changes in dietary patterns, an aspect of the sustainability of the food supply (Kennedy.L.G., 2009).

Dietary diversity (DD) relates to nutrient adequacy (coverage of basic needs in terms of macro and micro nutrients) and to diet variety/balance, which are two of the main components of diet quality. DD is thought to reflect the adequate intake of essential nutrients either at the household level (HDD), in which case it can be measured by a HDD score. (HDDS) or by a Food Consumption Score (FCS), or at the individual level (IDD), in which case it can be measured by an IDD score (IDDS) (Bilinsky P. and Swindale A., 2006). Studies of dietary diversity and energy intake at the individual level show mostly a positive, significant relationship (Kennedy.L.G., 2009).

A more diversified diet is an important outcome in and of itself (Bilinsky P. and Swindale A., 2006). Some points regarding importance of diversified diet are given below.

- A more diversified diet is associated with a number of improved outcomes in areas such as birth weight, child anthropometric status, and improved hemoglobin concentrations.
- A more diversified diet is highly correlated with such factors as caloric and protein adequacy, percentage of protein from animal sources (high quality protein), and household income.
- Even in very poor households, increased food expenditure resulting from additional income is associated with increased quantity and quality of the diet.
- Questions on dietary diversity can be asked at the household or individual level, making it possible to examine food security at the household and intra- household levels.

2.14 Anemia

Anemia is the condition which is characterized by presence of low level of hemoglobin in the blood which is a major health problem in Nepal, especially among young children and pregnant women. Anemia may be an underlying cause of maternal mortality, spontaneous abortions, premature births, and low birth weight. Anemia is caused due to inadequate dietary intake of nutrients necessary for synthesis of hemoglobin, such as iron, folic acid, and vitamin B12. Anemia also results from sickle cell disease, malaria, and parasitic infections (MoHP, 2012).

Anemia is a condition in which the number of red blood cells or their oxygen-carrying capacity is insufficient to meet physiologic needs, which vary by age, sex, altitude, smoking, and pregnancy status. Iron deficiency is thought to be the most common cause of anemia globally, although other conditions, such as folate, vitamin B12 and vitamin A deficiencies, chronic inflammation, parasitic infections, and inherited disorder can cause anemia. In its severe form, it is associated with fatigue, weakness, dizziness and drowsiness. Pregnant women and children are particularly vulnerable.

2.14.1 Types of anemia

i. Aplastic anemia: It is a type of anemia in which not only red blood cells but also

white blood cell production by bone marrow is reduced or stopped. Exact cause is unknown but it is believed that any injury to bone marrow due to either of the cause chemotherapy, radiation, etc. cause aplastic anemia.

ii. Hypochromic anemia: This type of anemia develops as a result of premature or excessive destruction of red blood cells in the blood stream.

iii. Megaloblastic anemia: If either or both folic acid or vitamin B_{12} is deficient than this type of anemia is manifested in body.

iv. Pernicious anemia: It is caused by the deficiency of Vitamin B_{12} in diet or malabsorption of this vitamin as deficiency of Vitamin B_{12} effects the production of normal blood cell in the bone marrow.

v. Iron deficiency anemia: Iron is essential for bone marrow to produce hemoglobin. Low iron in body due to any reason and loss of blood result in iron deficiency anemia.

vi. Sickle-cell anemia: This is an inherited genetic disorder which is characterized by sickle shaped red blood cell.

vii. Thalassiemia: It is a group of inherited blood disorders that varies in severity depending on how many defective genes are in inherited. Anemia occurs as red blood cell cannot mature and grow properly (Cavendish M., 2008).

2.14.2 Hemoglobin level to diagnose anemia

The following cut off points are used to diagnose anemia (g/l) (WHO, 2011)

Table 2.1 Cut off points to diagnose anemia

		Anemia		
Population	**Non-anemia**	**Mild**	**Moderate**	**Severe**
Children 6 - 59 months of age	110 or higher	100-109	70-99	lower than 70
Children 5 - 11 years of age	115 or higher	110-114	80-109	lower than 80
Children 12 - 14 years of age	120 or higher	110-119	80-109	lower than 80
Non-pregnant women (15+ age)	120 or higher	110-119	80-109	lower than 80
Pregnant women	110 or higher	100-109	70-99	lower than 70

2.14.3 Prevalence of anemia in Nepal

In Nepal 46 percent of children in Nepal are anemic; 7 percent are mildly anemic, 18 percent are moderately anemic, and less than 1 percent are severely anemic. The prevalence of anemia among children under age 5 has declined by only 2 percentage points in the past five years.

Anemia is higher among children age 6-17 months (72-78 percent) than among children in other age groups. The prevalence of anemia among children age 6-23 months is 69 percent. Severe anemia, which has a serious impact on the health of an individual, is highest among children age 12-17 months (2 percent).The prevalence of anemia in male children is comparatively lower in males than females. The prevalence of anemia in children is different across ecological zones. Children residing in the terai are more anemic (50 percent) than children in the hill zone (41 percent). Children residing in the Far-western terai (60 percent) and Mid-western terai (57 percent) sub regions are more likely to be anemic than children in the Central mountain (33 percent) and Mid-western hill (36 percent) sub regions. There seems to be no significant linear relationship between anemia prevalence and mother's education or wealth quintile, although clearly children of mothers with no education are more likely to be anemic (MoHP, 2012).

2.14.4 Etiology of anemia

Anemia can be a manifestation of many abnormal condition such as dietary deficiencies, malignancy, chronic infection, overactive spleen, damaged bone marrow, bleeding from any organ or tract, hereditary causes(sickle cell anemia, thalassemia) (Rosdahl and Kowalski, 2008). Iron deficiency is thought to be the most common cause of anemia globally, although other conditions, such as foliate, vitamin B12 and vitamin A deficiencies, chronic inflammation, parasitic infections, and inherited disorders can all cause anemia (WHO, 2014).Basically, only three causes of anemia exist: blood loss, increased destruction of RBCs (hemolysis), and decreased production of RBCs. Each of these causes includes a number of disorders that require specific and appropriate therapy (Maakaron.E.J and Taher.T.A, 2016).

Genetic etiologies include the following:

- Hemoglobinopathies
- Thalassemias

- Enzyme abnormalities of the glycolytic pathways
- Defects of the RBC cytoskeleton
- Congenital dyserythropoietic anemia
- Rh null disease
- Hereditary xerocytosis
- Abetalipoproteinemia
- Fanconi anemia

Nutritional etiologies include the following:

- Iron deficiency
- Vitamin B-12 deficiency
- Folate deficiency
- Starvation and generalized malnutrition

Physical etiologies include the following:

- Trauma
- Burns
- Frostbite
- Prosthetic valves and surfaces

Chronic disease and malignant etiologies include the following:

- Renal disease
- Hepatic disease
- Chronic infections
- Neoplasia
- Collagen vascular diseases

Infectious etiologies include the following:

- Viral - Hepatitis, infectious mononucleosis, cytomegalovirus
- Bacterial - Clostridia, gram-negative sepsis
- Protozoal- Malaria, leishmaniasis, toxoplasmosis(Maakaron.E.J and Taher.T.A, 2016)

2.15 Other studies conducted on nutritional status of children

The association and child age i.e. children below 24 are more prone to wasting was seen in the study conducted in Northern Ethopia in topic "Prevalence of Malnutrition and Associated Factors among Children Age 6-59 Months at Lalibela Town Administration, North WolloZone, Anrs, Northern Ethiopia" which states younger children were more likely to be wasted than older children (Yalew, 2014).

The study done by in topic "Nutritional Status of Children Under Five Years of Age and Factors Associated in Padampur VDC, Chitwan" shows the association between stunting with minimum dietary diversity and minimum food frequency was found statically significant. Risks of stunting were 6.324 times higher on children who didn't get minimum dietary diversity than in the children who got (P=0.029). Similarly risk of stunting was also higher in children who didn't get minimum times of meal in comparison to the children who get minimum times of meal (P=0.017). As compared to the rich socioeconomic status, children from the poor socioeconomic status were 2.551 times more likely to stunting (P=0.001) (Ruwali, 2012).

Birth order was statistically significant with wasting ($P<0.05$) in the finding of the study on topic "Undernutrition and associated risk factors among school age children in Addis Ababa, Ethiopia" (Degarege *et al.*, 2015).

Minimum Dietary Diversity was associated with wasting ($P<0.05$) in topic "Association Between Dietary Diversity Score and Nutritional Status of Filipino Children". Children having good dietary diversity were less wasted (Ocampo-Guirindola *et al.*, 2016)

Individual dietary diversity has been described as a proxy measure of nutrition/dietary quality and can be a good indicator of overall household food security and positively associated with nutritional status in children, this would, therefore, explain why long term poor dietary diversity is likely to be reflected in stunting. Association was seen between severe food insecurity and stunting ($P = 0.023$) (Bukania *et al.*, 2014).

Another study done on topic "Low dietary diversity is a predictor of child stunting in rural Bangladesh" in rural area of Bangladesh showed that low dietary diversity was significantly associated with stunting($p<0.05$) (Rah *et al.*, 2010) where children below 5 years consuming more food groups were less stunted than consuming less food groups.

Part III

Materials and methods

3.1 Research methods

A community based cross-sectional survey was conducted to assess the nutritional status and associated factors among children aged 6-59 months which includes

a) Anthropometric measurement of 6-59 months children of *Tharu* Community in Duruwa VDC of Dang district.
b) Biochemical assessment to find the prevalence of anemia of 6-59 month children by using Hemocue kit.
c) General household survey by the application of questionnaire to the parents of children under study to find out the situation of household.

