ASSESSING MOTHERS KNOWLEDGE IN BREASTFEEDING AND CHILDCARE PRACTICES AND ITS IMPACT ON MALNUTRITION AMONG 6 TO 59 MONTHS CHILDREN IN THE MUSAHAR COMMUNITY OF RATUWAMAI MUNICIPALITY

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Assessing Mothers Knowledge in Breastfeeding and Childcare practices and its impact on Malnutrition among 6 to 59 months children in the Musahar community of Ratuwamai Municipality

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 ***Assessing Mothers Knowledge in Breastfeeding and Childcare practices and its impact on Malnutrition among 6 to 59 months children in the Musahar community of Ratuwamai Municipality*** presented by **Dipesh Khanal** has been accepted as the partial fulfillment of the requirements for the **B.Sc. degree in Nutrition and Dietetics.**

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Abstract

This study aimed to assess the mother's knowledge in breastfeeding and childcare practices and its impact on malnutrition among 6-59 months children in *Musahar* community of Ratuwamai Municipality, Morang. A community-based cross-sectional study was conducted with 116 children using census sampling. Data were collected via pretested, semi-structured questionnaires covering socio-economic and demographic factors, child characteristics, childcare practices, maternal characteristics, maternal knowledge on childcare practices, food frequency and hygiene practices. Anthropometric measurements (height, weight, MUAC) determined the prevalence of wasting, stunting, and underweight based on WHO standards. Data were analyzed using SPSS version 20 and WHO Anthro 3.2.2, with Chi-square for significant associations.

The prevalence of wasting, underweight and stunting was 24.1%, 33.6% and 29.3% respectively. Wasting and underweight were more prevalent in male children, while stunting was higher in female children. Underweight was most common in children aged 24-35 months, stunting in 36-47 months, and wasting in 12-23 months. About 49.1% of mothers had poor knowledge, 43.1% had average knowledge, and only 7.8% had good knowledge on breastfeeding and childcare practices. The mother's knowledge on breastfeeding and childcare practices was significantly associated with stunting and underweight but not with wasting. Significant factors for wasting included age, birth weight, and the mother's age at first pregnancy. Stunting was associated with family type, birth weight, colostrum feeding, baal-vita supplementation knowledge, and the mother's education level. Factors such as birth weight, malnutrition knowledge, complementary feeding knowledge, frequency of meal during pregnancy and lactation, mother's education were found to be significantly associated with underweight.

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List of Abbreviations

Abbreviations	Full form
BMI	Body Mass Index
CC	Chest Circumference
FFQ	Food Frequency Questionnaire
GoN	Government of Nepal
HAZ	Height for age Z-score
HC	Head Circumference
HFA	Height for Age
ICMR	Indian Council of Medical Research
IDA	Iron Deficiency Anemia
INGOs	International Non-Governmental Organizations
MAM	Moderate Acute Malnutrition
MoHP	Ministry of Health and Population
MUAC	Mid Upper Arm Circumference
NCDs	Non-Communicable Diseases
NDHS	Nepal Demographic Health Survey
NGOs	Non-Governmental Organizations
ORS	Oral Rehydration Solution
PEM	Protein Energy Malnutrition

RDA	Recommended Dietary Allowances
SAM	Severe Acute Malnutrition
SD	Standard Deviation
SPSS	Statistical Package for Social Science
UNICEF	United Nations International Children Emergency Form
VAD	Vitamin A Deficiency
VDC	Village Development Committee
WAZ	Weight for Age Z-score
WFA	Weight for Age
WFH	Weight for Height
WHO	World Health Organization
WHZ	Weight for Height Z-score

Part I

Introduction

1.1 Background of the study

Nutrition is the process by which living organisms take in and use food for the maintenance of life, growth, reproduction, the functioning of organs and tissues, and the production of energy. Optimal nutrition is achieved through a balanced diet that provides all essential nutrients, while poor nutrition can result from inadequate or excessive nutrient intake or poor utilization. Poor nutrition can lead to reduced immunity, increased susceptibility to disease, impaired physical and mental development, and reduced productivity (Mudambi SR, 2006).

Nutrition is the science that deals with digestion, absorption and metabolism of food, i.e., the utilization of food in the body. It may be defined as, the science that interprets the relationship of food to the functioning of living organism. It includes the uptake of food, liberation of energy, elimination of wastes and all the processes of synthesis essential for maintenance, growth and reproduction. These fundamental activities are characteristic of all living organisms from the simplest to the most complex plants and animals. Nutrition is the intake of food, considered in relation to the body's dietary needs. Good nutrition that comes from an adequate, well balanced diet combined with regular physical activity is a cornerstone of good health (Khanna, 2005). Inadequate nutrition and early exposure to disease and infection can have long-term effects on a child's development and health because early childhood is a period of rapid physical and mental growth. Approximately one-third of children are not getting adequate nourishment, especially during the critical first 1,000 days from conception to their second birthday, and often beyond (UNICEF, 2019).

The importance of nutrition education as a means for improving the nutrition of the community in the developing countries has been increasingly realized during recent years. Lack of knowledge of the dietary requirements and the nutritive value of different foods is the main contributory cause for the widespread occurrence of malnutrition among pre-school children and other vulnerable groups of the population in the developing countries. Nutrition education should be practiced and adopted to suit the socio-economic conditions, food habits and local food resources. It should include effective demonstration feeding in which mothers take active part (Swaminathan, 2008).

Childhood is a crucial period of life for humans, both physiologically and psychologically. Dring this time, the individual attains full adult stature and full functional capacity of organs and systems, achieves a mature view of the world and develops independence from parents. Childhood is the period of maximal growth, skeleton enlargement, and remodeling of body composition. During this phase, nutrition is essential for maintaining an appropriate growth characteristic, building immunity against infectious diseases, and ensuring good health in later life all depend on getting an adequate and balanced quantity of energy and nutrients (Evans, 2015).

Inadequate dietary intake leads to malnutrition in the form of wasting, stunting and underweight with characteristics symptoms like weight loss, growth failure and lower immunity. Severe and repeated infectious diseases lead to appetite loss, nutrient loss, mal absorption and also altered metabolism which finally leads to malnutrition and results in poverty. Malnutrition continues to be a primary cause of ill health and mortality among children in developing countries. It is one of the major public health problems and accounts for about half of all child deaths worldwide. Malnutrition commonly affects all groups in a community, but infants and young children are the most vulnerable because of their high nutritional requirements for growth and development. Women and young children bear the brunt of the disease burden associated with malnutrition (WHO, 2005).

Ratuwamai Municipality is situated in south-eastern Terai in Morang district and Koshi Province of Nepal. Ratuwamai municipality is named after the Ratuwa river. The total population of Ratuwamai municipality is 61139 with 26335 males and 29045 females (2021).This municipality covers an area of 142.15 km^2.It is surrounded by Ratuwa River in the east, Sunwarsi Municipality and Pathari Sanishchare Municipality in the west, Urlabari Municipality in the north and India in the South. The main occupation of the people is agriculture, most of the people earn by farming. 85 percent of the land in the municipality is utilized for agriculture purpose. Ratuwamai Municipality is home to a diverse population, including various ethnic and caste groups.

1.2 Statement of problem and justification

Malnutrition is a major public health problem over larger area of developing countries and particularly amongst low socio-economic groups. Half of the children born in low-income societies die before they are five years of age. Children's age under 59 months is the critical period for rapid physical growth as well as overall child development. They suffer from various forms of undernutrition if the nutritional requirement is compromised. Undernutrition among children is a significant contributor to the global disease burden and a leading cause of child mortality worldwide (Black *et al.*, 2008). Under-nutrition is the issue of concern among under-5 children in terms of morbidity and mortality as it is causing as high (175/1000) deaths in low-income countries compared to high income countries (6/1000 deaths). Under nutrition places children at an increased risk of impaired physical and mental growth, poor socio-emotional development due to deficiencies of micro and macro nutrients like protein, iodine, iron and vitamin A (Gaurav *et al.*, 2014).

Malnutrition, in every form, presents significant threats to human health. Today the world faces a double burden of malnutrition that includes both under nutrition and overweight. According to WHO report, 149 million children under the 5 years of age are stunted, 49 million children under 5 years are wasted, only 41% infants below 6 months are exclusively breastfed, 40 million children under 5 years are overweight and 15% babies are born with low birth weight worldwide (WHO, 2019b). Globally, 462 million are underweight, with its prevalence in children under five in South Asia being 27.4%. Around 70–80% of undernourished children worldwide live in lower and middle-income countries, including Nepal. Half of the cases of mortality in children under five years of age (54 per 1000 live births) are associated with malnutrition (Shrestha *et al.*, 2023). According to NDHS 2022, 25% of children under 5years of age are stunted (short for their age), 8% are wasted (thin for their height), 19% are underweight (thin for their age), and 1% are overweight (heavy for their height). 55% of children under age 0-23 months were breastfed within 1 hour of birth, and 56% of children under 6 months were exclusively breastfeed. 78% of children age 6-23 months received meals with minimum recommended diversity (at least 5 out of 8 defined food groups) (MoHP, 2022).

The indicators of nutritional status are wasting, stunting, underweight and overweight among the children (Ridesh Pokharel *et al.*, 2019). Wasting, stunting and underweight each

reflect different processes. Wasting reflects acute nutritional deprivation. Stunted children have experienced cumulative retardation in their physical growth because of chronic malnutrition; that may be aggravated by many other associated factors. Underweight is associated with both chronic and acute undernutrition; however, it may not appropriately distinguish between taller but wasted children and shorter children of adequate weight (Pasricha *et al.*, 2010).

The *Musahar* community, in Terai Nepal, is socially and economically one of the most marginalized communities in Nepal and they are poorest amongst poor. The *Musahar* community falls under the category of the Dalit. The Musahars, they are famous as named by "rat eaters". It is considered the worse of the Dalit groups, the untouchables, which are the most segregated communities in Nepal. They are discriminated for their skin color, religion, and traditions. *Musahar* community is suffering from the extreme nutritional problem. Their nutrition status directly affects the health status of the country. The factors behind the poor nutritional status are needed to be identified to support the community to improve their nutritional status (S. Shah *et al.*, 2016). *Musahar* community is one of the oldest communities in Nepal. Their economic condition is still poor so that there is lack of accessibility for foods consumption and health facilities. Most of them are illiterate and uneducated so, they are not much aware of food habits and the nutrition. Their hygiene and sanitation behaviors are still to be improved so their children are more susceptible to the various communicable diseases and prone to be malnourished (Ojha, 2003).

Study conducted among *Musahar* children aged between 12-59 months in urban Siraha district showed that 47%, 36% and 21% of children were stunted, underweight, and wasted respectively (S. Shah *et al.*, 2016). Similar study conducted among 6-59 months children in *Musahar* community of Madheli VDC, Sunsari revealed 61.7%, 41.7% and 10% of children under five years were stunted, underweight and wasted (Chaudhary, 2018).A study conducted in *Musahar* children of Ramdhuni Municipality, Sunsari found 51.5% stunted, 12.1% wasted and 37.6% underweight among 6-59 months children (Dahal, 2018).The results of these studies indicated that under nutrition is still a serious problem among under five children in underprivileged community.

1.3 Objectives of the study

1.3.1 General objective

The general objective of this survey is to assess the mother's knowledge in breastfeeding and childcare practices and its impact on malnutrition among 6-59 months children of *Musahar* community in Ratuwamai Municipality.

1.3.2 Specific objectives

a) To determine the nutritional status of *Musahar* children aged 6-59 months in Ratuwamai Municipality.
b) To find out factors associated with malnutrition in children.
c) To assess the knowledge of mother on breastfeeding and childcare practices.
d) To assess the association between mother's knowledge and nutrition status of children.

1.4 Research questions

a) What is the current nutritional status of 6-59 months *Musahar* community children in Ratuwamai Municipality?
b) What is the level of maternal knowledge in breastfeeding and childcare practice in the study Population?
c) What are the factors associated with nutritional status of 6-59 months *Musahar* children?
d) Is there any association between mother's knowledge and nutritional status of children?

1.5 Significance of the study

The findings of the study will be helpful to:

a) Identify nutritional status of 6-59 months of *Musahar* children who are malnourished or risk of being malnourished.
b) Discover the problems related to child nutrition, care practice, feeding pattern, beliefs and other direct or indirect associated factors of *Musahar* community.

c) Act as a guide for the development of proper nutritional program as a corrective measure of the prevalent situation in the community by analyzing the discovered facts.
d) Provide nutritional knowledge to mother on childcare practice and also encourage other local people to improve current nutritional status of children by improving feeding pattern, faulty food habits and food beliefs of 6-59 months of children.
e) Provide information to government, other private sector and voluntary institution like NGOs, INGOs about nutritional status of under-five year *Musahar* children.

1.6 Limitations

a) As this is a cross sectional study, the prevalence of malnutrition might be affected by seasonal variation, which is not taken into consideration during data collection.
b) The study was conducted with limited resources due to which other important assessments like biochemical and clinical assessment could not be done.

PART II

Literature review

2.1 Nutrition status

Nutrition is the basic foundation of human life, health, and development across the life span, which is essential for survival from the earliest stage of fetal development, at birth to old age. Good nutrition includes physical growth, mental development, performance and productivity, health, and well-being (Banstola and Acharya, 2015).

Nutritional status is defined as the health status of individuals or population groups as influenced by their intake and utilization of nutrients Optimal nutrition in infancy and early childhood is essential to meet the demands of rapid growth and development. Under-nutrition reduces immunological capacity to defend against diseases, and recurrent infections, in turn reduce and deprive the body from essential nutrients (De and Chattopadhyay, 2019).

Nutritional status is the result of complex interactions between food consumption and the overall status of health and health care practices. Similarly, it can be defined as the condition of health of the individual as influenced by the utilization and interaction of nutrients in body. It can be determined through a careful medical, dietary history, physical examination, and appropriate laboratory investigation (Robinson, 1972).

Nutritional status of children is a proxy indicator for assessing the entire population health status and one of the major predictors of child survival (T. R. Bhandari and Chhetri, 2013). The nutritional status of an individual is determined by the quality of nutrients consumed, and the body's ability to utilize them for its metabolic needs. Thus, nutritionally vulnerable under 5-year children's nutritional status is generally accepted as an indicator of the nutritional status of any particular community. The prevalence of poor nutrition status on developing country is mainly due to the low income, low production of food, low productivity of crops and livestock, unequal distribution of food, low literacy, socio-culture and poor environmental sanitation (Davidson, 1992).

2.2 Mother nutritional knowledge

Mothers' nutrition knowledge and child feeding practices are essential in child's growth and development. Without adequate nutrition knowledge and optimal feeding practices, poor nutritional status among children can arise even in households with adequate income and food, good sanitation and health services (Jemide *et al.*, 2016a) . Nutritional awareness of mothers plays a significant role in the health of children below five years. The type of care she provides depends to a large extent on her knowledge and understanding of some aspects of basic nutrition and health care. Mothers educational level, health and nutritional status is central to the quality of life and is a key ingredient of her child's health, nutritional status, behavioral and other aspects of child welfare in developing countries (Kaur *et al.*, 2015). Knowledge of mothers has a significant role in the maintenance of nutritional status of the children. Having adequate knowledge about various aspects of feeding practices during pregnancy and infancy is essential especially among females as they are going to influence the feeding practices of this vulnerable group. The knowledge of child nutrition and caring practices can be expected to have significant bearing on their children's nutritional status as studies have observed a positive relationship between childhood malnutrition and maternal knowledge and beliefs regarding nutrition (Mary, 2013).