3.2 Study variables

Study variables were categorized into two groups: dependent variable and independent variable. Dependent variable of this study was nutritional status of 6-59 months children as indicated by stunting, wasting and underweight. Whereas, independent variables of the study were:

a) Socio-economic and demographic variables: Family size, income, occupation, education.
b) Child characteristics: age, sex, birth order, breastfeeding status
c) Child care practices: Feeding, hygiene
d) Maternal characteristics: age, iron intake, number of children born,
e) Environmental health condition: water supply, hygiene and sanitation.

3.3 Study area and its justification

This study was conducted in Duruwa VDC of Dang District situated in Rapti Zone according to National Population and Housing Census 2011 The map of Duruwa VDC is given in Appendix D.

3.4 Target population

The population source of the study was all 6-59 months children living in the concerned VDC and the study population was *Tharu* children of age 6-59 months of *Tharu* community which are randomly selected and included in the study.

Inclusion and exclusion criteria

Inclusion criteria: - *Tharu* children of age 6-59 months who live in Duruwa VDC of Dang District were included in the study.

Exclusion criteria: - Participants who were seriously ill or who were not available at the period of survey were not included in the study.

3.5 Sampling techniques

Random sampling method is used for the selection of sample unit. Each sample is randomly selected on survey area. Systematic random sampling was used to select the population unit for determining anemia. The basic criterion for the selection of household sample was that the household with at least one child of 6-59 months of age was included in the sample. In households with more than one children of age between 6-59 months, one child was chosen by lottery method.

3.6 Sample size

The sample size was determined by using a single proportional formula assuming the prevalence rate of malnutrition to be 50% in the survey area, 95% confidence interval (CI), 7.5 % margin of error (d) and 10% non-response rate was added to the total calculated sample size.

Prevalance of malnutrition (p)= 0.5

Z value at 0.05 level of significance (z) = 1.96

Margin of error (d) = 0.075

Sample size (n_1) = $\frac{p(1-p)*Z^2}{d^2}$

$=0.5(1-0.5) \times 1.96^2 / (0.07)^2$

=171

Considering non-response rate as 10%. The corrected sample size is calculated as:

$N = n_1 + n_1 \times 10\%$

=171+18

=189

For measuring prevalence of anemia:

Systematic sampling was done, every fourth child under the study was chosen for the sake of convenience. Thus the sample size for determining prevalence of anemia is calculated as

$N_1 = \frac{N}{4}$

= 189/4

= 48

3.7 Research instruments

Data was collected using structured questionnaire and anthropometric measurement. Interview was conducted with parents/care takers of the concerned children to fill the questionnaire. In households with more than one children of age between 6-59 months, one child was selected by lottery method.

Instruments and equipment necessary for the conduction of the survey are:

a) Weighing Machine :- Weighing machine with the capacity of 100kg and having the least count of 0.1Kg.(1piece)
b) Height measuring scale (stadiometer) :- 1 Piece
c) MUAC Tape :- For measuring mid-upper arm circumference.(1piece)
d) HEMOCUE Kit:- For assessing hemoglobin status
e) Questionnaire: - A well designed and pretested set of questionnaire to collect household information

3.8 Sampling Frame

All the 6 – 59 months children were included in the sampling frame from the wards of

Duruwa VDC.

3.9 Pre - testing the data collection tools

First of all the nutritional assessment and use of questionnaire was done in few household community with children of 6- 59 month old children of *Tharu* community and with parents/caretakers of children of age group 6-59 months old children of *Tharu* community respectively who are under the sampling plan. The questionnaire was again modified according to their views. Questionnaire was be revised in accordance with the findings of pre-testing.

3.10 Validity and reliability of the research

To ascertain the degree to which the data collection instruments measure what they purposed to measure, the instruments was validated by comparing with standard known weights(for weighing balance).Reliability refers to quality control measure of data collected. Questionnaire was checked for completeness, consistency and clarity.

Reliability of the instruments (Stadiometer and weighing scale) was tested by the test retest method. Two consecutive measurements were made at a short time difference by the same observer and were compared, validity and reliability of the study was ensured by pre-testing of the tools, using standardized instruments. Instruments was set at 0 reading before taking measurements with standardized reference one. Close supervision was done in the field.

For validation of *Hemocue* hemoglobin photometer 2 samples were taken from study population as trial samples and their specimen were taken to a District hospital of Dang for hemoglobin diagnosis as managed by DHO. The results obtained from the *Hemocue* hemoglobin photometer and from Hospital were identical.

3.11 Data collection techniques

Data was collected using semi-structured questionnaire and anthropometric measurement. Interview was conducted with parents/care takers of the children to fill the questionnaire.

Secondary data was obtained from Village Development Committee office, Nepal Demographic Health Survey (MoHP, 2012), Central Bureau of Statistics, and key informants like Female Community Health Volunteers (FCHV), local leaders etc.

There were two sets of tools to gather the information. Part I is the structured interview schedule to generate data pertinent to factors associated with nutritional status of children and Part II is a form, consisting of child information anthropometric measurements was recorded in it. Form was developed to record the measurements of height, weight, Mid Upper Arm Circumference and structured pre-tested interview schedule was used to collect information from the respondents. The questionnaires comprised mainly of details on household profiles like age, sex, education level and occupation of household members and household size. Data on sources of income was also collected. Anthropometric measurements and hemoglobin assessment taken for children aged (6-59) months included:

3.11.1 Date of birth

The date of birth of the child was asked and its reliability was checked with supportive questions like age of mother at pregnancy, birth order of child and age of mother at marriage and the reliability of the data was checked.

3.11.2 Length/height

Stadiometer was used to measure the height of children. The length of children below 2 years was measured by recombinant method i.e. the length of each child aged 6 - 24 months was measured lying flat and centrally on measuring boards placed on a hard flat surface on the ground. The length was read to the nearest 0.1 cm (head and feet against the base of the board and foot piece respectively) (Rockenbach *et al.*, 2011). The height of children aged above 24 months was measured standing straight on measuring board placed on hard flat surface with line of sight perpendicular to the horizontal surface. Children were made to stand bare foot on height board and with feet parallel and joined together and with heels and buttock touching the wall. It was made sure that that head was held erect and hands were hung closely at the sides. The child's height was measured to the nearest one decimal place.

3.11.3 Weight

Firstly, the clothes and shoes worn by child were removed and Weight was measured by electronic digital weight scale and read to the nearest 0.1 Kg. Calibration was done before and after weighing every child by setting it to zero. For the children age below two years and are unable to stand by them, their weight was obtained from the difference between weights of mother as she/he holds the child and the weight of the mother alone

3.11.4 MUAC

MUAC was taken on the left hand midway between the elbow and shoulder joint so that the hand was simply relaxed and hanging by the side. Standard MUAC tape given by ACF was used for measuring MUAC.

3.11.5 Blood hemoglobin

Measurement of blood hemoglobin was done using *HemoCue* hemoglobin photometer (Cohen and Seidl-Friedman, 1988).

Hemoglobin measurement:

Following steps were carried out for the measurement of hemoglobin

a. The hand was made warm by rubbing it with towel.
b. Tip of middle finger was cleaned by using spirit dipped cotton.
c. Tip of finger was wiped dry using cotton.
d. Slight pressure was applied for accumulation of blood towards the tip.
e. A small prick was made by using lanchet.
f. First two drops were wiped away and third blood drop was taken for analysis.
g. Using cuvette the blood was drawn in it and the sides of the cuvette was wiped clean with blotting paper.
h. Cuvette was placed in pre activated *HemoCue* hemoglobin *photometer* and data was recorded (Von Schenck *et al.*, 1986).

3.11.6 Individual dietary diversity score and food frequency

DD questionnaires are very simple in their conception and use. However, they need to be adapted to each context. In particular, the food groups list to be used in the questionnaire (which is not necessarily the one that will be used to compute the score and often range from 9 to 25 food items/groups) must be carefully designed and a list of examples of foods for each food group must be established (UNSCN, 2006).

There is currently no standard list of foods or food groups, and no cut-off point, upon which the international community agrees for a broad use in all contexts. However, a huge research work is currently ongoing and several propositions have already been made to standardize the indicators (UNSCN, 2006).

After the data collection was done by using questionnaire. The results were checked and

stored for further analysis. The questionnaire was classified with 12 food groups and we categorized IDDS on the following basis (Palermo *et al.*, 2013).

i. Low individual dietary diversity if consumed <5 groups
ii. Medium dietary diversity if consumed 5 to 8 groups per day
iii. High dietary diversity if child consumed 9 to 12 groups per day

Based on 12 food groups, frequency of consumption was measured within 7 days and was calculated by adding the frequencies of consumption of all 12 food groups by the child. The score 1 is given for one food group eaten in one day from the 12 different food groups. Consumption of at least 5 or more food group per day is considered as minimum dietary diversity met. The individual dietary diversity was determined by summing all the food groups consumed by the child. The lists of 12 food groups are given in Appendix B.

3.12 Data management

Collected data was managed carefully. The collected data were assigned numbers then these were stored safely for further analysis.

3.13 Data analysis

The data was checked for completeness and consistency. The collected data was first organized, coded and entered into Microsoft excel 2010 and then into statistical package for social science (SPSS) version 20.0 and into WHO Anthro version 3.2.2. The collected data was analyzed by using both descriptive and inferential statistics. Descriptive analysis was used to describe the percentages and number distributions of the respondents by socio-demographic characteristics and other relevant variables in the study. The data were presented in different table. The nutritional status was measured by WHO Standards and Mid Arm circumference (MUAC).

The cutoff points were used to categories anemia in in Severe, moderate and mild anemia. For IDDS cutoff point was used for categorizing in Low, medium and high dietary diversity. Anthropometric indices were calculated using reference medians recommended by the World Health Organization (WHO) and classified according to standard deviation units (z-scores), based on the WHO criteria. Wasting (weight-for-height z-score–WHZ) indicates thinness. It is usually the result of recent nutritional deficiency and is affected by seasonal shifts associated with availability of foods and/or prevalence of disease. A WHZ

of <-2 defines the presence of acute malnutrition (wasting). Stunting, represented by low height-for-age z-score (HAZ), results from extended periods of inadequate food intake, poor dietary quality, increased morbidity, or a combination of these factors. A HAZ of <-2 defines chronic malnutrition (stunting). Weight-for-age z-score (WAZ) is essentially a composite of weight-for-height and height-for-age, thus a measure of both acute and chronic malnutrition. A WAZ of <-2 is used for defining a child as underweight. A z-score of <-3 defines severe levels of each of the indices (Tamiru *et al.*) The chi square test was applied to test the association between the nutrition status and its associate factors.

3.14 Logistic and ethical considerations

Ethical clearance was obtained from Nepal Health Research Council and permission to conduct survey in Duruwa, permission was obtained from office of the Village Development Committee of Duruwa VDC, District Development Committee Dang and District health office Dang. Verbal consent from parents/care taker of study subjects was obtained and the objective of the study was explained lucidly to them. Privacy and confidentiality of collected information was ensured at all level. The ethical approval given by NHRC is shown in Appendix- C.

PART IV

Results and discussion

The survey was conducted to find the prevalence and the factors associated with Nutritional status in *Tharu* children of Duruwa VDC which is located in Dang district. The total household population was 189 and the results obtained are shown in following headings. The results of the study have 100% of response rate.

4.1 Socio-economic and demographic characteristics

Table 4.1 shows that, out of the 189 households, 98.4% of household were Hindu and the rest 1.6% followed Christian religion. 76.2% of household had family members 5 or more than 5 whereas 23.8% of household had family members less than 5.

Table 4.1 Socio-economic and demographic characteristics

Variables	Frequency	Percent
Mother's education		
Illiterate	23	12.2
Primary level	90	47.6
Secondary level	58	30.7
Higher Secondary level or more	18	9.5
Annual income		
Less than 1 lakhs	61	32.3
1 to 3 Lakhs	94	49.7
More than 3 lakhs	34	18.0
Main occupation of house		
Agriculture	59	31.2
Service	16	8.5
Labor	43	22.8
Business	5	2.6
Foreign Employment	66	34.9
Family size		
less than 5	45	23.8
5 or greater than 5	144	76.2

The average no children below 5 years of the total studied households were found to be 1.37±0.044. The study shows that 32.3% of the household had annual income less than 1 lakhs, 49.7% of the household had annual income in range between 1 to 3 lakhs whereas 18.0% of the household earned more than 3 lakhs annually.

The study shows that the major occupation of the household as foreign employment with the highest percentage of 34.9%, the second main occupation of family was found to be agriculture with 31.2% and the household engaged in labor, service and business were 22.8%, 8.5% and 2.6% respectively.

12.2% of the mothers were illiterate, mothers having primary level education were 47.6%, mothers having secondary level education were 30.7% and mother who had studied higher secondary level and more were 9.5% which is shown in table 4.1.

4.2 Child characteristics

Out of 189 children of age group 6 – 59 months taken in study, 97 (51.3%) were males 92 (48.7%) were females. The mean age of the children was 28.42±14.58 months. Majority of children fall between 12 – 23 (35.4%) months age group followed by 36 – 47 (35.4%), 24 – 35 (17.5%), 48 – 59 (12.2%) and 6 – 11 (11.1%) (Table 4.1) .

23.8% of children had low birth weight (less than 2.5 kg), 66.1% of children had normal birth weight (2.5 kg and above) and 10.1% of respondents didn’t know the birth weight of their children. 88.9% of children were born by natural birth whereas 11.1% babies were delivered by caesarean birth.

130 (68.7%) families under study had only one child below 5 years of age while 50 (26.5%) of families had 2 child and 9 (4.8%) of families had more than 3 child under five respectively. 55.0% of children under study were eldest child of the household. 33.9% of the children under study were second child and the rest of them were 3 and above.

Excluding those families having only one child, 58.6% of children had age gap of less than 3 years with their elder sibling 31.1% of children had age gap between 3-5 years with their elder sibling and 10.3% of children hag age gap of 5 and above with their elder sibling respectively. The mean birth spacing was 3.37±1.8 years. Maximum and minimum birth spacing was found to be 9 year and 1 year respectively.

Table 4.2 Child characteristics

Variables	Frequency	Percent
Gender		
Male	97	51.3
Female	92	48.7
Birth weight		
Low birth weight	45	23.8
Normal birth weight	125	66.1
Don't Know	19	10.1
Type of birth		
Natural Birth	168	88.9
Caesarean Birth	21	11.1
Age group (months)		
6-11	21	11.1
12-23	67	35.4
24-35	33	17.5
36-47	45	23.8
48-59	23	12.2
Number of under 5 children		
1	130	68.7
2	50	26.5
3	7	3.7
4	2	1.1
Birth order		
1	104	55
2	64	33.9
3	16	8.5
4 and above	5	2.6
Age gap with elder children		
Less than 3	51	58.6
3 – 5	27	31.1
5 and above	9	10.3

4.3 Child caring practices

This survey shows that the breastfeeding was almost universal, 99.5 % of mother breastfed their child while 0.5% did not get their mother's milk. 75.6 % of mother breastfed their child within 1 hour of the delivery, 9% of them breastfed their child within 8 hour whereas 12.2% of mother breastfed their child after 24 hours and 3.2% didn't knew the time of initiation of breastfeed (Table 4.3).

97.9% of the mothers in survey fed colostrum to their children, 0.5% of mother didn't fed colostrum milk to their children while 1.6% of mothers didn't remember about colostrum feeding to their child. Feeding cow's milk as prelacteals was seen in this survey, 6.3% of total mothers fed cow's milk to their child before initiation of breastfeeding while 93.7% of mothers didn't fed anything to their child before breastfeeding. Majority of mothers 84.7% exclusively breastfed their child until 6 months of age while 15.3 % of child were not exclusively breastfed. 10.1% of children were fed with commercial milk while 89.9% of children weren't fed with commercial milk. Majority of child initiated complimentary feeding at the age of 6 month with 88.4%, following at the age of 5 month with 7.9%, 7 month with 2.6% respectively and 1.1% fed in 4 months. 7.9% of child fed with Sabottam pitho while 92.1% of children were not fed.

Only 79.4% of household use packaged iodized salt. This finding didn't resemble the findings of National Demographic and Health Survey 2011 which revealed that more than 95% of households were using iodized salt (MoHP, 2012). During survey, it was found that, the household having greater family member mostly uses non-iodized salt as non-iodized salt is bought in bulk and is relatively cheaper than iodized salt. So, bulk consumption of non-iodized salt occurs in household having greater family members.

Most of the child consumed vitamin A and deworming tablet i.e. 98.4% of total children, while 1.6% of children were deprived from consumption of Vit. A and deworming tablet. The effectiveness of national Vitamin A supplementation program was similar to that of the country as well as the national data on Vit A supplementation stated that nine in ten children aged 6 -59 months received Vitamin A supplement (MoHP, 2012).

Majority of household first place choice of treatment for their baby was nearest heath post and hospital with 56.1%. Visiting female community health volunteer during illness was found to be 21.7%, 19% of the household use to take their child in Pharmacy during

illness while 3.2% of house having spiritual beliefs used to take their children to Dhami Jhakri when their child become ill.

In survey calculation of IDDS of children was carried out to find the feeding status of children. IDDS also shows the current food security status of the family. The result showed that most of the child had medium dietary diversity 118 (62.4%) followed by low dietary diversity 54 (28.6%) and very few had high dietary diversity with 17 (9%). Regarding food frequency of child within 7 days, the result showed that mean food frequency of child within 7 days was 80±18.303. Children having food frequency less than or equal to 80 were 66 (34.9%) whereas children having food frequency more than 80 were 123 (65.1%).

Table 4.3 Child caring practices

Variables	Frequency	Percent
Breastfeeding status		
No	1	0.5
Yes	188	99.5
Time of initiation of breastfeeding		
Within 1 hour	143	75.6
Within 8 hours	17	9
After 24 hours	23	12.2
Don't remember	6	3.2
Colostrum Feeding		
Yes	185	97.9
No	1	0.5
Don't remember	3	1.6
Feeding Prelacteals		
Nothing	177	93.7
Cow's Milk	12	6.3
Exclusive breastfeeding		
Yes	160	84.7
No	29	15.3
Feeding commercial milk		
Yes	19	10.1
No	170	89.9

Initiated complementary feeding		
Yes	186	98.4
No	3	1.6
Time of initiation of complementary food		
4 months	2	1.1
5 months	15	7.9
6 month	167	88.4
7 month	5	2.6
Feeding sarbottam pitho		
Yes	15	7.9
No	174	92.1
Type of salt consumption		
Iodized	150	79.4
Non-iodized	39	20.6
Vitamin A and albendazole consumption		
No	3	1.6
Yes	186	98.4
Place of first treatment		
Nearest Health post or Hospital	106	56.1
Pharmacy	36	19
Female Community Health Volunteer	41	21.7
Dhami Jhakri or Religious Treatment	6	3.2
Individual dietary diversity score		
Low dietary diversity	54	28.6
Medium dietary Diversity	118	62.4
High dietary diversity	17	9
Food frequency		
Less than or equal to 80	66	34.9
More than 80	123	65.1

4.4 Maternal characteristics

Table 4.4 shows that most of the mothers were of age group 20 – 30 years with highest frequency of 143 (75.7%), followed by less than 20 years with frequency 34 (18%) and mothers of age group 30 and above with frequency 12 (6.3%). The mean age of mother in survey was 23.6 ±3.646 with the mother of minimum age of 17 years to maximum age of 40 years. On giving contrast to the mother's education we found that 12.2% of them were illiterate, 47.6% of mothers were educated to primary level, 30.7 % of them were educated to secondary level and remaining 9.5% of mothers were educated to higher secondary level and above. Most of the mothers worked as housewife with highest percentage of 81.5%, 7.9% of mother's occupation was labor, 5.3% of mothers were involved in job and 5.3% of mothers were involved in business work.