A study conducted in *Batar* children under five years of age in Jhorahat VDC showed that mothers' nutritional knowledge is significantly associated with wasting and underweight. Mothers who had poor knowledge score level have higher percentage of wasted children's than mother who had average or good knowledge score. Also, prevalence of underweight was significantly higher among children whose mothers had poor nutritional knowledge (Rai, 2021).

A survey conducted in Nigeria revealed the significant association between maternal knowledge on child health and nutrition with underweight and stunting, but not with wasting. Underweight and stunting prevalence was lowest among mothers who exhibited good knowledge about health and nutrition of children compared with those who showed poor or average knowledge (Jemide *et al.*, 2016a).

2.3 Malnutrition in children

Malnutrition is the result of deficiency, excess or imbalance of nutrients. It is a state of impaired functional ability which may occur due to insufficient food intake or the lack of foods that supply the nutrients. Thus, the term malnutrition also covers the term undernutrition which is defined as "the state in which either the food intake is inadequate in some respect to meet the body demands or the physiological and environmental conditions are such that the body is unable to utilize the sufficient food material to provide for proper growth, maintenance and repair (Khanna, 2005).Malnutrition in early childhood is associated with significant functional impairment in adult life, reduced work capacity and decreasing economic productivity. Severe malnutrition can do irreparable damage to the body affecting physical, mental and intellectual well-being of a person (Banstola and Acharya, 2015).

Malnutrition remains one of the most common causes of morbidity and mortality among under-five children throughout the World. Every year, 7.6 million children die before they reach the age of five, most from preventable or treatable illnesses and almost all in developing countries. Malnutrition is an underlying cause of more than a third (35%) of these deaths. Malnourished child has lowered resistance to infection; therefore, they are more likely to die from common childhood diseases such as diarrhea and respiratory infections. In addition, malnourished children that survive are likely to suffer from frequent illness, which adversely affects their nutritional status and locks them into a vicious cycle of recurring sickness, faltering growth and diminished learning ability (Mengistu *et al.*, 2013).Malnutrition continues to be a major public health problem in developing countries. It is the most important risk factor for the burden of diseases. About one-third of all children under the age of 5 years in developing countries are stunted, and 20% are underweight. Wasting, which is also known as moderate acute malnutrition (MAM), has a global prevalence of 10% (55 million children affected).Underweight, stunting, and wasting contribute to 19%, 14.5%, and 14.6% of deaths, respectively, among children under the age of 5 years in the developing world (Ahmed *et al.*, 2020). According to the Nepal Demographic and Health Survey report, 25 percent of children under five years are stunted, 8 percent are wasted, 19 percent are underweight and 1 percent of children under age 5 are overweight (NDHS, 2022).

2.4 Causes of malnutrition:

Malnutrition can be caused by various factors. There is no single cause of malnutrition. Causes of malnutrition may range from individual, families, district, country, regions, and global level. Unavailability of enough food, having difficulty in eating or absorbing nutrient can cause malnutrition. Health conditions such as vomiting, loss of appetite, mental health disorders, and some medicines can also cause malnutrition (Ersado, 2022). The causal path of acute malnutrition is very complex, whereby biological, cultural and socio-economic factors are interrelated. The common causes of malnutrition are lack of access to the availability of food, poor feeding practices, inappropriate complementary feeding practice, infections, lower birth weight, lack of mother's education and low knowledge of micronutrient management. Early marriage age and lack of maternal autonomy are also the factors affecting nutritional status of children (Prajapati *et al.*, 2018).

As described by the UNICEF casual framework (Fig.2.1), the causes of malnutrition are divided into immediate, underlying and basic causes; inadequate dietary intake and disease are the immediate causes; household food insecurity, inadequate care and poor sanitation and hygiene practice are underlying causes; other socio-economic characteristics are classed as basic causes of malnutrition in developing countries (Qureshi, 2019).

2.4.1 Immediate causes of malnutrition

The very first immediate cause of nutritional deficiency is inadequate dietary intake in terms of quality and quantity. The normal Nepalese diet typically comprises mostly of carbohydrates but not enough protein and other micronutrients. Not all Nepalese are privileged to have meat, eggs, milk, legumes, fruits, vegetables. Even if they do, they do not consume regularly. Recurrent infection like acute respiratory infections, gastroenteritis, worm infestations further aggravate the problem. The relationship between malnutrition and infection is cyclic, nutritional deficiency can make an individual more susceptible to disease, while disease contributes to nutritional deficiency. All of this adds up to an increased risk of death (Devkota *et al.*, 2015).

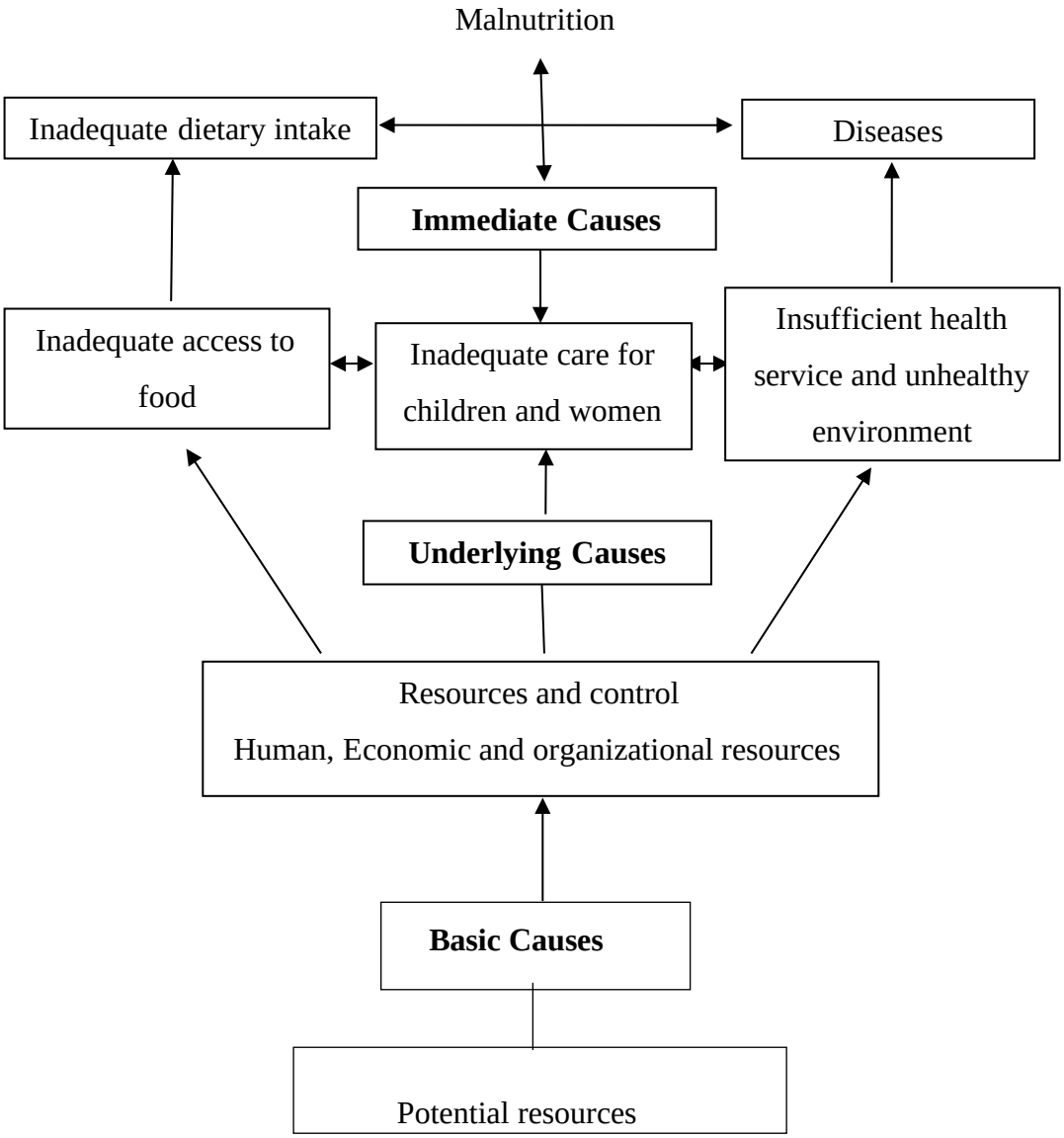

Fig. 2.1 UNICEF Conceptual Framework of Malnutrition(Den Hartog *et al.*, 2006)

2.4.2 Underlying causes of malnutrition

The underlying cause of nutritional deficiency disorders are lack of household food security, lack of proper social services and care environment and lack of health care and healthy environment. Seventy percent of the population of Nepal are involved in agriculture but still not growing enough food grains. Average household food production can meet their food needs for only about four months. Likewise, ineffective and insufficient health care services, improper care practices, inadequate or delayed treatment of childhood illnesses, lack of

proper environmental sanitation, lack of proper care of vulnerable group of population, lack of proper nutrition education are other contributing factors for the problems. These underlying causes are not discrete causes but interact in important ways, as shown in the Figure (Devkota *et al.,* 2015).

2.4.3 Basic causes of malnutrition

The causes of malnutrition identified in UNCIEF conceptual framework on causes of malnutrition included potential resources and control (human, economic, and organizational resources). In basic causes, there are three essential parts of resources: human resource (people, knowledge, skill, and time), economic resource (assets, lands, income, and others), and organizational resources (formal and informal institutions, extended families, and child care organizations). The basic causes of malnutrition are poverty, lack of information, political and economic insecurity, war, lack of resources at all levels, unequal status of women, and/or natural disasters (Ersado, 2022).

2.5 Forms of malnutrition

Malnutrition can be classified into four forms i.e., under-nutrition, over-nutrition, specific deficiency and imbalance (Jelliffe, 1997).

a) Under-nutrition: It is the condition which results when insufficient food is eaten over an extended period of time. Undernutrition means, the body lacks sufficient amounts of the nutrients needed to produce energy, grow, maintain and repair tissues, and support the body's systems, especially the immune system. Undernutrition occurs when someone has not eaten enough energy or essential nutrients because of a poor diet, illness, or a loss of appetite (Jelliffe, 1997).

b) Over-nutrition: It is defined as the pathological state resulting from the consumption of excessive quantity of food over an extended period of time. It occurs when a person consumes more energy than the body needs. Obesity is a risk factor for several nutrition-related non-communicable diseases (NCDs), including cardiovascular diseases, type 2 diabetes, and some cancers (Jelliffe, 1997).

c) Specific deficiency: This is the pathological state resulting from a relative or absolute lack of an individual nutrient. Micronutrient deficiencies such as Vitamin A deficiency,

Iodine deficiency disorders, Iron deficiency disorders are some examples of specific deficiency. It occurs due to a low intake, limited ability of the body to absorb or use the micronutrient, or excessive loss from the body usually because of illness (Jelliffe, 1997).

d) Imbalance: It is the pathological state resulting from a disproportion among essential nutrients with or without the absolute deficiency of any nutrients (Jelliffe, 1997).

2.6 Types of malnutrition

The main types of malnutrition prevailing in humans are protein energy malnutrition (PEM) and micronutrient malnutrition, brief descriptions of which are described in the following sections.

2.6.1 Protein energy malnutrition (PEM)

PEM is defined as range of pathological conditions arising from coincident lack of varying proportions of protein and calorie, occurring most frequently in infants and young children and often associated with infection (Srilakshmi, 2014) . It results from a diet deficit in energy and protein because of lack of all major macronutrients, such as carbohydrates, fats and proteins. In children, protein–energy malnutrition is defined by measurements that fall below 2 standard deviations under the normal weight-for-age (underweight), height-for-age (stunting) and weight-for-height (wasting). Protein-energy malnutrition usually manifests early, in children between 6 months and 2 years of age and is associated with early weaning, delayed introduction of complementary foods, a low-protein diet and severe or frequent infections (Müller and Krawinkel, 2005). The term protein-energy malnutrition (PEM) applies to a group of related disorders that include marasmus, kwashiorkor and intermediate states of marasmic kwashiorkor. The peak prevalence of kwashiorkor is frequently seen in the age group of 2-3 years and marasmus in 1-2 years (Srilakshmi, 2014).

The following are the causes for underweight for age which may precipitate into PEM (Srilakshmi, 2014):

- Due to poverty, mother is not able to provide sufficient food to the child resulting in under nutrition.

- The starchy gruels made from local staple food like rice, wheat, bajra, ragi, jowar or maize would result in “dietary bulk with a low caloric density”. Hence, the child may not be able to meet calorie requirement.
- Late weaning and ignorance of importance of weaning can lead to under nutrition.
- Malnutrition can result in less enzymes synthesis and less appetite leading to less consumption of food.
- Chronic infections like primary complex may result in anorexia.
- Infestation like ascariasis particularly giardiasis may lead to anorexia.

Classification of PEM is as follows:

i. Marasmus: The term marasmus is derived from the Greek word marasmos, which signifies wasting. Marasmus involves inadequate intake of protein and calories and is characterized by emaciation. Marasmus is caused by a severe nutritional deficiency in general. It is usually found in very young infants and very young children. It can be prevented by breastfeeding. It is actually caused by the total or partial lack of nutritional elements in the food over a period of time (Müller and Krawinkel, 2005).

Symptoms of marasmus includes (Jee, 2021):

- Severe growth retardation
- Loss of subcutaneous fat
- Severe muscle wasting
- Limbs appear as skin and bone
- Wrinkled skin
- Irritability, fretfulness and apathy
- Frequent watery diarrhea and acid Stools
- Mostly hungry but some are anorectic
- Dehydration
- Oedema and fatty infiltration are absent

ii. Kwashiorkor: It is derived from African word meaning ‘the sickness the older child gets when the next baby is born’. It refers to the observation that the first child develops PEM, when the second child is born. The new child then replaces the first child from receiving

breast milk thus obtaining less calories. 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 (Joshi, 2016).

Symptoms of kwashiorkor includes (Jee, 2021):

- Changes in skin pigment.
- Decreased muscle mass
- Diarrhea
- Failure to gain weight and grow
- Fatigue
- Hair changes (change in color or texture)
- Increased and more severe infections due to damaged immune system
- Irritability
- Large belly that sticks out (protrudes)
- Lethargy or apathy
- Loss of muscle mass
- Rash (dermatitis)
- Swelling (edema)

Difference between marasmus and kwashiorkor (Samanka, 2012) is as follows:

a) Edema is usually seen in kwashiorkor but not common with marasmus.
b) Marasmus usually affects very young children while kwashiorkor affects slightly older children.
c) In marasmus, muscle wasting is obvious with severe loss of subcutaneous fat, but in kwashiorkor, muscle wasting is sometime hidden by edema.
d) Marasmus children need to be treated with additional doses of vitamin B and a nutritious diet. Kwashiorkor patients are treated by adding more protein in their diet.
e) In marasmus weight is less than 60% of the mean for the age while in kwashiorkor body weight is 60-80% of the expected weight.
f) Hair changes are uncommon in marasmus, but in kwashiorkor, hair is spare and de-pigmented.

iii. Marasmic- Kwashiorkor: A child with features of both nutritional marasmus and kwashiorkor are diagnosed as having marasmic-kwashiorkor. A child with early kwashiorkor can develop marasmus by severe infective diarrhea and prolonged under feeding. Similarly, an infant with marasmus may develop kwashiorkor if fed on protein deficient carbohydrate rich food along with adequate salt (Müller and Krawinkel, 2005).