The mean age at first pregnancy of the mothers in this survey was found to be 19.45±1.942 years. The minimum age of first pregnancy of mothers included in this survey is of 15 years and maximum age is of 25 years. 70.4 % of mothers were pregnant first time at age group less or equal to 20 years while 29.6% of mother were above 20 years during their first pregnancy. The minimum age to be pregnant is after 20, there is a Nepali saying about marriage regarding girl's maturity and appropriate time of marriage *"Bihebari Bis barsa pari*" but in *Tharu* community most of the women were pregnant below 20 years of age. 84.7% of mothers were supplemented with iron tablets during their pregnancy while 15.3% of mothers don't. The mean duration of intake of iron tablet was 177.12±56.015 days.

Regarding knowledge about malnutrition, 38.1% of respondent had knowledge about malnutrition while 61.9 replied that they were unknown about malnutrition. Further checking, the knowledge of respondents who said they knew about malnutrition (n=72), causes of malnutrition were asked to them. 98.6% gave correct answer i.e. lack of balance diet while 1.4% said that it is caused due to evil eyes.

Table 4.4 Maternal characteristics

Variables	Frequency	Percent
Age group of mother		
Less than 20	34	18.0
20 – 30	143	75.7
30 and above	12	6.3
Mother's education		
Illiterate	23	12.2
Primary level	90	47.6
Secondary level	58	30.7
Higher Secondary level or more	18	9.5
Occupation of mother		
House wife	154	81.5
Service	10	5.3
Labor	15	7.9
Business	10	5.3
Age at first pregnancy		
Less or equal to 20	133	70.4
Above 20	56	29.6
Intake of iron tablet		
No	29	15.3
Yes	160	84.7
Knowledge about malnutrition		
Yes	72	38.1
No	117	61.9
Causes of malnutrition (N= 72)		
Lack of balance Diet	71	98.6
Evil eyes	1	1.4

4.5 Hygiene and sanitation

Safe drinking water and proper sanitation and hygiene practices are basic necessities for good health. Table 4.5 shows that the main source of drinking water used by the household was well 98 (51.8%). 57 (30.2%) of household drink water from Drinking water tap. 27 (14.3%) of household get their drinking water from tubewell while 7 (3.7%) of household fetch their drinking water from river. In addition only 61 (32.3%) of household purify water before drinking while rest 128 (67.7%) of household drink water without purifying. Every household had toilet facilities of their own with 100%.

Table 4.5 Hygiene and sanitation

Variables	Frequency	Percent
Drinking water source		
Tube well	27	14.3
River	7	3.7
Well	98	51.8
Drinking Water Tap	57	30.2
Purification of water for drinking		
No	128	67.7
Yes	61	32.3
Toilet facilities		
Yes	189	100.0

4.6 Nutritional status of children

Anthropometric indices are the major tool for the assessment of nutritional status of children. Deviation of anthropometric indices from the reference standard of those indices is the evidence of malnutrition. Generally, underweight, stunting and wasting are widely used indicators of malnutrition (Shrestha, 2014).

The overall magnitude of malnutrition among 6 – 59 months children in Duruwa VDC of Dang District were 27%, 13.2% and 21.2% for stunting, wasting and underweight respectively as shown in Figure 4.1. Moreover, severe and moderate malnutrition was found among the child stunting 6.9% and 20.1%, wasting 2.6% and 10.6% and underweight 3.7% and 17.5% respectively where severe and moderate malnutrition is defined as less than minus 3 Z-Score and less than minus 2 and greater or equals to minus

3 Z- Score respectively. No overweight or obese children were found in the survey population.

There was high prevalence of wasting in children of age group 12 – 23 months and there was low prevalence of wasting in children of age group 24 – 35 months. Stunting was highly prevalent in children of age group 36 – 47 months and there was low prevalence of stunting in children of age group 6 – 11 months. There was high prevalence of underweight in children of age group 36 – 47 months and there was low prevalence of underweight in children of age group 24 – 35 months. The age wise distribution is given in Table 4.6.

From the survey result we found that 13.2%, 27%, and 21.2% of children are wasted, stunted and underweight respectively. NDHS 2011 shows the national data on wasting, stunting and underweight to be 11%, 41% and 29% respectively. The prevalence of wasting is somehow similar to the National wasting data but nutrition status regarding stunting and underweight of Duruwa VDC was found better than the country's nutritional status except wasting. The prevalence of wasting and underweight was found somehow similar with the nutritional status of under five children in Western Nepal where 15.1% were wasted and 20.2% were underweight respectively but the stunting was somehow lower in Duruwa VDC than in western Nepal (Shrestha, 2014).

The age wise categorizations of malnutrition in different age groups of children are shown in Table 4.6.

Table 4.6 Age wise categorization of malnutrition

Age Group	WHZ(%)		HAZ(%)		WAZ(%)	
(months)	<3	<-2 - ≥3	<-3	<-2 - ≥3	<-3	<-2 - ≥3
(6-11)	4.80%	14.30%	4.80%	9.50%	9.50%	9.50%
(12-23)	4.50%	14.90%	4.50%	19.40%	3.00%	14.90%
(24-35)	Nil	6.10%	9.10%	15.20%	6.10%	9.10%
(36-47)	2.20%	6.70%	11.10%	24.40%	Nil	31.10%
(48-59)	Nil	8.70%	4.30%	30.40%	4.30%	17.40%

Table 4.7 Prevalence of nutritional status on the basis of MUAC

Class	MUAC reading	Frequency	Percent
Severe Acute malnutrition	<115 mm	Nil	Nil
Moderate Acute Malnutrition	115mm - 125mm	17	9
Normal	>125 mm	172	91

On the basis of MUAC, 9% of the children fall into Moderate acute malnutrition criteria (MUAC= 115mm – 125mm), there were any child that fall into Severe acute malnutrition criteria and the rest 91% were normal (Table 4.7).