2.6.2 Micronutrient malnutrition

Micronutrient deficiencies, i.e., deficiencies of vitamins and minerals, are significant contributors to the global burden of disease. Micronutrient malnutrition goes largely unrecognized and hence is also referred to as 'hidden hunger', the consequences of which are high morbidity and mortality among young children (Vijayaraghavan, 2018). Deficiencies in iron, iodine, vitamin A and zinc are still major public health problems in developing countries. Micronutrient deficiencies affect at least 2 billion people worldwide (Müller and Krawinkel, 2005).

a) Vitamin A deficiency (VAD): Vitamin A is an essential micronutrient for humans, meaning that it cannot be biosynthesized in the body and thus must be obtained from dietary sources. Vitamin A is essential in regulating numerous key biologic processes in the body, including those involved in morphogenesis, growth, maturation, vision, reproduction, immunity, and more broadly, cellular differentiation and proliferation throughout life (Oruch and Pryme, 2012). VAD is the leading cause of preventable blindness in young children in the low-income countries in the world. Children even with milder signs of VAD have higher risk of morbidity and mortality. Inadequate dietary intakes of vitamin A with poor bioavailability associated with frequent infections are the primary contributory factors. Inadequate intakes of vitamin A in women during pregnancy and lactation, increase the chances of VAD in the offspring (Vijayaraghavan, 2018).

Vitamin A deficiency (VAD) is a persistent public health problem in developing countries, including Nepal. A recent study in 2016 revealed that VAD persists in most remote areas in Nepal. The study reported 4% and 3% VAD prevalence in children and women, respectively. This prevalence is partly due to socioeconomic factors such as illiteracy, limited accessibility to healthcare facilities, and financial constraints as well as nutritionally poor local diets (Thapa *et al.*, 2023).

b) Iron Deficiency Anemia (IDA): Iron is essential to all living organisms and is integral to multiple metabolic functions. The most important function is oxygen transport in hemoglobin. Iron deficiency results when iron demand by the body is not met by iron absorption from the diet. Iron deficiency anemia (IDA) is the most common nutritional deficiency worldwide. It can cause reduced work capacity in adults and impact motor and mental development in children and adolescents. There is some evidence that iron deficiency without anemia affects cognition in adolescent girls and causes fatigue in adult women. IDA may affect visual and auditory functioning and is weakly associated with poor cognitive development in children (Killip *et al.,* 2007). Iron deficiency slows the growth of children and increases their susceptibility to infectious disease. Children with iron deficiency have low developmental scores and poor ability to process information and are less happy, more wary and more dependent upon their mothers for social support (Lozoff *et al.*, 2006).

According to the data from NDHS 2022, 43% of children aged 6–59 months are anemic, including 25% are mildly anemic, 18% are moderately anemic, and less than 1% who are severely anemic. Similarly, 34% of women are anemic, including 18% are mildly anemic, 15% are moderately anemic, and 1% who are severely anemic. Women living in the Terai ecological zone are more likely to be anemic (45%) than those living in hills (20%) and mountain (23%) regions. More than half of the women are anemic in Madhesh Province, which is in the terai ecological zone (Ministry of Health and Population, 2022).

c) Iodine deficiency disorder (IDD): Iodine is an essential nutrient and is needed for the production of thyroid hormone. Iodine deficiency disorders (IDD) can lead to enlargement of the thyroid, hypothyroidism (resulting into slow metabolism), and to mental retardation in infants and children whose mothers were iodine deficient during pregnancy. Serious iodine deficiency during pregnancy can result in stillbirth, spontaneous abortion, and congenital abnormalities (Zimmermann *et al.*, 2008). Iodine deficiency during pregnancy and infancy may also impair growth and neurodevelopment of the offspring and increase infant mortality. Deficiency during childhood reduces somatic growth and cognitive and motor function. Iodine deficiency not only causes goiters, but may also result in irreversible brain damage in the fetus and infant and retard psychomotor development in the child. Iodine deficiency is the most common cause of preventable mental retardation; it also affects a child's learning ability (Zimmermann, 2020).

Iodine deficiency is one of the most global nutritional problems. The most important risk factor for iodine deficiency is residing in an area with soil and water poor in iodine. Almost one-third of the world's population lives in areas of iodine deficiency. More than 17 million babies in South Asia were estimated to born every year unprotected from brain damage due to iodine deficiency. Nepal recognized iodine deficiency disorder as a serious public health problem by early 1970s and started its first national control program in 1973, with the Goiter Control Project and the Goiter and Cretinism Eradication Project that distributed iodized oil injections and capsules and coordinated salt iodization activities. Salt iodization was continued as the sole strategy from 1998. In 2001, the standard for iodized salt with minimum 50 ppm at the production level and minimum 30 ppm at the retail level was implemented and significant awareness efforts on using the two-child logo refined salt were started, along with observing February as national iodine month for awareness (Lamichhane *et al.*, 2022).

d) Zinc deficiency: Zinc is necessary for normal child growth, enhancing immune system, healthy pregnancy and reducing morbidity from diarrhea and pneumonia. Zinc deficiency among children has deleterious effects on immunity making them more prone to infections, such as diarrhea and pneumonia. Inadequate zinc from the diet, malabsorption of zinc, or excess losses of zinc during diarrhea can cause zinc deficiency (Maret, 2017). Zinc deficiency slows physical growth, impairs cognition and learning, delays wound healing, and in many contexts drives diarrhea, infectious disease, and anemia(Bevis *et al.*, 2023).

Zinc deficiency is often difficult to identify as its clinical manifestations are largely non-specific. The symptoms of severe deficiency include dermatitis, retarded growth, diarrhea, mental disturbances and recurrent infections. People who live in low and middle-income countries consume mainly plant-based diets which contain a high amount of phytate (a substance that inhibits the absorption of zinc), and diets based on starchy roots and/or tubers which are known to have low zinc content that can eventually result in zinc deficiency (Tuerk and Fazel, 2009). Mild to moderate zinc deficiency is more common throughout the world than severe zinc deficiency. Children of Nepal are also at higher risk of zinc insufficiency, where poor diets and gastrointestinal infections are prevalent. Globally, zinc deficiency is highly associated with chronic and infectious diseases like cancer, and diabetes, and measles, HIV (Human Immunodeficiency Viruses), tuberculosis, and pneumonia, respectively. The

Government of Nepal (GoN) has introduced zinc supplements to manage and treat childhood diarrhea in 2007 (Mehata *et al.*, 2020).

2.7 Nutritional requirements

Nutrient requirement can be defined as the minimum amount of the absorbed nutrients that is necessary for maintaining the normal physiological functions of the body (Srilakshmi, 2014). It refers to the amount of food, energy and nutrient needed on an average per day by specific group and sex categories to meet the needs of healthy individuals for normal functioning of the body for work and growth (Tudehope *et al.*, 2013). The recommended daily allowance (RDA) of nutrients for preschool children (1-6 years) is shown in Table 2.1:

Table 2.1 RDA of pre-school children

Nutrients	**(6-12) months**	**(1-3) years**	**(4-6) years**
Energy (kcal)	670	1010	1360
Protein (g)	10.5	11.3	15.9
Calcium (mg)	300	500	550
Magnesium (mg)	75	135	155
Iron (mg)	3.0	8.0	11
Zinc (mg)	2.5	3.0	4.5
Thiamine (mg)	0.4	0.7	0.9
Riboflavin (mg)	0.6	0.9	1.3
Niacin (mg)	5.0	7.0	9.0
Vitamin B6 (mg)	0.6	0.9	1.2
Folate (µg)	85	110	135
Vitamin B12 (µg)	1.2	1.2	1.2
Vitamin A (µg)	350	390	510

Source: ICMR (2020)

The amount of each nutrient needed for an individual depends upon his/her age, body weight and physiological status. Adults need nutrients for maintenance of constant body weight and for ensuring proper body function. Infants and young children grow rapidly and require nutrients not only for maintenance but also for growth. In physiological conditions like pregnancy and lactation, adult woman needs additional nutrients to meet the demand for fetal growth and maternal tissue expansion in pregnancy and milk secretion during lactation. These extra intakes of nutrients are essential for normal growth of infants in uterus and during early post-natal life (Srilakshmi, 2014).

2.8 Breastfeeding status

Breastfeeding supports children's growth and development and also benefits mothers' health. Initiation of breastfeeding within the first hour of birth is important for both the mother and the child. The first breast milk contains colostrum, which is highly nutritious and has antibodies that protect the newborn from infections. Early initiation of breastfeeding also encourages bonding between the mother and her newborn, especially through skin-to-skin contact, which facilitates the production of breast milk. Feeding newborns anything other than breast milk in the first 2 days after birth can delay early initiation of breastfeeding and interrupt exclusive breastfeeding and is not recommended unless medically indicated. Breastfeeding should continue for the first 2 years or beyond because breast milk lowers children's risk of illness, promotes their recovery during illness, and remains an important source of nutrients for healthy growth and development. Longer durations of breastfeeding have many health benefits for women, including reducing risks of certain breast and ovarian cancers and diabetes (WHO and UNICEF 2021).

Over half (55%) of children are put to the breast within 1 hour of birth, Contrary to the recommendation that children under age of 6 months be exclusively breastfed, only 56% of the infants under age of 6 months were found to be exclusively breastfed. In addition to breast milk, 6% of these young infants consume plain water, 1% consume non-milk liquids, 18% consume formula and/or animal milk, and 3% consume solid, semisolid or soft foods. Exclusive breastfeeding among children under age of 6 months increased from 53% in 2006 to 70% in 2011. However, in 2022, there was a decline in the percentage of exclusively breastfed children, to 56% (NDHS, 2022).

2.9 Complementary feeding

WHO defines the complementary feeding period as the additional foods or liquids are introduced alongside breastmilk. This includes any nutrient-containing foods or liquids given to young children in addition to breast milk. Introducing complementary foods at the right time during infancy is crucial for nutritional and developmental purposes and helps facilitate the transition from milk feeding to family foods. As infants grow older, breast milk alone becomes insufficient to meet their macronutrient and micronutrient needs. Therefore, complementary feeding is associated with significant changes in the intake of these essential nutrients (Agostoni *et al.*, 2008).

After the first 6 months, breast milk alone is no longer sufficient to meet all of the nutritional needs of an infant. After 6 months, appropriate complementary foods should be introduced while breastfeeding is continued until age 2 or older. The transition from exclusive breastfeeding to complementing breastfeeding with family foods is when children are most vulnerable to becoming undernourished. During this time, it is important that children receive solid, semisolid, or soft foods (WHO, 2003).

From the data of NDHS 2022, 85% of children age 6-8 months received timely complementary foods. The most commonly consumed foods are made from grains, followed by food made from legumes and nuts, and foods made from roots and tubers. Sixty-seven percent of these breastfeeding children received food made from grains; 66% received beans, peas, lentils, nuts, and seeds; 26% received white/pale starchy roots, tubers, 18% received vitamin A-rich fruits and vegetables, 11% received eggs, 5% received meat, fish, poultry, or organ meats and 30% received other fruits and vegetables (NDHS, 2022).

2.10 Assessment of nutritional status

Nutritional assessment is the systematic process of collecting and interpreting information in order to make decisions about the nature and cause of nutrition related health issues that affect an individual. It is the interpretation of anthropometric, biochemical (laboratory), clinical and dietary data to determine whether a person or groups of people are well nourished or malnourished (over-nourished or under-nourished). It is a systematic method for obtaining, verifying and interpreting data needed to identify nutrition related problems, the associated etiologies related to the problem, the significance of the problem, as well as

the signs and symptoms manifested by the nutrition-related problem (Sungurtekin *et al.*, 2008). It can also be used to identify high-risk groups and to assess the role of different epidemiological factors in nutritional deficiencies. The assessment of the nutritional status involves two methods: Direct method that deals with individuals and measures the objective criteria and Indirect method that uses community health indices for reflecting nutritional influences (Shrivastava *et al.*, 2014).

2.10.1 Direct Method

a) Anthropometric method of nutritional assessment:

Anthropometric measurements are widely used in the assessment of nutrition status, particularly when a chronic imbalance between intakes of protein and energy occurs. Such disturbances influence the patterns of physical growth and the relative portions of body tissues including body fat, lean body mass or muscle tissue, and total body water. Anthropometric measurements include information about the patient's height, weight, weight history, BMI, growth pattern indices and percentile ranks. The advantage of anthropometry is that the available methods are simple, inexpensive and non-invasive. Measurements of length or height and weight provide important clues about health and nutritional well-being. Weight and height measurements are important in identifying infants and children who already have or may be at risk of a nutritional problem (Al-Jassir *et al.*, 2002).

The most commonly used anthropometric indexes for assessing child growth are:

i. Height for age (H/A): This indicator helps to find out whether a child has appropriate height for his age nor not. The height for age of children is used as an indicator of the prevalence of undernutrition, i.e., 'stunting'. Stunting suggests that there was inadequate health and or nutrition for a long period of time. Stunting is often associated with long-term factors such as chronic malnutrition, especially PEM and frequent illness, but cannot measure short-term changes in malnutrition. It is therefore an indicator of past growth failure and is often used for long-term planning of policies and intervention programs in non-emergency situations (Borooah, 2005).

Height-for-age is a measure of linear growth retardation and cumulative growth deficits. Children whose height-for-age Z-score is below minus two standard deviations (-2 SD) from

the median of the reference population are considered short for their age (stunted), or chronically undernourished. Children who are below minus three standard deviations (-3 SD) are considered severely stunted (Blossner *et al.*, 2005).

ii. Weight for height (W/H): It helps to find whether a child is having appropriate weight for his height or not. W/H is normally used as an indicator of current nutritional status, and can be useful for screening children at risk and for measuring short-term changes in nutritional status. Low W/H relative to the child of same age and sex in a reference population is referred to as "thinness" and extreme cases are referred to as "wasting". The term wasting refers to the situation where a child has failed to achieve sufficient weight for height. Wasting may be the consequence of starvation or severe disease. It can also be due to chronic conditions or combination of both (INDEPTH, 2008).

Children whose Z-score is below minus two standard deviations (-2 SD) from the median of the reference population are considered thin (wasted), or acutely undernourished. Children whose weight-for-height Z-score is below minus three standard deviations (-3 SD) from the median of the reference population are considered severely wasted (Blossner *et al.*, 2005).

iii. Weight for age (W/A): Weight-for-age reflects body mass relative to chronological age. W/A is a composite measure of height-for-age and weight-for-height. Low W/A of a child in comparison to the reference population with identical condition is referred to as "lightness" and severe cases are referred as "underweight". Underweight is a condition where child weighs less than expected at his or her age. W/A is commonly used for monitoring growth and to assess changes in the magnitude of malnutrition over time. However, W/A confounds the effects of short and long-term health and nutrition problems (INDEPTH, 2008).

Children whose weight-for-age Z-score is below minus two standard deviations (-2 SD) from the median of the reference population are classified as underweight. Children whose weight-for-age Z-score is below minus three standard deviations (-3 SD) from the median are considered severely underweight (Blossner *et al.*, 2005).

iv. Mid-upper arm circumference (MUAC): MUAC is a measure of the diameter of the upper arm, and gauges both fat reserves and muscle mass. It is primarily used for children, but can also be applied to pregnant women to assess nutritional status. The measurement is

simple and requires minimal equipment. MUAC has therefore been proposed as an alternative index of nutritional status, in particular situation where data on height, weight, and age are difficult to collect (INDEPTH, 2008). Child having a MUAC<115mm is considered to be suffering from Severe acute malnutrition (SAM) and MUAC ≥115 to < 125 mm is an indication of Moderate acute malnutrition (MAM).

v. Head circumference (HC): Head circumference (HC) is a major indicator of brain development, especially in early childhood and is correlated with cognitive function in children. Head circumference below (-2 SD). of the mean may be an indicator of severe undernutrition and accurately reflects retarded brain growth during the first year of life. The long-term effects of severe undernutrition at an early age may result in delayed head circumference growth, delay of brain development and decreased intelligence and scholastic achievement (Ivanovic *et al.,* 2004). At birth the circumference of head is greater than that of the chest (John *et al.,* 2004).

vi. Chest circumference (CC): Chest circumference is related to the growth of rib cage, muscle mass, subcutaneous fat and the lung tissues. The circumference of the head and the chest are about the same at six months of age. After this the skull grows slowly and the chest more rapidly. Therefore, between the ages of six months and five years the chest / head circumference ratio of less than one may be due to failure to develop or due to wasting of muscle and fat of chest (John *et al.,* 2004).

b) Biochemical Method

The biochemical evaluation of nutritional status includes quantitative determinations of nutrients (minerals and vitamins) their products of metabolism in the body and urine. Example: serum albumin, hemoglobin estimation, serum retinol, urinary iodine, etc. Biochemical measurements usually reflect the immediate past intake of nutrients or the changes produced by a long-standing deficient intake of a nutrient. They may be helpful in indicating the presence of inadequate dietary intake before the development of a biochemical lesion or a later clinical lesion which results from functional impairment of a tissue or organ (Sauberlich, 2018).

c) Clinical assessment

Clinical examination involves assessing the health of body parts that are easily observable during a routine physical check-up. This type of examination includes observing specific signs and symptoms that are linked to nutrient deficiencies in different organs, such as the skin, hair, mouth, tongue, and nails (Maqbool *et al.*, 2008).

d) Dietary assessment

Dietary assessment involves the collection of information on foods and drinks consumed over a specified time that is coded and processed to compute intakes of energy, nutrients and other dietary constituents using food composition tables. A wide variety of dietary assessment methods are available to collect dietary information (Dao *et al.*, 2019). Dietary assessment deals with assessing a person normal food intake and quality of that diet. It consists of (Bauer, 2002):

- 24-hours dietary recall
- Food frequency questionnaire
- Dietary history
- Food diary technique
- Observed food consumption

2.10.2 Indirect method

These include three categories (Jelliffe, 1997):

Vital health statistics: Vital health statistics like infant mortality rate, under-five mortality rate, nutritionally relevant diseases (for example diarrhea, tropical ulcer, tuberculosis and measles). A variety of vital statistic may be considered as indirect indicators of the nutritional status of the community (Jelliffe, 1997).

Ecological variable: Ecological variables include crop production, soil, irrigation, storage, transport and economic level of the population, as well as on such cultural influence as local cooking practice and food classifications, especially in relation to the distribution or restriction of foods for vulnerable age groups (Jelliffe, 1997).

Socio-economic factor: Socio-economic factor like per capita income, occupation, prices of food, budgeting, etc. (Jelliffe, 1997).

2.11 Factors associated with nutrition status of Musahar children

Study conducted among 6-59 months children in *Musahar* community of Madheli, VDC, Sunsari found significant difference in stunting with weaning age and age of mother at first pregnancy. The age of mother at first pregnancy was also associated with underweight (Chaudhary, 2018).

Study conducted in Ramdhuni Municipality, Sunsari among 6-59 months *Musahar* children showed that gender of child, MNP intake, source of drinking water and toilet use are significantly associated with stunting. Factors such as family size, mothers age at marriage, frequency of cereals intake, vegetables intake by child were associated with wasting (Dahal, 2018).

Study conducted among *Musahar* children aged between 12 to 59 months in urban Siraha District, Nepal found significant difference in stunting with sex, socioeconomic status and age of child whereas wasting was not found statistically significant with sex of the children. Musahar community had 65 % children who had at least one kind of under-nutrition. Prevalence of stunting was found high among the children whose mother had more children (S. K. Shah *et al.*, 2021).

PART III

Materials and Methodology

3.1 Research Design

A community based cross-sectional survey was conducted in *Musahar* community of Ratuwamai Municipality, Morang to assess the mother's knowledge in breastfeeding and childcare practices and its impact on malnutrition among children aged 6-59 months. It consisted of;

a) Anthropometric measurement of children under five years of age.
b) Household survey with the help of questionnaires.

3.2 Research instruments

Instrument used during the survey were:

a) Digital weighing machine: Child weighing machine made by Micro Life Pvt. Ltd. having capacity of 150 kg (1 piece) and having the least count of 0.1 kg was used for measuring the weight of children.
b) Height measuring scale (Stadiometer): The height measuring scale of 2 m capacity (1 piece). The instrument was designed according to UNICEF standards which was easily transportable and accurate within the limits required (0.1 cm).
c) Mid Upper Arm Circumference (MUAC) tape: MUAC tape was used to measure the MUAC reading. The tape was flexible, non-stretchable and used to measure to the nearest 0.1 cm.
d) Questionnaire: A well designed and pretested set of questionnaires containing-questions was used to collect information on household characteristics, maternal characteristics, child caring practices, food frequency, mother's knowledge, hygiene and sanitation characteristics, etc.

3.3 Study area

The study was conducted in Ratuwamai Municipality, Morang district of Koshi province.

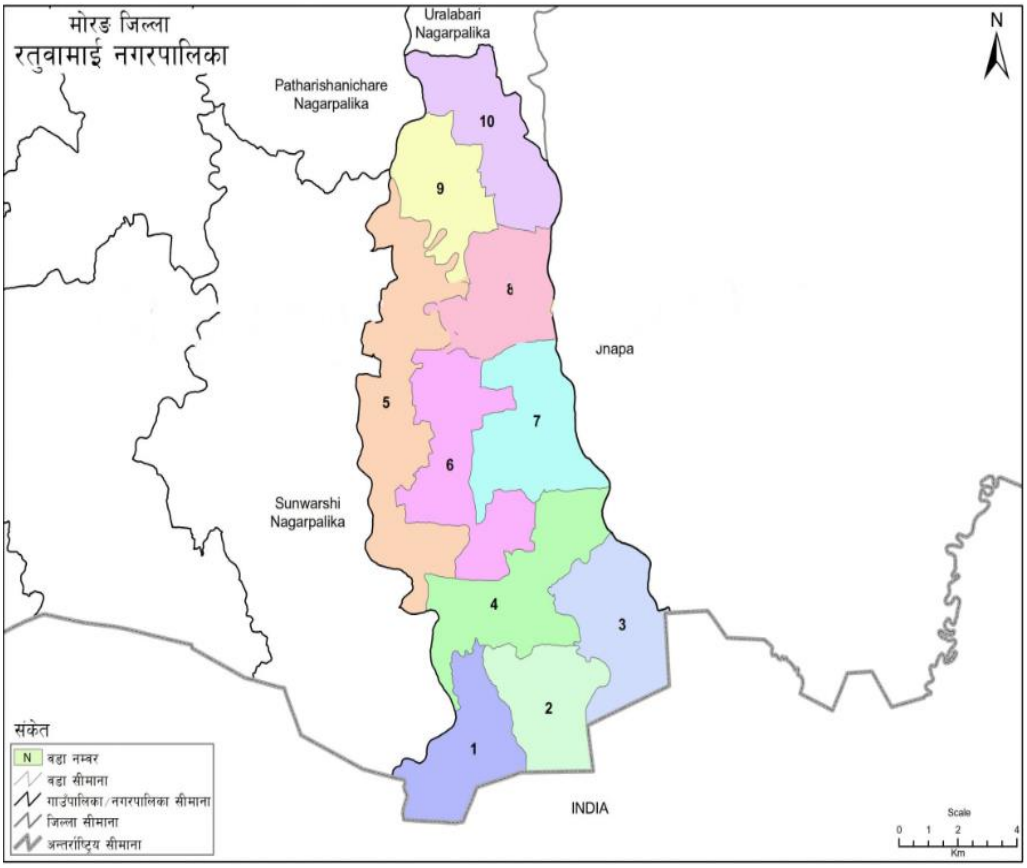

Fig. 3.1: Map of Ratuwamai Municipality

3.4 Target population

The target population of the study was 6–59 months *Musahar* children who are living in Ratuwamai Municipality for assessment of nutritional status and mothers/caretakers were the targets for the assessment of knowledge on breastfeeding and childcare practice.

Inclusion and exclusion criteria:

a) **Inclusion criteria**: *Musahar* children aged 6-59 months living in Ratuwamai Municipality were included in the study. The mothers of selected children were also selected for the questionnaire.
b) **Exclusion criteria**: In case of subject (child) being seriously ill.

3.5 Study variables

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

- Socio-economic and demographic variables: family type, ethnicity, father's occupation, father's education, head of household, annual income and food purchaser etc.
- Child characteristics: age, sex, number of under five children, birth order, birth weight and morbidity status etc.
- Maternal characteristics: mother's education, occupation, age at marriage, age during first delivery, pregnancy related factors: vaccinations, iron and folate intake, intake of extra food during pregnancy etc.
- Childcare practices: Initiation of breastfeeding, exclusive breastfeeding, colostrum feeding etc.
- Food frequency: Intake of cereals, pulses, vegetables, fruits, dairy etc.
- Maternal knowledge: knowledge about exclusive breastfeeding, malnutrition, lito, ORS, complementary feeding, diarrhea etc.
- Hygiene and sanitation practices: source of water supply, water-processing techniques, toilet facility, hand washing practices etc.

3.6 Sampling technique

This survey has adopted as census method. Census method is used where samples are less. So, every household of *Musahar* children who are between 6 to 59 months of age were studied.

3.7 Sample size

The sampling technique used in this case is census method. The sample size is equal to the total number of children who lie in between age group of 6 months to 59 months and belongs to *Musahar* community of Ratuwamai Municipality. According to personal communication with female health volunteers of Ratuwamai Municipality, the total population of 6-59 months of age children was about 116. Thus, the sample size for the study was 116.

3.8 Pre-testing

Preliminary visit was done and designed questionnaire was tested before conducting final survey. Pre-testing was performed in few under five-year *Musahar* children. The pre- testing was conducted in order to maintain accuracy and clarity of questionnaire, to check the consistency in interpretation of questions and to identify ambiguous items. After pre-testing, all the ambiguous, misleading and wrongly interpreted questions were omitted and questionnaire was revised in accordance with the findings of pre-testing.

3.9 Validity and reliability

To ascertain the degree to which the data collection instruments measure what they purpose to measure, the instruments were 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 through pre-testing as mentioned earlier.

Reliability of the instruments (stadiometer and weighing balance) 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 pretesting of the tools, using standardized instruments. Instruments was set at zero reading before taking measurements with standardized reference one. Close supervision was done in the field.

3.10 Data collection techniques

The data was collected with the help of structured questionnaire form, by face-to-face interview with mother of child in which answers of every question was coded and recorded with unique identity number for each household of 6-59 months children. The relevant data recorded were as follows:

a) Length/Height: Stadiometer was used to measure the height of children. The length of children below 2 years was measured by recombinant method. 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). 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 the head was held erect and hands were hung closely at the sides. The child's height was measured to the nearest one decimal place.

b) Weight: Firstly, the clothes and shoes worn by child were removed and weight was measured by electronic digital weighing 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 if were unable to stand by them, their weight was obtained from the difference between weights of mother as she held the child and the weight of the mother alone.

c) MUAC: The subject was asked to bend his arms 90 degree with his/her palm facing upward. 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.

d) Edema: Firm pressure for three seconds with one digit on the lower portion of the median surface of the tibia was applied. The sign was taken as positive if there was a visible and palpable pit that persists after the pressure is removed and recorded only if present bilaterally.

e) Set of questionnaires: A well designed and pretested set of questionnaires was used for collecting household information and knowledge of childcare practices among mothers from various literature, FAO guidelines (FAO, 2014), Saka (2014), Appoh and Krekling (2005). There were twenty self-administrated questionnaires related to knowledge. Based on the responses, each correct answer was given a score of 'one' and the wrong answer was given a score of 'zero'. The range of knowledge level score was adapted from National Journal of Community Medicine in which 0 to 10 scores indicate poor knowledge, 11 to 16 scores indicate average and 17 to 20 scores indicate good knowledge score of mothers (Shettigar et al., 2013).

f) Dietary practices: Dietary practices of the respondents were assessed using the FFQ. The consumption of food was considered "regular" if ingested at least once a day or at least 4 times a week, "frequent" when ingested 2-3 times a week and "rare" if ingested once a week or less (Tokudome et al., 2001).

3.11 Data analysis

The data obtained from final survey was checked for completeness and consistency. First of all, collected Quantitative data was coded and entered in Statistical software WHO Anthro version 3.2.2, then in Microsoft excel 2019 and Statistical package for social science or SPSS version 25. 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.

Qualitative data were transcribed and coded by assigning labels to various categories. Both descriptive and inferential statistics were used for data analysis. Descriptive analysis was used to identify percentages and number of distributions of the respondents by the sociodemographic characteristics and other relevant variables in the study. Chi-square test was used to find out the association between nutritional status and its associated factors.

3.12 Logistical and ethical considerations

Permission to conduct survey was taken from Central Campus of Technology, Department of Nutrition and Dietetics and Ratuwamai Municipality. The study participants were provided with written informed consent prior to the study and the objective of the study was explained to mothers. Privacy and confidentiality of collected information was ensured at all level.

Part IV

Results and Discussion

The cross-sectional descriptive study with sample size of 116 was conducted in *Musahar* community of Ratuwamai Municipality in order to determine the mother's knowledge and its impact on malnutrition among 6-59 months children. The important findings of the study are listed below:

4.1 Socio economic and demographic characteristics

Table 4.1 shows that, out of the 116 households, 60.3% of households were nuclear and 39.7% were of joint family type. The major occupation of fathers was labor (66.4%), followed by foreign employment (26.7%) and agriculture (6.9%). Most of the family (69.0%) had their annual income below 1 lakh whereas 19.8% of the families had their annual income between 1 lakh to 2 lakhs and 11.2% of the families had annual income above 2 lakhs.

Majority (75.0%) of households were headed by male while (25.0%) of them were headed by female. From the study population, 12.1% of father had achieved primary level education, 4.3% had achieved secondary level education and remaining 83.6% had no education. Regarding the type of house, 88.8% had concrete house whereas 11.2% had house made up of mud. Among the households under study, maximum mothers were involved in food purchasing for house than fathers.