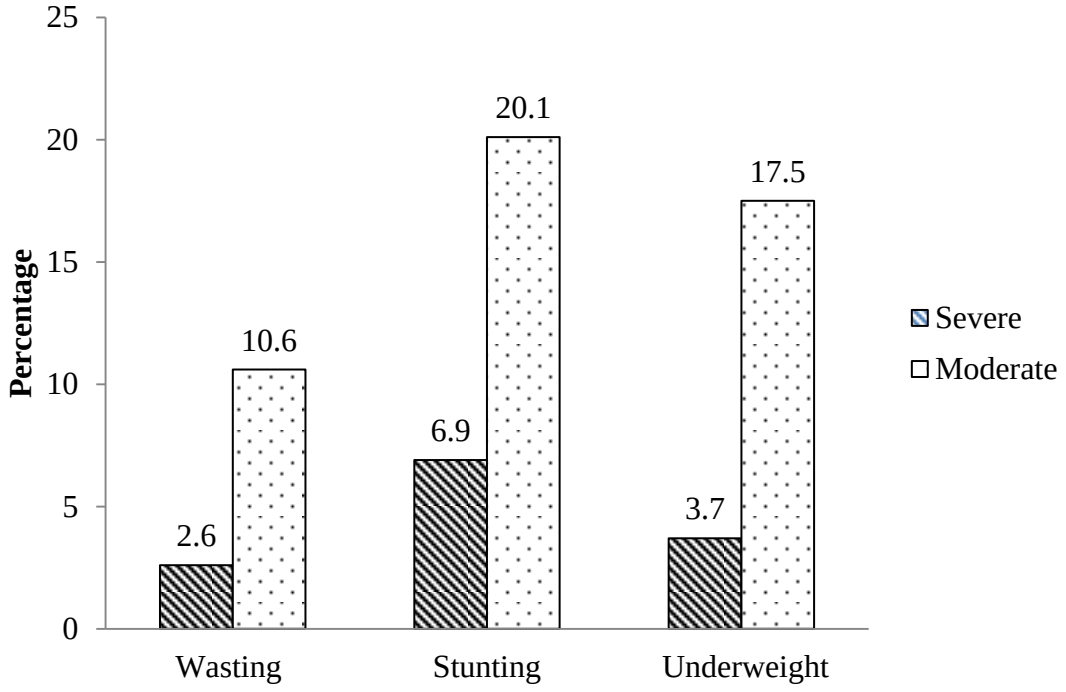

Fig. 4.1 Present status of malnutrition in *Tharu* children of Duruwa VDC

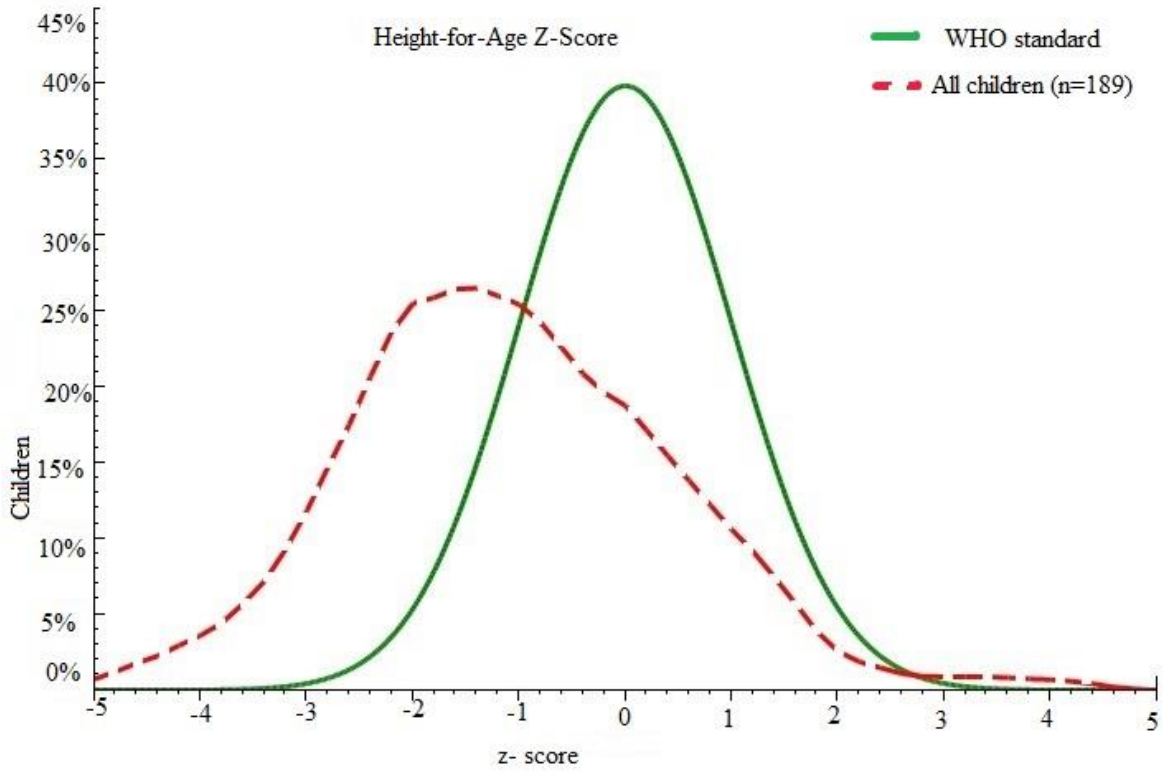

Fig. 4.2 Regarding Height for Age, 20.1% were below -2 SD (z-score) and 6.9% were below -3 SD (z-score)

Figure 4.2 shows that the median height for Age z-score of survey children was found to be -1.24 which is less than the reference to WHO standard. This cause curve is skewed to the left side of WHO standard curve showing the prevalence of stunting among study population. During survey it was found that the mothers of *Tharu* community of Duruwa VDC had very less knowledge regarding feeding. Hence long term inappropriate feeding behavior causes nutrient deficiency in children leading them towards malnutrition. Family having low income have very small allocation of budget for the food, quality of the food might not be maintained, proper healthcare service might not maintained which may cause stunting in the children. Individual dietary diversity was the risk factor for stunting in Tharu children. Long term poor dietary diversity is likely to be reflected in stunting (Bukania *et al.*, 2014).

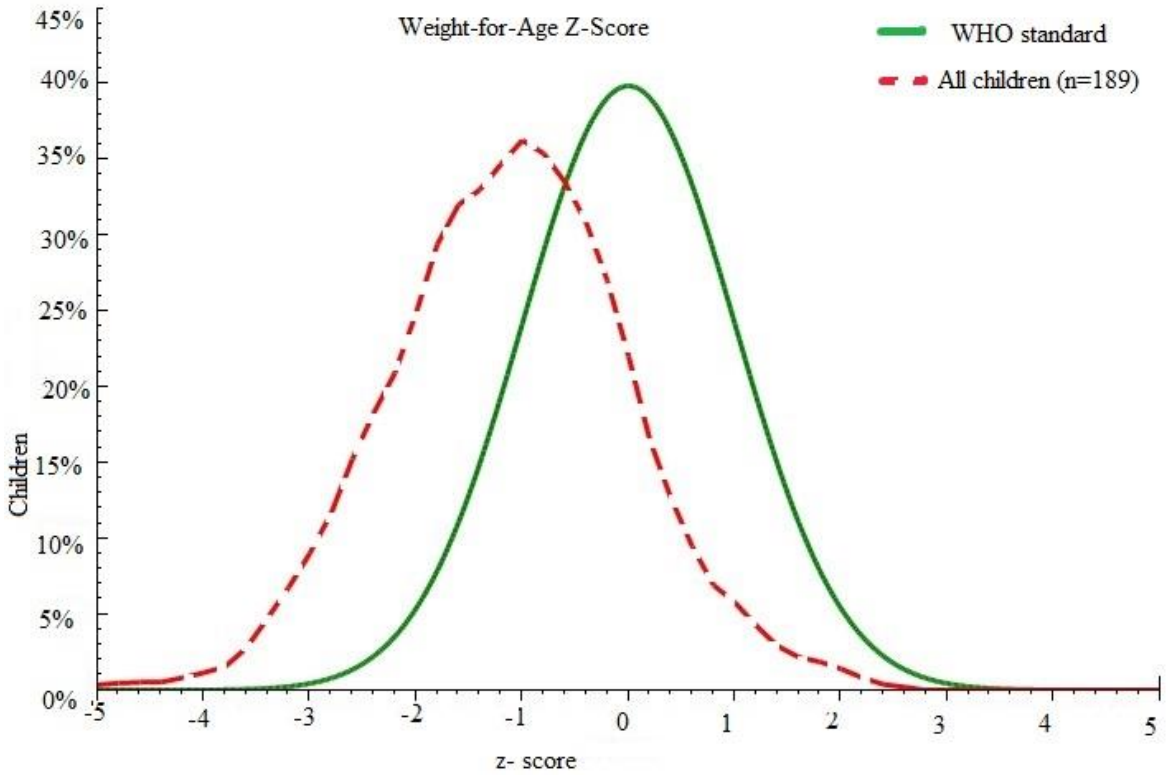

Fig. 4.3 Regarding Weight for Age, 17.5% were below -2 SD (z-score) and 3.7% were below -3 SD (z-score)

Figure 4.3 shows that the median height for Age z-score of survey children was found to be -1.17 which is less than the reference to WHO standard. This cause curve is skewed to the left side of WHO standard curve showing the prevalence of underweight among study population. The underweight was still a problem in *Tharu* community of Duruwa VDC. The parents or caretaker of *Tharu* community might not be well known regarding proper feeding and care (complementary feeding, hygiene and sanitation etc.) of the child in case of first child. Also the youngest child in the family is still given more privilege may be the reason for underweight in *Tharu* children of Duruwa VDC of Dang.

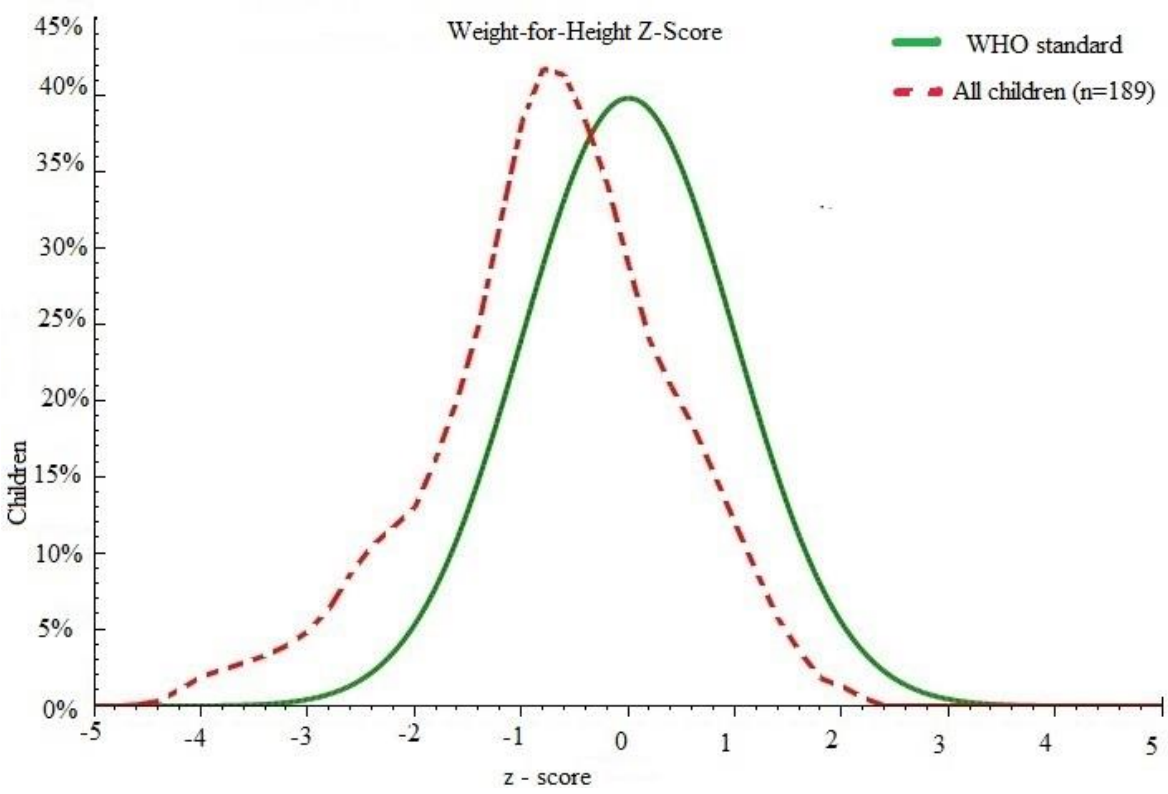

Fig. 4.4 Regarding Weight for Height, 10.6% were below -2 SD (z-score) and 2.6% below -3 SD (z-score)

Figure 4.4 show that the median height for Age z-score of survey children was found to be -0.67 which is less than the reference to WHO standard. So the curve is skewed to the left side of WHO standard curve showing the prevalence of wasting among study population. The prevalence wasting was more in the study community than national data. The inappropriate time of initiation of complementary feeding, outbreaks of diarrhea and other diseases may be the reason behind this. This may be due to low hygiene and sanitation in the community which may cause disease outbreak and parasitic infection in children causing wasting in children. The inadequate amount of diversified food consumption results in calorie and protein deficit which might be the cause of wasting in children.