Table 4.1 Socio economic and demographic characteristics of study population

Variables	Frequency	percent
Family Type		
Nuclear	70	60.3
Joint	46	39.7
Father's occupation		
Agriculture	8	6.9
Foreign	31	26.7
Labor	77	66.4
Annual Income		
< 1 lakh	80	69.0
1 lakh to 2 lakh	23	19.8
> 2 lakhs	13	11.2
Head of the Household		
Male	87	75.0
Female	29	25.0
Father's education		
Primary	14	12.1
Secondary	5	4.3
No education	97	83.6
House structure		
Concrete	103	88.8
Mud	13	11.2
Household Food Purchaser		
Father	47	40.5
Mother	69	59.5

4.2 Child characteristics

Table 4.2 shows that out of 116 children of age group 6-59 months, 47.4% were boys and 52.6% were girls.

Table 4.2 Child characteristics of the study population

Variables	Frequency	Percent
Gender		
Male	55	47.4
Female	61	52.6
Age Category		
6-11 months	20	17.2
12-23 months	30	25.9
24-35 months	21	18.1
36-47 months	19	16.4
48-59 months	26	22.4
Child order		
First	38	32.8
Second	33	28.4
Third	31	26.7
More	14	12.1
Birth Weight		
≥ 2.5 kg	51	43.9
< 2.5 kg	25	21.6
No idea	40	34.5
Death of child under five years		
Yes	13	11.2
No	103	88.8
Recent Disease		
Yes	11	9.5
No	105	90.5

Among 116 children surveyed, 32.8% of children were the first child in the family, followed by 28.4% of children who were the second born child, 26.7% of the children were found to be the third child of the family and 12.1% of children were of birth order greater than third. The birth weight of 21.6% of children were less than 2.5kg whereas the birth weight of 43.9% of the children were greater than and equal to 2.5 kg. About 34.5% of mothers had no idea about the birth weight of their children. As indicated, about 9.5 % of children were recently suffered during the survey period from various childhood illness such as common cold, fever, pneumonia and jaundice. From the study population 13 mothers reported the death of their previous child before 5 years of age.

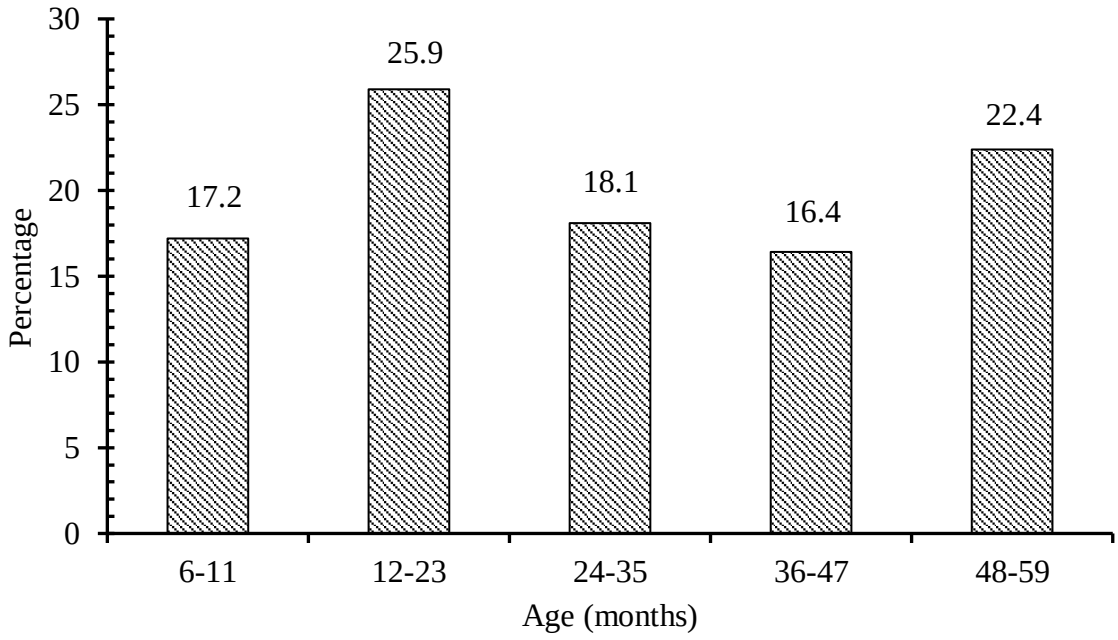

Fig 4.1 Age distribution of survey children

The children of age 6-59 months were categorized according to WHO standard into 5 groups and shows that the age group of 12-23 months were maximum occupying 25.9% of the whole sample from both of the age groups. Similarly, 22.4% of children were of 48-59 months followed by 18.1% of children of age 24-35 months,17.2% of children of age 6-11 months and 16.4 % of children of age 36-47 months.

4.3 Maternal characteristics

Table 4.3 indicates that more than half (60.4%) of mothers were illiterate, whereas 28.4% and 11.2% of mothers had some primary and secondary level education. From the study group 91.4 % of mothers were married before the age of 20 years. Similarly, 84.5% of mothers had their first pregnancy before 20 years of age.

Table 4.3 Maternal characteristics of survey population

Variables	Frequency	Percent
Mother's education		
Primary	33	28.4
Secondary	13	11.2
No education	70	60.4
Age at marriage		
Below 20	106	91.4
20 and above	10	8.6
Age at first Pregnancy		
Below 20	98	84.5
20 and above	18	15.5
Intake of Iron Folate		
Yes	103	88.8
No	13	11.2
Vaccination		
Yes	107	92.2
No	9	7.8
Amount of Food during pregnancy		
More than usual	31	26.7
Less than usual	28	24.1
As usual	57	49.2
Frequency of eating in pregnancy		
less than 3 times a day	21	18.1
About 3-4 times a day	72	62.1
More than 4 times a day	23	19.8

Study shows 92.2% of total females reported to have received the vaccination during pregnancy. Similarly, the percentage of women who took iron and folate tablets during pregnancy were 88.8%. Among 116 mothers, 26.7% reported that they used to consume food in more than the usual amount during pregnancy, 49.2% said their intake was as usual and 24.1% reported to have decreased intake during their pregnancy period. The frequency of eating food 3-4 times a day was found in 62.1% of mothers, 18.1% reported they ate less than 3 times in a day and 19.8% ate more than 4 times in a day during their pregnancy period.

4.4 Child care practices

Table 4.4 Child caring practices of the study population

Variables	Frequency	Percent
Initiation of Breastfeeding		
Within 1 hour	79	75.0
Within 24 hours	31	19.8
After 24 hours	6	5.2
Colostrum feeding		
Yes	107	92.2
No	9	7.8
Exclusive breastfeeding		
Yes	71	61.2
No	45	38.8
Pre- lacteal feed		
Yes	21	18.1
No	95	81.9
Child vaccine		
Yes	109	94.0
No	7	6.0
Initiation of complementary food		
4-5 months	11	9.4
5-6 months	23	20.0
> 6 months	82	70.6

Table 4.4 shows that 75% of the surveyed children were breast fed as soon as their birth, 19.8% were breast fed within 24 hours whereas 5.2 % were breast fed after 24 hours. The breast milk substitutes used among those who were not initiated into breastfeeding within one hour after birth were cow milk, milk of other women, lactogen or sometimes nothing. Colostrum was given to 92.2% of children and pre-lacteal feeds was given to 18.1% of the children. Among the surveyed children, 61.2% were exclusively breastfed. Survey shows 94% of children had received all the immunization according to their age. The initiation of complementary feeding of 70.6% of children was done at the age greater than 6 months followed by 9.4% at the age of 4-5 months and 20% at the age of 5-6 months.

4.5 Hygiene and sanitation practices

Table 4.5 Distribution of hygiene and sanitation practices

Variables	Frequency	Percent
Sources of drinking water		
Tube well	116	100
Water Purification		
Yes	6	5.2
No	110	94.8
Hand washing after defecation		
Yes	116	100
Hand washing before feeding		
Yes	116	100
Hand washing after feeding		
Yes	116	100
Toilet facility		
Yes	109	94.0
No	7	6.0
Method of hand washing		
Using normal water	85	73.3
Soap	31	26.7

From the table 4.5, it was found that the major source of drinking water was tube well water as 100% of households were using tube well water as a water source. Water processing methods were used by 5.2% of households and remaining 94.8% of houses reported the use of water without any prior processing methods. All the caretakers of surveyed households reported to have the practice of hand washing after defecating, before the feeding of child and after the completion of feeding the child. Among the total 116, 26.7% were using soap for hand washing purpose, 73.3% reported of using normal water for hand washing.

4.6 Mother's knowledge on breastfeeding practices

Table 4.6, shows that 49.1% of mothers knew that breastfeeding should be initiated within 1 hour of child birth, while 31.9% of mothers responded within 24 hours and 19% of mothers had no idea about the time of initiation of breastfeeding.

Table 4.6 Mother's knowledge on breastfeeding practices

Variables	Frequency	Percent
Knowledge on initiation of breastfeeding		
Within 1 hour	57	49.1
Within 24 hours	37	31.9
No idea	22	19.0
Knowledge on colostrum feeding		
Good for child health	44	38.0
No idea	72	62.0
Knowledge on exclusive breastfeeding		
Yes	52	44.8
No	64	55.2
Knowledge on duration of breastfeeding		
< 2 years	24	20.7
≥2 years	72	62.1
Don't know	20	17.2
Need of Pre lacteal Feed		
Yes	31	26.7
No	85	73.3

Survey shows that 38% of mothers were aware about the importance of colostrum feeding for the child health while 62% of mothers were unaware about the importance of colostrum feeding. Only 44.8% of mothers had knowledge about exclusively breastfeeding until six months of age. Regarding duration of breastfeeding, 62.1% of mothers said a child should be breastfeed above 2 years of age, 20.7% of mothers said a child should be breastfeed below 2 years of age where as 17.2% of mothers were unaware about it. About the need of pre lacteal feed, 73.3% mothers knew that pre lacteal feed is not necessary but 26.7% of mothers said that it is important for the child.

4.7 Mother's knowledge on childcare practices

Knowledge regarding start of complementary feeding to the child, only 30.2% of mothers gave correct answer i.e., at six months of age. There was a variation in answers regarding times for initiation of weaning.

Table 4.7 Mother's knowledge on childcare practices (a)

Variables	Frequency	Percent
Complementary feeding knowledge		
At 6 months	35	30.2
Other	81	69.8
Frequency of complementary feeding		
Less than 3 times	29	25.0
3 or more times	87	75.0
Knowledge about lito preparation		
Yes	38	32.7
No	78	67.3
Knowledge about malnutrition		
Yes	25	21.6
No	91	78.4
Reason for malnutrition		
Right	17	14.7
Wrong	8	6.9
Don't know	91	78.4

Knowledge regarding the frequency of complementary feeding given to the child, 75% of mothers said that a child should be fed 3 or more times whereas 25% mothers said less than 3 times per day. Only 32.7% of mothers had knowledge about lito preparation. Based on the survey, majority (78.4%) of mothers did not know about malnutrition. Regarding the cause of malnutrition, 14.7% of them were right, 6.9% of them were wrong while maximum (78.4%) of them had no idea about the cause of malnutrition as shown in Table 4.7 (a).

Table 4.7 (b) shows that almost all mothers (96.6%) had knowledge about diarrhea but only (57.7%) of them were right about the cause of diarrhea while 42.3% of them were unaware about the cause of diarrhea. Among the surveyed mothers, 47.4% of them knew to prepare ORS solution while 52.6% did not know about it. Regarding the knowledge about type of food given to children during diarrhea, 35.3% of mothers replied that usual food should be given during diarrhea and 11.2% of mothers said soup/fluid should be given during diarrhea while 53.4% did not know what kind of food should be given during diarrhea. Only 30.2% of mothers had known about baal-vita while remaining mother did not know about baal-vita.

Regarding the knowledge about growth monitoring, 67.2% of mothers knew about growth monitoring while 32.8% of mothers did not know about growth monitoring. Maximum mother (87.9%) had knowledge about vitamin-A and deworming supplementation. About 40.6% of mothers had known that maad contain nutrients while 59.4% of mothers were unaware about it. The knowledge of mothers regarding use of iodized salt was satisfactory. Almost all mothers 97.4% replied that using iodized salt was good as compared to other salt. Knowledge about cutting vegetables, 62.1% of mothers used to wash vegetables before cutting while 37.9% of mothers used to wash vegetables after cutting.

Table 4.8 Mother's knowledge on childcare practices (b)

Knowledge about diarrhea		
Yes	112	96.6
No	4	3.4
Reason for diarrhea		
Right	67	57.7
Don't know	49	42.3
Knowledge on ORS preparation		
Yes	55	47.4
No	61	52.6
Foods during diarrhea		
Soup	13	11.2
Same as usual	41	35.3
No idea	62	53.4
Knowledge about baal-vita		
Yes	35	30.2
No	81	69.8
Knowledge about Growth Monitoring		
Yes	78	67.2
No	38	32.8
Vitamin A and de-worming supplement		
Yes	102	87.9
No	14	12.1
Knowledge about nutrients in maad		
Yes	47	40.6
No	69	59.4
Knowledge on salt consumption		
Iodized salt	113	97.4
Normal salt	3	2.6
Wash vegetables		
Before cutting	72	62.1
After cutting	44	37.9

4.8 Mother's knowledge level score

The mother's knowledge level score was taken from the similar study published in National Journal of Community Medicine in which 0 to 10 scores indicate poor knowledge, 11 to 16 scores indicate average and 17 to 20 scores indicate good knowledge score of mothers (Shettigar *et al.,* 2013). The scores found for mothers of the study area are shown in Table 4.9. The score was ranges from minimum 6 to maximum 17. Table shows that, 57 (49.1%) of mothers had poor knowledge, 50 (43.1%) of mothers had average knowledge and 9 (7.8%) of mothers had good knowledge regarding childcare practices. From the result obtained, it can be concluded that higher percent of mothers had poor knowledge regarding breastfeeding and childcare practices.

Table 4.9 Mother's knowledge level score (n=116)

Level of knowledge	Scores	Mothers(n=116) (%)
Poor	0-10	57 (49.1%)
Average	11-16	50 (43.1%)
Good	17-20	9 (7.8%)

4.9 Dietary Intake

4.9.1 Food Consumption pattern

Dietary practices of the respondents were assessed using the FFQ. The consumption of food was considered "regular" if ingested at least once a day or at least 4 times a week, "frequent" when ingested 2-3 times a week and "rare" if ingested once a week or less (Tokudome *et al.,* 2001).

As shown in Table 4.10, cereals were consumed by all the children regularly as a major staple food of their diet, the percentage of children who consumed pulses regularly was low, while most of them consumed it only frequently. Green leafy vegetable consumption was either frequent or regular in most of the participants, similarly other vegetables were consumed on regular basis by most of the children. The consumption of dairy products, meat, eggs and fruits was very poor on the study population. The seasonal variations as well as climatic condition influenced their food consumption pattern.

Table 4.10 Food Consumption pattern

	Frequency (%)		
Food groups	**Regular**	**Frequent**	**Rare**
Cereals	116(100%)	-	-
Pulses	24(20.7%)	75(64.7%)	17(14.6%)
GLV	44(37.9%)	63(54.3%)	9(7.8%)
Other vegetables	85(73.3%)	23(19.8%)	8(6.9%)
Dairy	6(5.2%)	13(11.2%)	97(83.6%)
Meat	3(2.6%)	47(20.7%)	66(76.7%)
Egg	1(0.9%)	25(21.6%)	90(77.5%)
Fruits	-	-	116(100%)

4.10 Nutritional status of children

Out of 116 children, 55 were males and 61 were females. Among these children 29.3% of the children were stunted with 6% severely stunted. Similarly, 24.1% were found to be wasted with 6.9% severely wasted. The prevalence of underweight was found among 33.6% of children and among them 8.6% were severely underweight as shown in Fig. 4.2. According to the report of NDHS 2022, 19% of under five children are underweight, 8% are wasted and 25% are stunted (MoHP, 2022). The result of this study showed that the prevalence of stunting, wasting and underweight was higher than that of NDHS result.