4.7 Distribution of malnutrition based on sex

Table 4.8 shows that the prevalence of stunting was seen more in female than in male with 28.30% of stunted in female while 25.80% of male were stunted. Prevalence of underweight was found greater in males with 23.70% while 18.50% of females were underweight. Prevalence of wasting was seen very slightly greater in males with 13.40% while 13.00% of females were wasted.

Table 4.8. Distribution of malnutrition based on sex

Undernutrition	Normal	Malnourished
Stunting		
Male	74.20%	25.80%
Female	71.70%	28.30%
Underweight		
Male	76.30%	23.70%
Female	81.50%	18.50%
Wasting		
Male	86.60%	13.40%
Female	87.00%	13.00%

4.8 Prevalence of anemia

The total numbers of sample for measuring prevalence of anemia were 48. 60.4% of the children were anemic. Among them, 2.1% were severely anemic, 29.15% were moderately anemic and 29.15% were mildly anemic whereas 39.6% were normal which is shown in Table 4.9. According to NDHS the prevalence of anemia in mid-western terai was 56.9%, mild anemic 28.4%, moderate anemic 26.5% and severely anemic 2% (MoHP, 2012). The results obtained from the survey were similar to the national data.

The most common cause of anemia is inadequate dietary intake of nutrients necessary for synthesis of hemoglobin, such as iron, folic acid, and vitamin B12. Anemia also results from sickle cell disease, malaria, and parasitic infections (MoHP, 2012). The prevalence of anemia was high may be due to low consumption of diversified food causing lack of vital nutrients needed for hemoglobin formation and lack of safe drinking water consumption which may cause parasitic infection and leading to hemoglobin loss.

On further analyzing the result, it showed that prevalence of anemia was more in female in comparison to male. Figure 4.5 shows that male population who were anemic were 10 (45.5%) whereas 19 (73.1%) of females were anemic. The similar result was found in the survey done by NDHS where the female child were more anemic in comparison with the male child (MoHP, 2012). This may be due to male children are given more priority than female in Nepalese society and female children have less food choice in the household.

Table 4.9 Prevalence of anemia

Hemoglobin level (n=48)	Frequency	Percent
11 or more than 11 (Non anemia)	19	39.6
10 to 10.9 (Mild anemia)	14	29.15
7 to 9.9 (Moderate anemia)	14	29.15
less than 7 (Severe anemia)	1	2.1

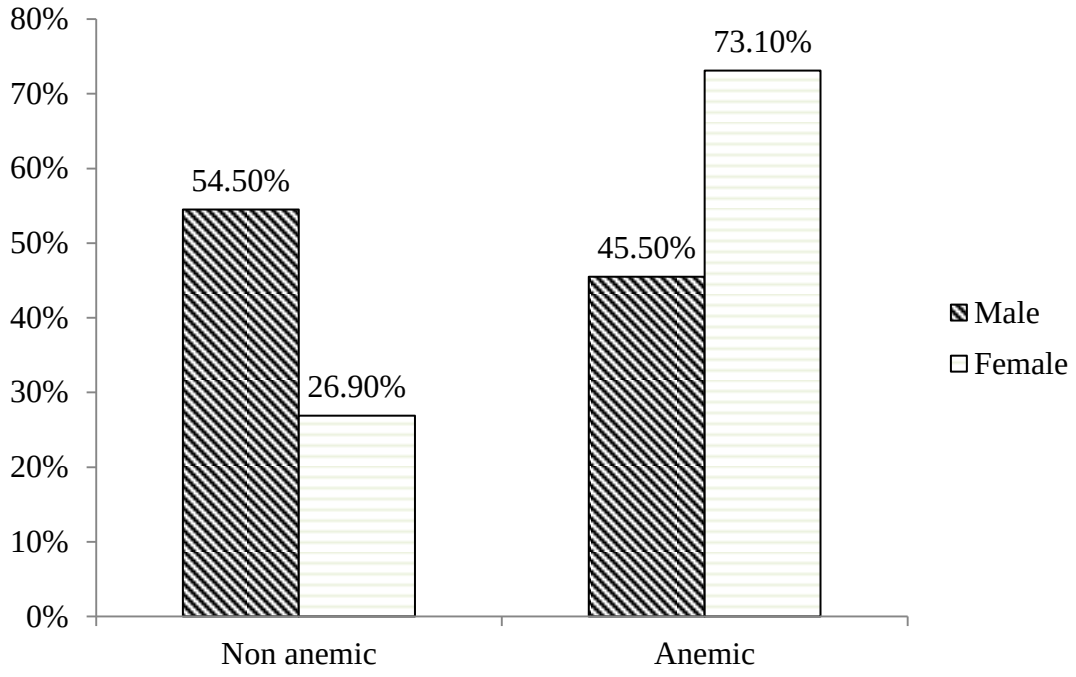

Fig 4.5 Sex wise distribution of anemia

4.9 Factors associated with undernutrition of children

Anthropometric results are most widely used for the assessment of undernutrition and it was assessed by stunting, wasting and underweight. In this survey result Chi - square test was used for finding out factors those are responsible for nutritional situation.

4.9.1 Factors associated with wasting

Table 4.10 showed that there was significant association of wasting with child age and IDDS. Child age classified as less than 24 months and more than 24 months was found to be significant with wasting (P=0.021). The children less than 24 months are more prone to

wasting than the child above 24 months. Association of wasting and child age i.e. children below 24 are more prone to wasting is similar to the study conducted in Northern Ethopia which states younger children were prone to be wasted than older children (Yalew, 2014).

The result shows that wasting is significantly associated with IDDS (P=0.021) This finding was similar to the findings obtained from the study conducted in Taguig City, Philippines which states that low dietary diversity is significantly associated with wasting (p<0.05) (Ocampo-Guirindola *et al.*, 2016). Children having low dietary diversity were more prone to wasting than the children whose minimum diversity is met. This can be explained in that, greater the Individual Dietary Diversity Score lesser will be the chance of getting wasted as having greater dietary diversity means the children is consuming varieties of food from different food groups. The inadequate amount of diversified food results in calorie and protein deficit in child which might be the cause of wasting in children.

Table 4.10 Factors associated with wasting

Predictors		**WHZ status**		**Chi-square**	**P-value**
		Wasted	**Normal**		
Gender	Male	13 (13.4%)	84 (86.6%)		
	Female	12 (13%)	80 (87%)	0.005	0.942
Family size	Less than 5	6 (13.3%)	39 (86.7%)		
	5 or more than 5	19 (13.2%)	125 (86.8%)	0.001	0.981
Mother's education	Illiterate	5 (21.7%)	18 (78.3%)		
	Literate	20 (12%)	146 (88%)	1.653	0.199
Annual Income	< 1 lakh	9 (14.8%)	52 (85.2%)		
	≥1 lakh	16 (12.5%)	112 (87.5%)	0.183	0.669
Children age	< 24 months	17 (19.3%)	71 (80.7%)		
	> 24 months	8 (7.9%)	93 (92.1%)	5.322	0.021*
Birth order	1st child	18 (17.3%)	86 (82.7%)		
	Other child	7 (8.2%)	78 (91.8%)	0.687	0.407
IDDS	Low IDDS	12 (22.2%)	32 (59.3%)		
	Min. IDDS met	13 (9.6%)	122 (90.4%)	5.321	0.021*
Food frequency	less than 80	8 (12.1%)	58 (87.9%)		
	80 or more	17 (13.8%)	106(86.2%)	0.108	0.742
Age at first pregnancy	20 or <20	18 (13.5%)	115 (86.5%)		
	>20	7 (12.5%)	49 (87.5%)	0.037	0.848

* Statistically significant (P < 0.05)

4.9.2 Factors associated with stunting

Table 4.11 shows that there was significant association of stunting with IDDS (P=0.007) and food frequency (P=0.013) and annual income (P=0.022). The result also shows that there was no significant association of stunting with gender of child, family size, mother's education, children age, birth order and age at first pregnancy. Those children having low IDDS are more likely to get stunted than those having greater diversity. Children whose food frequency is more than 80 are less prone to stunting. Income was also related to the stunting of the child. Children of poor family having income less than 1 lakh were more prone to stunting in comparison to family having income more than 1 lakhs. This finding can be supported with fact that the family having low income have very small allocation budget for the food, quality of the food might not be maintained, proper healthcare service might not maintained which leads to stunting in the children.

The result was similar to the study done by Ruwali in Padampur VDC which shows the association between stunting with minimum dietary diversity and minimum food frequency was found statically significant. Risks of stunting were 6.324 times higher on children who didn't get minimum dietary diversity than in the children who got (P=0.029). Similarly risk of stunting was also higher in children who didn't get minimum times of meal in comparison to the children who get minimum times of meal (P=0.017). As compared to the rich socioeconomic status, children from the poor socioeconomic status were 2.551 times more likely to stunting (P=0.001) (Ruwali, 2012).

The result was also similar to study done in rural area of Bangladesh where low dietary diversity was significantly associated with stunting ($P<0.05$) (Rah *et al.*, 2010) where children below 5 years consuming more food groups were less stunted than consuming less food groups.

Individual dietary diversity has been described as a proxy measure of nutrition/dietary quality and can be a good indicator of overall household food security and positively associated with nutritional status in children, this would, therefore, explain why long term poor dietary diversity is likely to be reflected in stunting. Similarly, an association between low dietary diversity and stunting was found in study done in Kenya supporting the finding of this thesis ($P = 0.023$) (Bukania *et al.*, 2014).

Table 4.11 Factors associated with stunting

Predictors		HAZ status		Chi-square	P-value
		Stunted	Normal		
Gender	Male	25 (25.8%)	72 (74.2%)		
	Female	26 (28.3%)	66 (71.7%)	0.148	0.7
Family size	Less than 5	9 (20%)	36 (80%)		
	5 or more than 5	42 (29.2%)	102 (70.8%)	1.462	0.227
Mother's education	Illiterate	6 (26.1%)	17 (73.9%)		
	Literate	45 (27.1%)	121 (72.9%)	0.011	0.918
Annual Income	< 1 lakh	23 (37.7%)	38 (62.3%)		
	≥1 lakh	28 (21.9%)	100 (78.1%)	5.254	0.022*
Children age	< 24 months	19 (21.6%)	69 (78.4%)		
	> 24 months	32 (31.7%)	69 (68.3%)	2.431	0.119
Birth order	1st child	29 (27.9%)	75 (72.1%)		
	Other child	22 (25.9%)	63 (74.1%)	0.095	0.758
IDDS	Low IDDS	22 (40.7%)	32 (59.3%)		
	Min. IDDS met	29 (21.5%)	106 (78.5%)	7.261	0.007*
Food frequency	less than 80	25 (37.9%)	41 (62.1%)		
	80 or more	26 (21.1%)	97 (78.9%)	6.109	0.013*
Age at first pregnancy	20 or less than 20	38 (28.6%)	95 (71.4%)		
	>20	13 (23.2%)	43 (76.8%)	0.574	0.449

* Statistically significant (P < 0.05)

4.9.3 Factors associated with underweight

There was significant association of underweight with birth order, food frequency and IDDS. There was no significant association of underweight with mother's education, annual income, age of children, age at first pregnancy, family size and gender (Table 4.12).

The prevalence of underweight in first child and child other than first child in the survey children were 28 and 12 respectively. The analysis of survey also revealed that there was significant relation between birth order of children and underweight (P =0.032). The first child was more likely to be underweight than other child. The finding of the study depicts that there were greater risk of underweight in first child born in a household. The result obtained from this survey show contradiction to the study done in Ethopia where birth order was statistically significant with underweight (P<0.003) where the child other than first child were more prone to underweight (Degarege *et al.*, 2015). This finding can be supported with fact that the parents or caretaker might not be well known regarding proper

feeding and care (breastfeeding, complementary feeding, immunization, hygiene and sanitation etc.) of the child in case of first child. Also the youngest child in the family is still given more privilege than elder child in Nepalese society.

Similarly there was association between underweight and Individual Dietary Diversity Score (P=0.003). There was significant association between underweight and food frequency (P=0.01). The found result was similar to the study done by (Ruwali, 2012) which shows the association between underweight and minimum food frequency was found statically significant (P<0.05). Children whose minimum food frequency was met had less chances of being underweight than those children whose minimum food frequency wasn't met (Ruwali, 2012). This may be due to the low annual income which is not sufficient for buying diversified food, illiteracy and ignorance.

Association of underweight and IDDS was also found similar in study done in Kenya by (Nduku, 2013) which states that low dietary diversity was associated with risk of underweight in children.

Table 4.12 Factors associated with underweight

Predictors		**WAZ status**		**Chi-square**	**P-value**
		Underweight	**Normal**		
Gender	Male	23 (23.7%)	74 (76.3%)		
	Female	17 (18.5%)	75 (81.5%)	0.775	0.379
Family size	Less than 5	6 (13.3%)	39 (86.7%)		
	5 or more than 5	34 (23.6%)	110 (76.4%)	2.171	0.141
Mother's education	Illiterate	6 (26.1%)	17 (73.9%)		
	Literate	34 (20.5%)	132 (79.5%)	0.38	0.537
Annual Income	< 1 lakh	15 (24.6%)	46 (75.4%)		
	≥1 lakh	25 (19.5%)	103 (80.5%)	0.634	0.426
Children age	< 24 months	16 (18.2%)	72 (81.8%)		
	> 24 months	24 (23.8%)	77 (76.2%)	0.878	0.349
Birth order	1st child	28 (26.9%)	76 (73.1%)		
	Other child	12 (14.1%)	73 (85.9%)	4.597	0.032*
IDDS	Low IDDS	19 (35.2%)	35 (64.8%)		
	Min. IDDS met	21 (15.6%)	114 (84.4%)	8.908	0.003*
Food frequency	less than 80	21 (31.8%)	45 (68.2%)		
	80 or more	19 (15.4%)	104 (84.6%)	6.899	0.01*
Age at first pregnancy	20 or less than 20	28 (21.0%)	105 (78.9%)		
	>20	49 (87.5%)	7 (12.5%)	0.03	0.954

Part V

Conclusion and recommendations

5.1 Conclusion

The aims of the present study were to assess the prevalence of undernutrition and identify causes of undernutrition among children of 6 to 59 months in the *Tharu* community of Duruwa VDC, Dang. The followings are the concluded things in brief:

1) This study demonstrated that undernutrition continues to be a serious problem in the *Tharu* community of Dang district. The overall magnitude of malnutrition among 6 – 59 months children in Duruwa VDC of Dang District were 27%, 13.2% and 21.2% for stunting, wasting and underweight and prevalence of anemia was found to be 60.4%.
2) Low dietary diversity was the factor for all stunting wasting and underweight. Low food frequency was the factor for stunting and underweight.
3) Factors like Annual income of family, birth order and children age were associated with risk of stunting, underweight and wasting respectively.
4) The results of the present study will be useful for policy makers in their endeavor to formulate various developmental and health care programs.

5.2 Recommendations

Based on the results from the thesis the following are the recommended points to increase the nutritional status of children of *Tharu* community of Duruwa VDC Dang.

1) Nutrition education by health extension works should be strengthening to improving the feeding practice of parents on appropriate children feeding.
2) Households should be treat drinking water which obtained from sources by boiling or with filter.
3) Use of family planning should be encourage at community level as there should be at least 5 years of age gap between two child.
4) Dietary pattern should be changed to overcome anemia, use of iron rich foods should be promoted.
5) Potential income generating programs should be conducted to decrease the risk of malnutrition due to poverty.
6) Further study should be done to see other unexplored factors that were not included in the present study.

Part VI

Summary

A community based cross-sectional study was conducted to assess the factors associated with nutritional status and prevalence of anemia of 6 – 59 months *Tharu* children in Duruwa VDC of Dang District, Nepal. 189 children were selected using random sampling technique; anthropometric measurements (weight, height, MUAC) were performed to find the nutritional status of children and Hemocue was used to determine anemia. A pre-coded questionnaire was used to collect information and was administered to caretaker. WHO Anthro version 3.2.2 and SPSS version 20 were used to analyze data. χ^2 - test was used to analyze the factors associated with nutritional status of child.

The survey was carried out *Tharu* community where all the population was from *Tharu* caste. Out of the 189 children, 51.3% were males 48.7% were females. 98.4% of household were Hindu and the rest 1.6% were Christian. 32.3% of the household had annual income less than 1 lakhs, 49.7% of the household had annual income in range between 1 to 3 lakhs whereas 18% of the household earned more than 3 lakhs annually. The major occupation of the household was foreign employment 34.9%, followed by agriculture with 31.2%, the household engaged in labor, service and business were 22.8%, 8.5% and 2.6% respectively. 12.2% of the mothers were illiterate, 47.6% studied upto primary level, 30.7% secondary level and 9.5 % of mothers studied upto higher secondary level and above. 23.8% of children had low birth weight and the others birth weight were normal. 88.9% of children were born by natural birth whereas 11% babies were delivered by caesarean birth. The mean birth spacing was 3.37±1.8 years. Maximum and minimum birth spacing was found to be 9 year and 1 year respectively. 99.5 % of mother breastfed their child while 97.9% of the mothers in survey fed colostrum to their children. Majority of mothers 84.7% exclusively breastfed their child until 6 months and majority of child initiated complimentary feeding at the age of 6 month. 79.4% of household use packaged iodized. 98.4% of total children were fed with Vit.A and deworming tablet.

62.4% of the child had medium dietary diversity followed by low dietary diversity 28.6% and very few had high dietary diversity with 9%. Regarding food frequency of child within 7 days, the result showed that mean food frequency of child within 7 days was

80±18.303. Children having food frequency less than or equal to 80 were 34.9% whereas children having food frequency more than 80 were 65.1%.

The total numbers of sample for measuring prevalence of anemia were 48 where 60.4% of the children were anemic. Among them, 2.1% were severely anemic, 29.15% were moderately anemic and 29.15% were mildly anemic whereas 39.6% were normal.

According to length/height for age, 27% of children were stunted. Among them, 6.9% were severely stunted while 20.1% were moderately stunted. Prevalence of stunting was seen more in female than in male with 28.30% of stunted in female while 25.80% of male were stunted. According to weight for height, 13.2% children were wasted and among them 10.6% were moderately wasted and 2.6% were severely wasted. Prevalence of wasting was seen very slightly greater in male with 13.40% while 13.00% of females were wasted. According to weight for age, 21.2% of children were underweight among them 3.7% were severely underweight and 17.5% were moderately underweight. Prevalence of underweight was found greater in males with 23.70% while 18.50% of females were underweight.

Chi – square test revealed that IDDS ($P<0.05$) was significantly associated with stunting, wasting and underweight. Greater the Individual Dietary Diversity Score lesser will be the chance of getting malnourished. Food frequency ($P<0.05$) was significantly associated with stunting and underweight. Children whose food frequency is more than 80 were less prone to stunting Child age ($P<0.05$), Annual income ($P<0.05$), Birth order ($P<0.05$) was significantly associated with wasting, stunting and underweight respectively. The children less than 24 months are more prone to wasting than the child above 24 months. Children of poor people having income less than 1 lakh were more prone to stunting in comparison to children of family having income more than 1 lakhs. The findings of the study depicts that there were greater risk of underweight in first child born in a household.