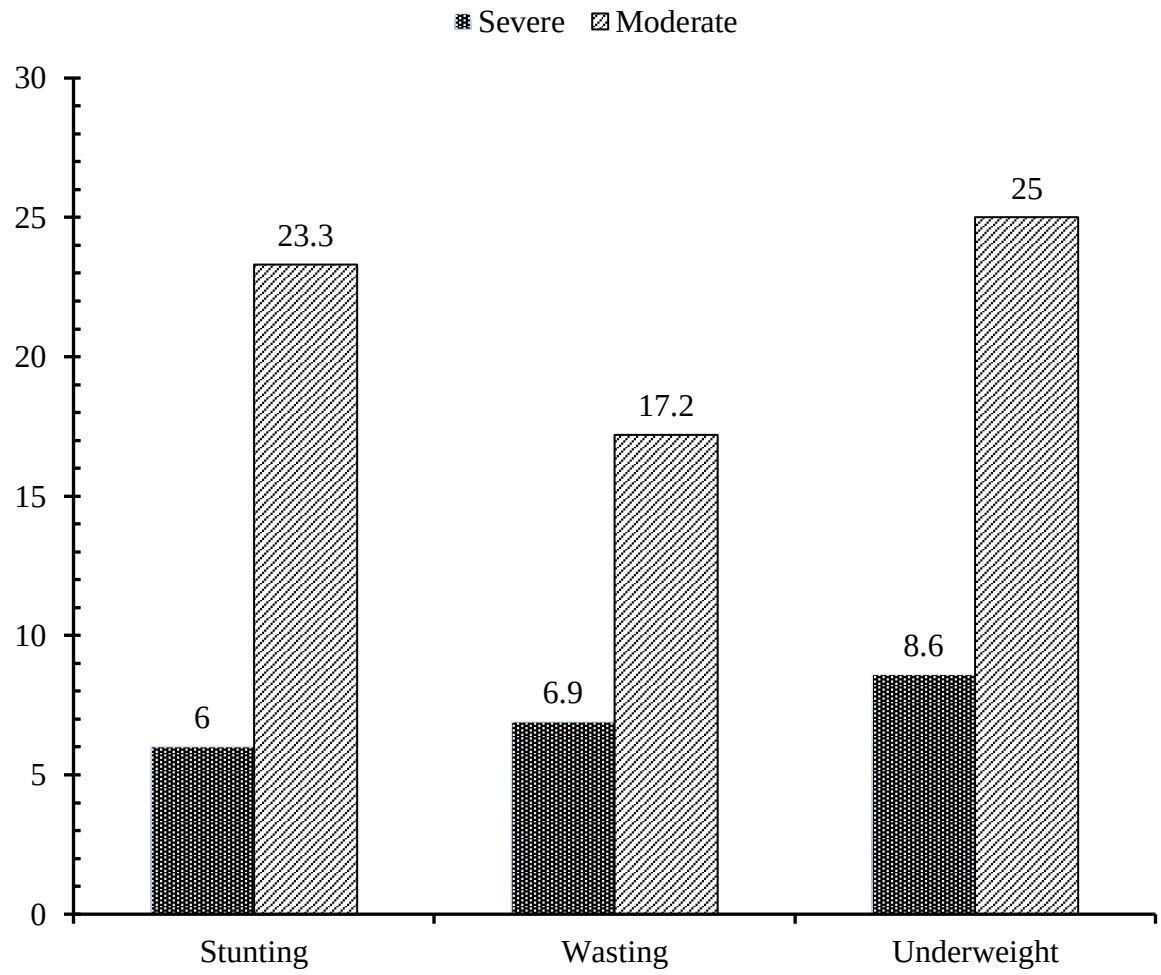

Fig. 4.2 Prevalence of malnutrition among surveyed children

4.11 Distribution of wasting, stunting and underweight among different age group

From the study data as represented in Table 4.11, The prevalence of severe wasting was higher in the age group of 24-35 months with 14.3% whereas the prevalence was nil in the age groups 48-59 months. Similarly, the percentage of moderate wasting was found to be higher in the age group 12-23 months (26.7%) and lower in 48-59 months. In the age group of 36-47 months, the rate of severe stunting was found to be higher 21.1% than the other groups whereas the prevalence was nil in the age group 6-11 months and 48-59 months. The rate of moderate stunting was higher in the age group 24-35 months with 33.3%, which was followed, by 36-47 months child (31.5%) and the 48–59-months age group had the lowest prevalence of moderate stunting with 15.4 %.

The prevalence of severe underweight was highest in the age group 36-47 months (15.8%) and followed by age groups 24-35 months (14.3%), 12-23 months (13.3%), whereas the prevalence was nil in age group 6-11 months. Similarly, the prevalence of moderate underweight was found to be higher in the age group 24-35 months (33.3%) and the lowest prevalence in 6-11 months with the prevalence of 15%.

Table 4.11 Distribution of malnutrition among different age group

Age groups (months)	N	WHZ (%)		HAZ (%)		WAZ (%)	
		<-3 SD	<-2 SD	<-3 SD	<-2 SD	<-3 SD	<-2 SD
6-11	20	5.0	20.0	Nil	20.0	Nil	15.0
12-23	30	6.7	26.7	6.7	20.0	13.3	26.7
24-35	21	14.3	19.0	4.8	33.3	14.3	33.3
36-47	19	10.5	15.8	21.1	31.6	15.8	21.1
48-59	26	Nil	3.8	Nil	15.4	3.8	19.2

4.12 Distribution of malnutrition based on Gender

From Table 4.12, it was found that 9.1 % of male children and 4.9 % of female children were found to be severely wasted. Similarly, 21.8 % of male children and 13.1 % of female children were moderately wasted. The result showed that 5.5 % of male children and 6.6 % of female children were found to be severely stunted whereas 20 % of male children and 26.2 % of female children were moderately stunted. In case of underweight, 10.9 % of male children and 6.6 % of female children were severely underweight whereas 27.3 % of male children and 22.9 % of female children were moderately underweight. The result showed that wasting and underweight was found to be higher in male children whereas stunting was higher in female children.

Table 4.12 Distribution of nutritional situation according to gender

	Severe	Moderate	Normal
Wasting			
Male	5(9.1%)	12(21.8%)	38(69.1%)
Female	3(4.9%)	8(13.1%)	50(82.0%)
Stunting			
Male	3(5.5%)	11(20.0%)	41(74.5%)
Female	4(6.6%)	16(26.2%)	41(67.2%)
Underweight			
Male	6(10.9%)	15(27.3%)	34(61.8%)
Female	4(6.6%)	14(22.9%)	43(70.5%)

4.13 Distribution of malnutrition based on MUAC

Table 4.13 Distribution of malnutrition (6-47 months) according to MUAC (n=90)

MUAC range	Frequency	Percent
Severe (< 11.5)	7	7.8
Moderate (11.5-12.5)	15	16.7
Normal (≥ 12.5)	68	75.5

On the basis of Mid-Upper Arm Circumference (MUAC), Tab 4.13 shows that 7.8% of children were found to be severely malnourished, 16.7% were moderately malnourished and remaining children were normal among age group (6-47 months).

Table 4.14 Distribution of malnutrition (48-59 months) according to MUAC (n=26)

MUAC range	Frequency	Percent
Severe (< 11.5)	Nil	Nil
Moderate (11.5-12.5)	3	11.6
Normal (≥ 12.5)	23	88.4

Table 4.14 indicates that, among children aged 48-59 months**,** there were no cases of severe malnutrition, with 11.6% found to be moderately malnourished and 88.4% having normal nutritional status based on MUAC measurement.

The comparative analysis of malnutrition between the two age groups based on MUAC measurements shows a difference in nutritional status. The younger children (6-47 months) were more prone to both moderate and severe malnutrition, highlighting nutritional challenges in early development. In contrast, older children (48-59 months) showed no cases of severe malnutrition and fewer occurrence of moderate malnutrition.

4.14 Weight for Height curve

The median weight-for-height z-score of survey children was found to be -1.34. This is why curve is slightly skewed to the left side of the WHO standard curve showing the prevalence of wasting among the study population as shown in the Fig. 4.3.

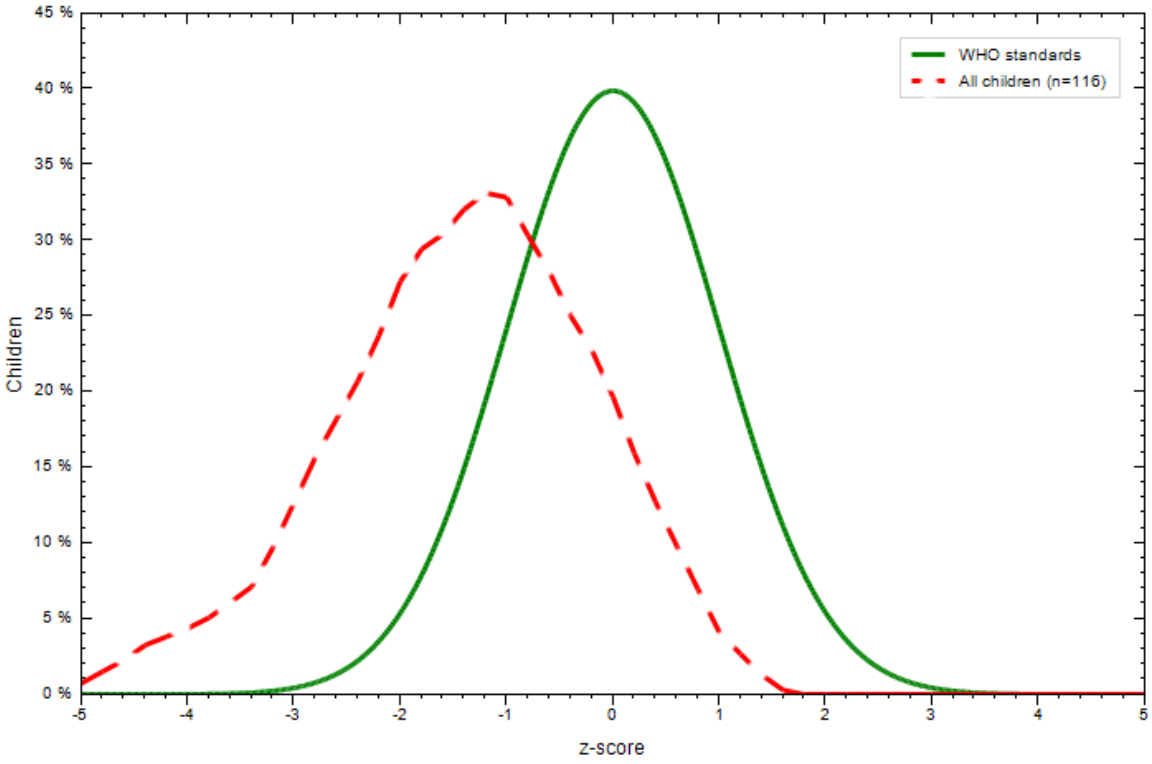

Fig. 4.3 Weight for Height curve with reference to WHO standard

4.15 Factors associated with wasting

The Chi- square test revealed that there was significant association of wasting with age category (P=0.034), birth weight (P=0.000), mothers age at first pregnancy (P=0.019) whereas there was no significant association with malnutrition knowledge (P= 0.109) and exclusive breastfeeding (P=0.162).

Children of the age category 12-23 months were found to be more wasted than other age groups children. Similar study done in Western Kenya to find prevalence and predictors of undernutrition among under five years found that children in the age group 12–23 months had the highest prevalence of wasting when compared with other age group (Bloss *et al.*, 2004).

Table 4.15 Factors associated with wasting (n=116)

Factors		WHZ			
		Wasted (%)	**Normal (%)**	**χ^2**	**p-value**
Age category	6-11 months	5 (25.0%)	15 (75.0%)		
	12-23 months	10 (33.3%)	20 (66.7%)		
	24-35 months	7 (33.1%)	14 (66.9%)	8.259	0.034*
	36-47 months	5 (26.3%)	14 (73.7%)		
	48-59 months	1 (3.8%)	25 (96.2%)		
Birth Weight	≥ 2.5 kg	5 (9.8%)	46 (90.2%)		
	< 2.5 kg	14 (56.0%)	11 (44.0%)	19.641	0.000*
	No idea	9 (22.5%)	31 (77.5%)		
Mothers age at first pregnancy	< 20 years	27 (27.6%)	71 (72.4%)	4.018	0.045*
	≥ 20 years	1 (5.6%)	17 (94.4%)		
Malnutrition knowledge	Yes	3 (12.0%)	22 (88.0%)	2.564	0.109
	No	25 (25.5%)	66 (72.5%)		
Exclusive breastfeeding	Yes	14 (19.7%)	57 (80.3%)	1.972	0.163
	No	14 (31.1%)	31 (68.9%)		

*Statistically significant at 5% level of significance (P-value <0.05)

The weight of child during the birth was also found to be significantly associated with the prevalence of wasting. Children who were below 2.5 kg during birth suffered from the wasting. Low birth weight refers to improper health and nutritional status of child during birth and the nutrient gaps become hard to fulfill as the growth progresses resulting into the wasting of the child. A study done to find association between birth weight and

nutritional status of children under five in sub-Saharan Africa found that children with low birth weight were more likely to be wasted (Aboagye *et al.*, 2022).

Mothers age at first pregnancy was found to be associated with the prevalence of wasting. Children whose mother's age were less than 20 years at the time of birth were more likely to be wasted compared to children whose mother's age were 20 years or above. Study from Bangladesh also highlighted existence of significant association with the prevalence of wasting and mother's age at birth below 20 years (Siddiqi *et al.*, 2011).

4.16 Height for age curve

The median height for age z-score of survey children was found to be -1.33. This is why the curve is slightly skewed to the left side of WHO standard curve showing the prevalence of stunting among study population as shown in Fig. 4.4.

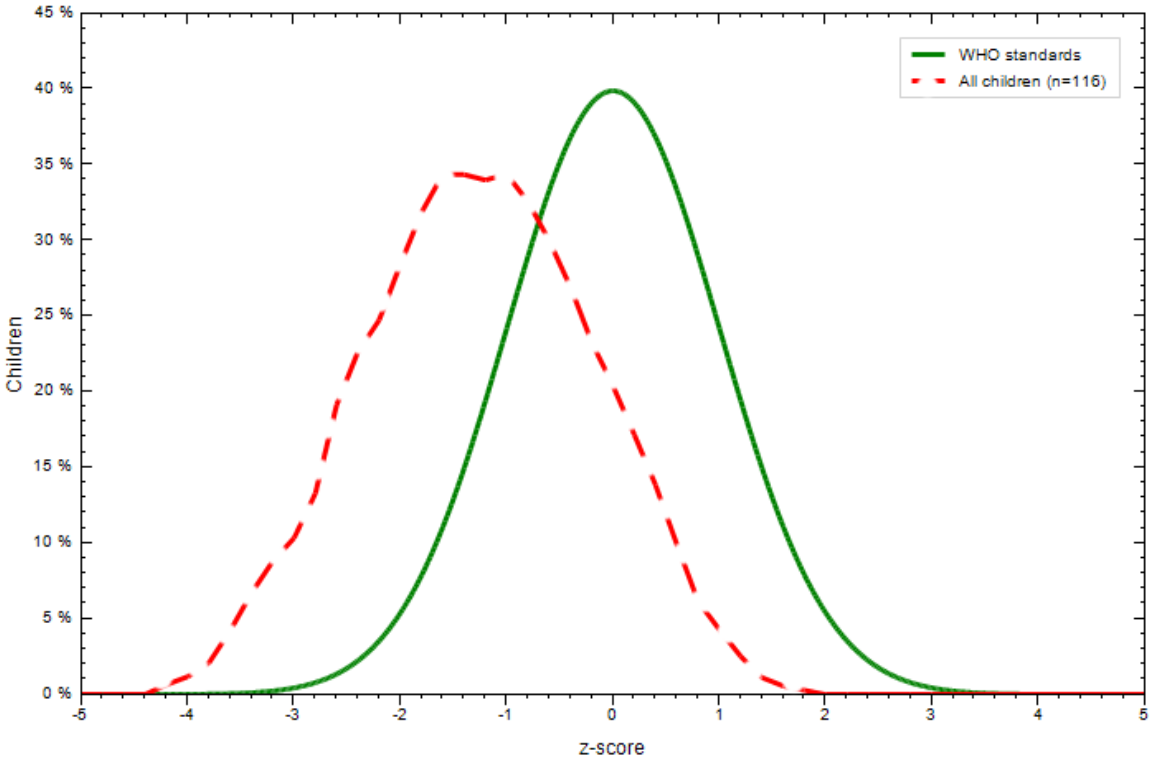

Fig 4.4 Height for age curve with reference to WHO standard

4.17 Factors associated with stunting

In this study, there was significant association of stunting with family type (P=0.007), birth weight (P=0.016), colostrum feeding (P= 0.018), knowledge about baal-vita (P=0.001) and mother's education (P= 0.026).

The survey shows that there was significant association of stunting with family type. Children living in joint family were more stunted compared to those living in nuclear family. This may be due to traditional feeding practices, food distribution among many members and larger household sizes often correlates with poverty and limited access to nutrition and healthcare. Result similar to this was found in a study conducted among under-five children in Maharashtra India where type of family were associated with stunting (Murarkar *et al.*, 2020).

The weight of child during the birth was also found to be significantly associated with the prevalence of wasting. Children who were below 2.5 kg during birth suffered from the stunting. A findings from Nepal Demographic and health Survey, 2006, 2011, and 2016 showed that children who were below average size at time of birth were 1.6 times more likely to be stunted compared with children who were average size or larger at time of birth (Murarkar *et al.*, 2020).

Colostrum feeding also showed significant association with the prevalence of stunting. This might be probably colostrum provides protective effect to the newborns. Similar case control study carried out in Ethiopia found children whose mothers squeezed out colostrum more likely contributes to stunting than who fed their children colostrum (Kahssay *et al.*, 2020).

Knowledge about Baal-vita was significantly associated with stunting. Children provided with Baal Vita were less likely to be stunted than the children who had no any Baal vita. A study conducted to find nutrition status and factors associated with malnutrition among under five children in Baglung district, Nepal found the similar result (S. K. Shah *et al.*, 2021).

Another factor that showed association with the stunting of children is mother's education. Children of mothers who had no education were found to be more stunted in comparison to mothers with primary and secondary education. This may be due to lower literacy level of mothers on maternal and child health care, infant and young child feeding practices, sanitation and hygiene, which ultimately affects the nutritional status of children. Similar study found that children born to mothers with primary and secondary education had lower odds of getting stunted than those who were born to mothers with no education in Nepal (Nepali *et al.,* 2019).

Table 4.16 Factors associated with stunting (n=116)

Factors		HAZ			
		Stunted (%)	**Normal (%)**	χ^2	**P-value**
Family Type	Joint	20 (43.5%)	26 (56.5%)	7.385	0.007*
	Nuclear	14 (20.0%)	56 (80.0%)		
Birth weight	≥ 2.5 kg	13 (25.5%)	38 (74.5%)		
	<2.5 kg	13 (52.0%)	12 (48.0%)	8.244	0.016*
	No idea	8 (20.0%)	32 (80.0%)		
Colostrum feeding	Yes	28 (26.2%)	79 (73.8%)	6.572	0.018*
	No	6 (66.7%)	3 (33.3 %)		
Knowledge about baal-Vita	Yes	3 (8.6%)	32 (91.4%)	10.404	0.001*
	No	31 (38.3%)	50 (61.7%)		
Mothers' education	Primary	5 (15.2%)	28 (84.8%)		
	Secondary	2 (15.4%)	11 (84.6%)	7.307	0.026*
	None	27 (38.6%)	43 (61.4%)		

*Statistically significant at 5% level of significance (P-value <0.05)

4.18 Weight for age curve

The median weight for age z-score of survey children was found to be -1.68. This causes the curve slightly skewed to the left side of WHO standard curve showing the prevalence of underweight among study population as shown in Fig. 4.5.

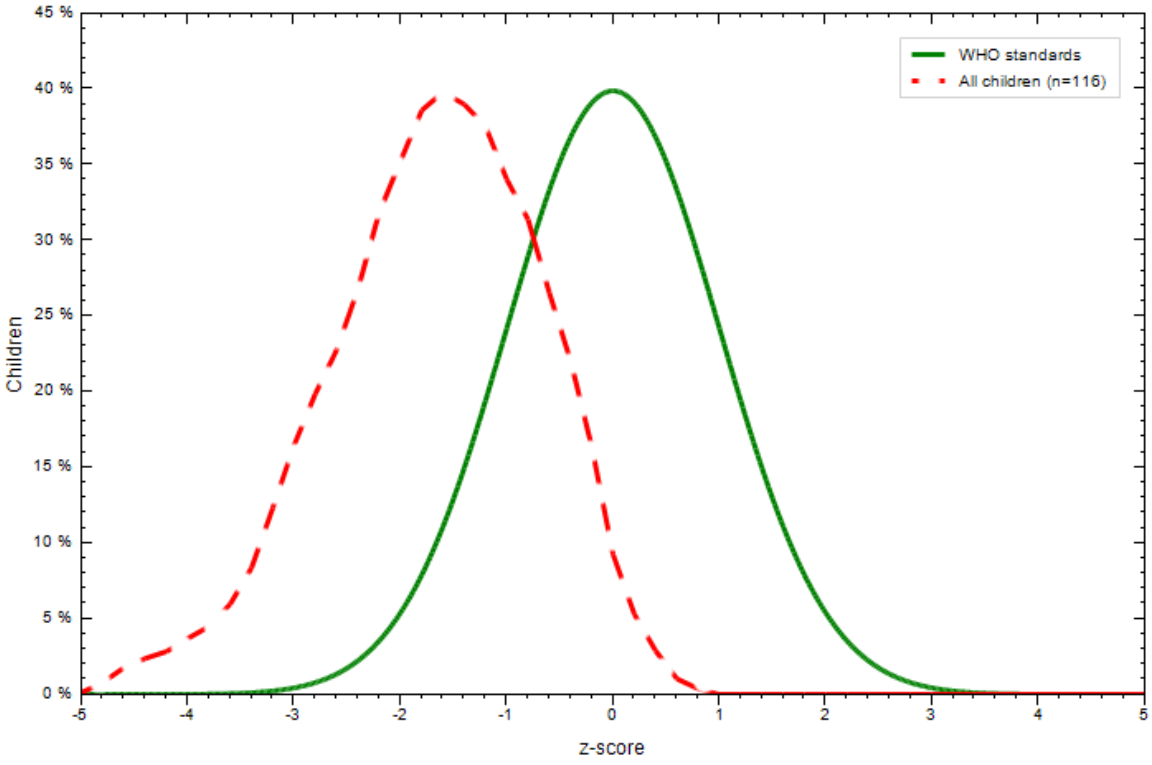

Fig. 4.5 Weight for age curve with reference to WHO standard

4.19 Factors associated with underweight

From the Table 4.16, the factors significantly associated with underweight in children, were birth weight (P=0.004), malnutrition knowledge (P=0.010), Complementary feeding knowledge (P=0.004), frequency of meal during pregnancy and lactation (P=0.049), mothers' education (P=0.033) whereas no significant association with mothers age at marriage (P=0.731).

The weight of child during the birth was found to be significantly associated with the prevalence of underweight. Children who were below 2.5 kg during birth suffered from the underweight. Low birth weight refers to improper health and nutritional status of child during birth and the nutrient gaps become hard to fulfill as the growth progresses resulting into the underweight of the child. Study done in Africa showed that underweight was higher among children with below 2.5kg birth weight, compared to those whose weight was 2.5kg and above (Aboagye *et al.*, 2022).

Knowledge about malnutrition and underweight were also found to be associated. The prevalence of underweight was higher among children whose mother had no knowledge about malnutrition. Similar study done in Nigeria found significant association between mother's malnutrition knowledge and underweight (Ogunba and Otunla, 2015).

Table 4.17 Factors associated with underweight (n=116)

Factors		**WAZ**			
		Underweight (%)	**Normal (%)**	**χ2**	**P-value**
Birth weight	≥ 2.5 kg	11 (21.6%)	40 (78.4%)		
	<2.5 kg	15 (60.0%)	10 (40.0%)	11.137	0.004*
	No idea	13 (32.5%)	27 (67.5%)		
Malnutrition knowledge	Yes	3 (12.0%)	22 (88.0%)	6.675	0.010*
	No	36 (39.6%)	55 (60.4%)		
Complementary Feeding Knowledge	At 6 months	5 (14.3%)	30 (85.7%)	8.396	0.004*
	Other	34 (42.0%)	47 (58.0%)		
Frequency of intake during pregnancy per day	< 3 times	11 (52.4%)	10 (47.6%)		
	3-4 times	24 (33.3%)	48 (66.7%)	6.029	0.049*
	> 4 times	4 (17.4 %)	19 (82.6%)		
Mothers' education	Primary	6 (18.2%)	27 (81.8%)		
	Secondary	3 (23.1%)	10 (76.9%)	6.848	0.033*
	None	30 (42.9%)	40 (57.1%)		
Mothers age at marriage	< 20 years	35 (33.0%)	71(67.0%)	0.200	0.731
	≥ 20 years	4 (40.0%)	6 (60.0%)		

*Statistically significant at 5% level of significance (P-value <0.05)

Complementary feeding knowledge was found to be associated with underweight of children. Children whose mothers lack adequate knowledge on initiation, meal frequency,

preparation, diversity of complementary feeds are found to be more underweight. A study conducted to find the effect of inappropriate complementary feeding practices in Northern Tanzania showed that inappropriate complementary feeding practices and inadequate knowledge was statistically significantly associated with higher risks of wasting and underweight (Masuke *et al.,* 2021).

The frequency of meal consumed by mother during their pregnancy and lactation period was also found to be significantly associated with the prevalence of underweight in the children. The prevalence of underweight was seen to be higher among the children whose mothers consumed food only 3-4 times a day and less than 3 times a day. A study conducted to find associated factors among under five children in Jhapa, Nepal found the similar result (Bhandari, 2021).

Likewise, mother's educational status also showed the significant association with the prevalence of underweight in the children. Children of mothers who had no education were found to be more underweight in comparison to mothers with primary and secondary education. The protective importance of maternal education against underweight is also reported in a study done in Kapilvastu District, Nepal (Bhandari & Chhetri, 2013). Similar study found that mother's low education level was significantly associated with child's underweight status in Pakistan (Khan *et al.*, 2019).

4.20 Association between mother's knowledge score and malnutrition

Analysis indicated a statistically significant ($p<0.05$) association between mothers' knowledge on breastfeeding and childcare practice with stunting and underweight, but not with wasting (Tab. 4.17). Prevalence of stunting and underweight was significantly higher among children whose mothers had poor knowledge level. Similar study conducted in Nigeria also showed significant association between maternal nutrition knowledge with stunting and underweight but not with wasting (Jemide *et al.,* 2016b). A study conducted among 6-59 months children in *Batar* community of Jhorahat VDC, Morang found that mothers nutritional knowledge in childcare practices is significantly associated with wasting and underweight (Rai, 2021).

Table 4.18 Association between mother's knowledge score and malnutrition (n=116)

Mothers' knowledge	**WFH**		**χ2**	**P-value**
	Wasted	Normal		
Poor	13 (22.8%)	44 (77.2%)		
Average	12 (24.0%)	38 (76.0%)	1.472	0.702
Good	3 (33.3%)	6 (66.7%)		
	HFA			
	Stunted	Normal		
Poor	24 (42.1%)	33 (57.9%)		
Average	9 (18.0%)	41 (82.0%)	9.030	0.011*
Good	1 (11.1%)	8 (88.9%)		
	WFA			
	Underweight	Normal		
Poor	26 (45.6%)	31 (54.4%)		
Average	11 (22.0%)	39 (78.0%)	7.223	0.026*
Good	2 (22.2%)	7 (77.8%)		

*Statistically significant at 5% level of significance (P-value <0.05).

Part v

Conclusions and Recommendations

5.1 Conclusions

The study has generally assessed the mother's nutritional knowledge in childcare practices and nutritional status of 6-59 months Musahar children in Ratuwamai, Municipality. Based on the study the conclusions are:

i. The prevalence of wasting, underweight and stunting in children between 6-59 months of *Musahar* children were 24.1%, 33.6% and 29.3% respectively. Among them severe wasting, severe underweight and severe stunting was found to be 6.9%, 8.6% and 6% respectively.
ii. Based on MUAC measurements, children aged 6-47 months had higher rates of moderate and severe malnutrition, while those aged 48-59 months had only fewer cases of moderate malnutrition.
iii. Wasting was highest in the age group between 12-23 months, stunting was highest in the age group between 36-47 months while underweight was highest in the age group 24-35 months
iv. Age category, birth weight, mothers age at first pregnancy has significant association with wasting.
v. Family type, birth weight, colostrum feeding, baal-vita supplementation knowledge and mother's education were found to be significantly associated with stunting.
vi. Birth weight, knowledge about malnutrition, knowledge about complementary feeding, frequency of meal during pregnancy and lactation, mother's education was significantly associated with underweight.
vii. From the mother's knowledge level score, it was found most of mothers had poor knowledge regarding breastfeeding and childcare practices.
viii. Mothers' knowledge was found to be significantly associated with stunting and underweight while there was no association with wasting.

5.2 Recommendations

Based on the results of this study following recommendations could be made in order to improve the nutritional status of children under-five years in the survey area.

i. There is the need for providing nutritional and health education as educated mothers are more likely to offer better care through proper nutrition and hygiene, which ultimately enhances the nutritional status of their children.
ii. Similar cross-sectional descriptive or longitudinal survey can be conducted to determine the magnitude and distribution of malnutrition and other probable causes of malnutrition.