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APPENDICES

APPENDIX- A

Consent letter

Namaste!

I Mr. Basudev Bhattarai, graduate student in Department of Nutrition and Dietetics conducting a dissertation work for award of bachelor's degree in Nutrition and Dietetics.

The topic for the study is "***Nutritional status and prevalence of anemia among 6 - 59 months children in Tharu community of Duruwa VDC, Dang***."

I have been told in a language that I understand about the study. I have been told that this is for a dissertation procedure, that my and my son/daughter's participation is voluntary and he/she reserve the full right to withdraw from the study at my own initiative at any time without having to give reason and that refresh to participate or withdraw from the study at any stage will not prejudice my/his/her rights and welfare. Confidentiality will be maintained and only be shared for academic purposes.

I hereby give consent to participate in the above study. I am also aware that I can withdraw this consent at any later date, if I wish to. This consent form being signed voluntarily indicates participate in the study until I decide otherwise. I understand that I will receive a signed and dated copy of this form.

I have signed this consent forms before my participation in the study.

Signature of parent/guardian: _____ Sign of witness: _____

Date: Date:

Place: Place:

I hereby state the study procedures were explained in the detail and all questions were fully and clearly answered to the above mentioned participant /his/her relative.

Investigator's sign:

Date:

APPENDIX- B

Questionnaire

Survey Questionnaire

Code no.:- ☐ Date of Interview: 2072/ /

A. General Information

1. Name of head of household:
2. Ward No.:
3. Respondent : Mother Father Other Family Members
4. Mother's Name:
5. Mother's Age:
6. Child Name: DOB:

B. Family Description

7. No. of total family members:
   Female: Male:
   No. of children: Boys: Girls:
   No. of children below 5 year:
8. Has any children died in your family till now?
   1. Yes 2. No

   If yes, how many ……
9. Type of family?
   1. Single 2. Large 3. Extended
10. House, currently you living is…
    1. Own 2. On rent
11. What is your religion?
    1. Hindu 2. Buddhist 3. Christian 4. Muslim 5. Others
12. What is the main occupation of your family?
    1. Agriculture 2. Service 3. Labour 4. Business 5. Foreign employment 6. Others
13. What is the main income source of your family?

1. Agriculture 2. Service 3. Labour 4. Business 5. Foreign employment 6. Others

14. How long is the family income sufficient to fulfill the needs of family members?

1. <3 months 2. 3 – 6 months 3. 6-12 months 4. >12 months 5. Can save some

15. Annual income of your family

1. < 1 lakh 2. 1 to 3 lakh 3. > 3 lakh

16. Mother's educational qualification

1. Illiterate 2. Primary level 3. Secondary level 4. Higher secondary level and above

17. Father's educational qualification

1. Illiterate 2. Primary level 3. Secondary level 4. Higher secondary level and above

19. What is the occupation of mother?

1. Housewife 2. Service 3. Laboour 4. Business 5. Others

C. Personal and environmental hygiene

20. What is your source of drinking water?

1. Tube well 2. River 3. Well 4. Drinking water tap 5. Other

21. Do you purify drinking water?

1. No 2. Yes

22. Do you have toilet facility in your house?

1. No 2. Yes

23. What cooking fuel do you use for cooking?

1. Fire wood 2. Dung gas 3. Dried animal dung 4. Stove 5. LPG 6. Others

24. How do you manage garbage coming out from your house?

……

D. Questions to be asked for mother of under 5 children

25. No. of under 5 year children:

26. In your absence, who is responsible to take care of your child?

1. Mother/Father in-law 2. Husband 3. Brother/Sister of child 4. Other family member 5. Relatives 6. Neighbor/Friend 7.Leave alone in home 8. Self 9. Others

27. Birth order of child under study:……

28. Birth spacing: …… months/years

29. Where do you take your children for treatment during illness?

1. Nearby health post 2. Pharmacy 3. FCHV 4.Traditional healer

5. Don't take anywhere 6. Others

D. Nutrition and Breast feeding related information

30. Did you breast fed your child on the day of birth?

1. No 2. Yes

31. Did you breast fed your child?

1. No 2. Yes

32. If not, what is the reason?

1. Lack of tradition 2. It harms 3. It is unhygienic 4. Child cannot swallow 5. Others

33. If Yes then when did you initiate breast feeding?

1. within 1 hour of birth 2. Within 8 hours of birth 3. Within 24 hour of birth

4. Cannot remember 5. Other

34. Did you feed colostrum to your baby?

1. Yes 2. No 3. Cannot remember

35. What did you feed to your baby before feeding colostrum milk?

1. Nothing 2. Honey and Ghee 3. Cow's milk 4. Alcohol 5. Others

36. Are you breast feeding your child ?

1. Yes 2. No

37. If yes, then how many times do you breast feed your child? …….. times/day

38. How long a child should be breast fed or how long did you breast feed your child?

…… months/years

39. Did you exclusively breast fed your baby for six months?

1. Yes 2. No

40. Did you feed commercial or formula milk to your baby?

1. Yes 2. No

41. Are you feeding food other than breast milk to your baby?

1. Yes 2. No

42. When did you start giving foods other than breast milk to your child?

1. 4 months 2. 5 months 3. 6 months 4. 7 months 5. More than 7 months

43. How many times do you feed food other than breast milk to your child?

…….. times/day

44. What do you feed to your child?

1. Lito 2. Jaulo 3. Supper flour porridge 4. Same as other family members
5. Others

45. Do you know about “supper flour porridge”?

1. Yes 2. No

46. Do you feed supper flour porridge to your baby?

1. Yes 2. No

47. If yes then from where did you obtain it?

1. Market 2. Prepare at home 3. Sometimes from market and sometimes prepare at home

48. What is the proportion of cereals and pulses in supper flour porridge?

1. 1:1 2. 1:2 3. 2:1 4. No fixed ratio

49. What type of food do your child like to have?

1. Home made 2. Fast food and Junk food

50. Do you know about malnutrition?

1. Yes 2. No

51. If yes, What is the main cause of malnutrition?

1. Inadequate balanced diet 2. Being touched by pregnant women
3. Curse of god 4. Others

52. What type of salt do you use in your home?

1. Rock Salt 2. Packaged Salt 3. Aayo Nun

53. Do you use iodized salt?

1. No 2. Yes

54. Did you give “Vit.A” capsule and “De-worming” tablet to your baby?

1. No 2. Yes

55. Do you feed green leafy vegetables to your child?

1. Always 2. Sometimes 3. When available 4. Never 5. Other

E. Child and Maternal Health Related Information

56. Mother's age when she got married? …….. year

57. Mother's age when she was pregnant for first time? …….year

58. Type of birth?

1. Natural 2. Caesarian

59. Weight of child during birth?

1. less than 2.5 Kg 2. More than 2.5 Kg 3. Don't know

60. Do pregnant mother require additional nutrients?

1. No 2.Yes

61. How do you manage food for pregnant women in your family?

1. Give more food than usual

2. Give less food than usual

3. Give same amount of food as before

62. Did you take iron and folate tablet during pregnancy?

1. No 2. Yes

66. If yes, how long did you take it? ……

F. Question about feeding of Child

a. Within 7 days how many times did you feed your child? ……..

S.N	Food	Frequency	SN	Food	Frequency
1	Cereals (Rice/bread/maize/lito/ khichadi/ pudding/ biscuit/noodles etc)		7	Fish and crab	
2	Root and tubers (potato/ sweet potato/ yam/ githa/ Pidalu etc.)		8	Legumes and pulses (Bhatmas, chana/ moong/ lentil/ pea/ rahar etc.)	
3	Green leafy vegetables and other vegetables (Rayo saag,/ Spinaich/ Khole saag/ cauliflower/ cabbage/ bottle guard/ash guard/ pumpkin/ bodi etc)		9	Milk and milk products(Milk/curd/yoghurt /paneer/mohi etc.)	
4	Fruits (Papaya/ banana/ pomogranate/ grapes/ gauva/ orange/ bhogate etc.)		10	Oil, Ghee, fat etc.	
5	Meat (chicken/ goat/ buffalo/ pig/ duck/ pigeon etc.		11	Sugar/honey etc.	
6	Egg		12	Others (Tea/ coffee/ beverages)	

b. For calculation of IDDS

……..

H. Anthropometric measurements

Age (months)	**Sex (M/F)**	**Weight (Kg)**	**Height (Cm){**	**MUAC (mm)**	**Oedema (Y/N)**
Z- Score					
WFA	**HFA**	**WFH**	**Hemoglobin (g/dl)**		

APPENDIX- C

Consent from NHRC

Government of Nepal

Nepal Health Research Council (NHRC)

Estd. 1991

Ref. No.: 628

03 October 2016
Mr. Basudev Bhattarai
Principal Investigator
Central Campus of Technology, Institute of Science and Technology
Dharan, Nepal

Ref: **Approval of Research Proposal** entitled **Nutritional status and anemia among 6 months to 59 months children in Tharu community of Duruwa VDC, Dang**
Dear Mr. Bhattarai

It is my pleasure to inform you that the above-mentioned proposal submitted on 09 August 2016 (**Reg. no. 222/2016** please use this Reg. No. during further correspondence) has been approved by Nepal Health Research Council (NHRC) National Ethical Guidelines for Health Research in Nepal, Standard Operating Procedures Section 'C' point no. 6.3 through Expedited Review Procedures.

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-1,000.00**. It is acknowledged that the above-mentioned processing fee has been received at NHRC.

If you have any questions, please contact the Ethical Review M & E Section at NHRC.

Thanking you,

Dr. Khem Bahadur Karki
Member- Secretary

APPENDIX- D

Map of Duruwa V.D.C

Photo Gallery

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1. Measuring Weight

2. Measuring MUAC

3. Measuring Haemoglobin level

4. Measuring Height