Summary

Nutritional status of children is a major indicator of child health and an important predictor of the entire population health status. Malnutrition in the form of stunting, wasting and underweight among children remains a major public health problem in Nepal. A community based cross-sectional study was conducted to assess the mother's knowledge in breastfeeding and childcare practices and it's on malnutrition among of 6-59 months children in *Musahar* community of Ratuwamai Municipality.

The study included 116 children of *Musahar* community. Census sampling method was taken for data collection. Anthropometric measurements (like height, weight, MUAC) were performed and edema was checked to assess the nutritional status of children, and a structured questionnaire was asked to their mothers to examine knowledge level in child care practices. Data collected from the survey was analyzed using WHO Anthro version 3.2.2 and SPSS version 25. Chi-square test and Fischer exact test were used to find the association and analyze the factors associated with nutritional status of children.

Out of 116 children, 55 of them were males and 61 of them were females. The prevalence of wasting, underweight and stunting was 24.1%, 33.6% and 29.3% respectively. Wasting and underweight was found to be higher in male children whereas stunting was higher in female children. In this study, most of the mothers had poor nutritional knowledge regarding childcare practices. Mother’s knowledge score was significantly associated with stunting and underweight but not with wasting. There was significant association of wasting with age category, birth weight, mothers age at first pregnancy. Family type, birth weight, colostrum feeding, baal-vita supplementation knowledge and mother's education were found to be significantly associated with stunting. Similarly, birth weight, knowledge about malnutrition, knowledge about complementary feeding, frequency of meal during pregnancy and lactation, mother's education was significantly associated with underweight.

From the findings of this study, it is concluded that malnutrition is still an important problem among 6-59 months of *Musahar* children in Ratuwamai Municipality, Morang. To reduce the burden of malnutrition among these children effective, efficient and equitable program should be designed and implemented to reduce child malnutrition. A healthy mother can give birth to a healthy child, thus the intervention programs for improving the nutritional status of children must focus not only on children but also on their mothers.

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Appendices

Appendix-A Consent letter

नमस्कार ।

मेरो नाम दिपेश खनाल हो। म केन्द्रिय प्रविधि क्याम्पस हात्तिसार धरानमा पोषण तथा आहार बिज्ञान , चौथो बर्ष (आठौ सत्र) मा अध्ययनरत विद्यार्थी हु। यस संकायको चौथो बर्ष (आठौ सत्र) पाठ्यक्रम अन्तर्गत म सोधपत्र गरिरहेको छु। मेरो सोधपत्रको बिषय "**Assessing Mother's Knowledge in Breastfeeding and Childcare Practices and its impact on malnutrition among 6-59 Months Children in Musahar Community of Ratuwamai municipality**" रहेको छ। यो अध्ययनको उद्येश्य यस नगरपालिकामा बसोबाश गर्दै आएका मुसहर समुधायका आमाहरुको पोषण सम्बन्धी ज्ञान र ५ बर्ष मुनीका बालबालिकाहरुको पोषण स्थितिको बारे जानकारी संकलन गर्नु रहेको छ। यस अनुसन्धानमा सोधिएका कुराहरु गोपनीय राखिनेछ।यस अध्ययनका लागि तपाइको छोरा/छोरीलाई सहभागी गराउन तपाइलाई केहि प्रश्नहरु सोधिने छ र बच्चाको केहि नाप लीइने छ । सोधकार्यमा सहभागी भई सोधिएका प्रश्नहरुको जवाफ दिन तपाई तयार हुनुहुन्छ भने यस अनुसन्धानमा सहभागी हुन सक्नुहुनेछ।

के तपाई यस अध्ययनमा सहभागी हुन इच्छुक हुनुहुन्छ? (इच्छुक भए मात्र सोधिनेछ)

म यस अध्ययनमा सहभागी हुन इच्छुक छु र यस अध्ययनका लागी आवश्यक पर्ने मेरो बच्चाको नाप तौल लिन अनुमति दिन्छु।

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अभिभावक हस्ताक्षर

Appendix- B Survey Questionnaire

A. General Description

Code no:	Ward no:
Child Name:	Date of Birth:
Gender: Male/Female	Age:
Mother's Name:	Age of mother:

B. Socio Demographic Information

Total number of family members:	Male: Female:
Total number of under 5 children:	Male: Female:
Family Type	Joint/ Nuclear
Religion	Hindu / Buddhist / Christian / Muslim
Head of Household	Male/ Female
What is your husband's occupation? (Father)	Agriculture/Business/Foreign/Labor/others……
What is your occupation? (Mother)	Agriculture/Business/Foreign/Labor/others…….
Father's education level?	Primary Level (1-5) / Secondary Level (6-10) / Intermediate / None
Mother's education level?	Primary Level (1-5) / Secondary Level (6-10) / Intermediate / None
Family annual income?	< 1 lakh/1 lakh to 2 lakh/> 2 lakhs
Who is responsible for buying food and food item	Father/Mother

Household type?	Concrete/Mud

C. Child description and Characteristics

Height (cm)	Weight (kg)	MUAC (cm)	Oedema

Child (sample subject) order:	First/Second/ Third/ Fourth/ Fifth
Weight of child during birth?	2.5 kg and above / < 2.5 kg / No idea
Is this child suffered from any health and medical complication till now?	Yes/no
If yes how Frequently?	Once in year/ two times in year/ three times or more in year
Is this child suffer from cold/ cough/ and or diarrhea in past 7 days	Yes/No
Is any under 5-year child death in past?	Yes/no
If yes, how many and reason of death?	……..

D. Maternal Characteristics

Age of marriage?	Below 20/ 20 and above
Age at first pregnancy?	Below 20/ 20 and above
Did you take iron and folic acid tablet during your pregnancy?	Yes/No
Vaccinations during pregnancy?	Yes/No
What amount of food did you eat during pregnancy/lactation?	More than usual/ less than usual/ as usual
How many times per day did you used to eat during pregnancy and lactation?	< 3time / 3-4 times/ > 4 times

E. Child care practices

When did you first initiate breast feeding?	Within 1hr of birth/ within 24hrs/ after 24 hrs.
Did you feed colostrum to your child?	Yes/No
Did you introduce any pre lacteal feeds to your child? If yes, what kinds of pre lacteal food given?	Yes/No Animal milk/ honey/ jaggery/ ghee/ herbal paste/ None
Did you exclusively breastfeed your child?	Yes/No
Has your child received all the immunization according to the age?	Yes/No
At what age did you start feeding other foods to the child?	4-5 months/5-6 months/>6 months

F. Mothers Knowledge in Breastfeeding and Childcare Practices

1. At what time is it suitable to initiate breastfeeding?	Within 1 hr. / within 24 hour/ No idea
2. Why colostrum feeding is important to the child?	Good for child health/Don't know
3. Do you know about exclusively breastfeeding?	Yes/No
4. How long a child should be breastfed?	< 2 years/ 2 years and above/ don't know
5. Is pre-lacteal feed essential for the child?	Yes/No
6. At what age to start feeding other foods to the child?	4/5/6/7/8
7. How many times per day child should be fed food?	<3 times/3 times and above

8. Do you have knowledge about lito preparation?	Yes/No
9. Do you have knowledge about malnutrition?	Yes/No
10. If you know about malnutrition, what may be the cause of it?	……..
11. Do you have knowledge about diarrhea?	Yes/No
12. If you know about diarrhea, what may be the cause of it?	……
13. Do you know to prepare Oral Rehydration Solution (ORS) at home?	Yes/No
14. What kinds of food should be given to the children during diarrhea?	Soup Same as usual No idea
15. Do you know about Baal-Vita?	Yes/No
16. Do you know about Growth Monitoring?	Yes/No
17. Do you have knowledge about Vit A and deworming supplementation?	Yes/No
18. Do you know extracted maad also have nutrients?	Yes/No
19. What kinds of salt are good to use at home?	Iodized salt/ Normal salt
20. When will you wash your vegetables?	Before cutting/After cutting

F. Food Frequency

How frequent you feed cereals to your child?	Daily/2-3 times a week/4-5 times a week/once a week/once in 15 days or less /never
How frequent you feed pulses to your child?	Daily/2-3 times a week/4-5 times a week/once a week/once in 15 days or less /never

How frequent you fed green leafy vegetable to your child?	Daily/2-3 times a week/4-5 times a week/once a week/once in 15 days or less /never
How frequent you fed other vegetable to your child?	Daily/2-3 times a week/4-5 times a week/once a week/once in 15 days or less /never
How frequent you fed milk and milk products to your child?	Daily/2-3 times a week/4-5 times a week/once a week/once in 15 days or less /never
How frequent you fed meat and fish to your child?	Daily/2-3 times a week/4-5 times a week/once a week/once in 15 days or less /never
How frequent you fed egg to your child?	Daily/2-3 times a week/4-5 times a week/once a week/once in 15 days or less /never
How frequent you fed fruits to your child?	Daily/2-3 times a week/4-5 times a week/once a week/once in 15 days or less /never

F. Hygiene and Sanitation Practices

Which water source do use?	Tap water/ Well/ River/ Tube well
Do you purify water before drinking	Yes/No
If yes, which purification method you use?	Filtering/ Boiling/ Adding Piyush
Do you practice washing hand after defecation?	Yes/ No
Do you have toilet facility?	Yes / No
Do you wash your hand before feeding child?	Yes/No
Do you wash your hand after feeding?	Yes/No
How do you wash your hand?	Normal water/soap/others…..

Appendix C Approval letter from Municipality

रतुवामाई नगरपालिका

नगर कार्यपालिकाको कार्यालय

सिजुवा, मोरङ

कोशी प्रदेश, नेपाल

रतुवामाई नगरपालिका नगर कार्यपालिकाको कार्यालय सिजुवा, मोरङ कोशी प्रदेश, नेपाल

प.सं.: २०८०/८१

च.नं. ९१८८

मिति : २०८०/११/०४

नेपाल संवत:११४४ सिल्लाथ्व, ७ बुक्रवार

श्री यो जो जस सँग सम्बन्धित छ।

विषय : स्वीकृती प्रदान गरिएको सम्बन्धमा।

प्रस्तुत विषयमा त्रिभुवन विश्वविद्यालय, केन्द्रीय प्रविधि क्याम्पस, धरानको मिति २०८०/१०/१५ गतेको प्रास पत्रानुसार हाल उक्त क्याम्पसमा वि.एस्सी.न्यूट्रिशन एण्ड डाईटेटिक्स चौथो वर्ष आठौ सेमेस्टरमा अध्ययनरत विद्यार्थी दिपेश खनालले **(Mother's nutritional knowledge in childcare practices and its association with nutrition status of 6-59 months children in Musahar community of Ratuwamai Municipality)** विषयमा आवश्यक सर्वेक्षण गर्ने कार्यका लागि अनुमती प्रदान गरिएको व्यहोरा जानकारीका लागि अनुरोध छ।

नागेश्वर प्रसाद सिंह गन्गाई

नगर प्रमुख

नागेश्वर प्रसाद सिंह गन्गाई

नगर प्रमुख

Appendix-D Photo Gallery

Fig. A Taking MUAC measurement

Fig. B Taking height measurement

Fig. C Filling up survey form

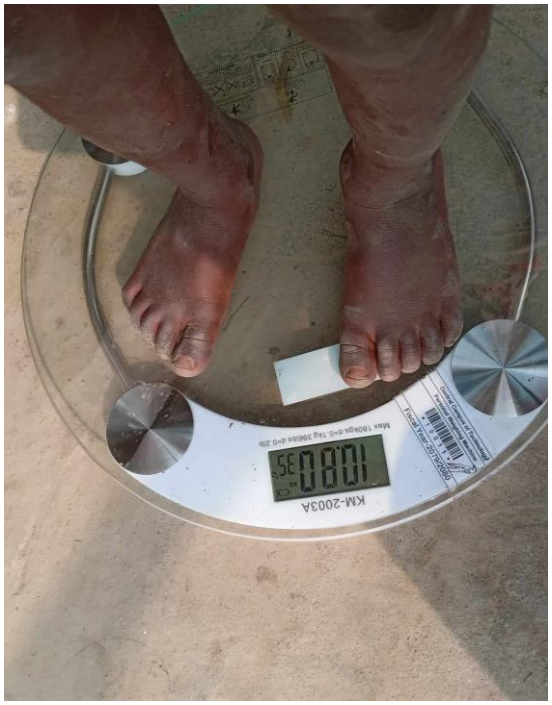

Fig. D Taking weight measurement

Appendix-E Relationship of study variables with malnutrition

Factors Associated with Wasting:

Variables		WHZ		χ^2	P-value
		Wasted	Normal		
Sex	Male	17 (30.9%)	38(69.1%)		
	Female	11 (18.0%)	50(82.0%)	2.619	0.106
Colostrum feeding	Yes	28(26.2%)	79(73.8%)	3.105	0.111
	No	0	9(100%)		
Family types	Joint	14(30.4%)	32(69.6%)	1.651	0.199
	Nuclear	14(20.0%)	56(80.0%)		
Annual Income	< 1 lakh	17(23.3%)	56(76.7%)	0.142	0.932
	1-2 lakh	8(26.7%)	22(73.3%)		
	>2 lakh	3(23.1%)	10(76.9%)		
Household food purchaser	Father	7(14.9%)	40(85.1%)	3.687	0.055
	Mother	21(30.4%)	48(69.6%)		
House structure	Concrete	24(23.3%)	79(76.7%)	0.352	0.511
	Mud	4(30.8%)	9(69.2%)		
Birth weight	≥ 2.5 kg	5(9.8%)	46(90.2%)	19.641	0.000*
	< 2.5 kg	14(56.0%)	11(44.0%)		
	No idea	9(22.5%)	31(77.5%)		
Mothers age at marriage	< 20 years	25(23.6%)	81(76.4%)	0.205	0.702
	≥ 20 years	3(30.0%)	7(70.0%)		
Mothers age at first pregnancy	< 20 years	27 (27.6%)	71(72.4%)	4.018	0.045*
	≥ 20 years	1(5.6%)	17(94.4%)		
Iron folate intake	Yes	24(23.3%)	79(76.7%)	0.352	0.511
	No	4(30.8%)	9(69.2)		
Mothers' vaccination	Yes	26(24.3%)	81(75.7)	0.020	0.889
	No	2(22.2%)	7(77.8%)		

Amount of food during pregnancy	More	9(29.0%)	22(71.0%)	1.435	0.488
	Less	8(28.6%)	20(71.4%)		
	As usual	11(19.3%)	46(80.7%)		
Frequency of intake during pregnancy per day	< 3 times	6(28.6%)	15(71.4%)	0.417	0.812
	3-4 times	16(22.2%)	56(77.8%)		
	>4 times	6(26.1%)	17(73.9%)		
Exclusive breastfeeding	Yes	14(19.7%)	57(80.3%)	2.564	0.109
	No	14(31.1%)	31(68.9%)		
Age category	6-11 months	5(25.0%)	15(75.0%)	8.259	0.034*
	12-23 months	10(33.3%)	20(66.7%)		
	24-35 months	7(33.1%)	14(66.9%)		
	36-47 months	5(26.3%)	14(73.7%)		
	48-59 months	1(3.8%)	25(96.2)		
Malnutrition knowledge	Yes	3(12.0%)	22(88.0%)	2.564	0.109
	No	25(25.5%)	66(72.5%)		
Child Vaccination	Yes	25(22.9%)	84(77.1%)	1.426	0.357
	No	3(42.9%)	4(57.1%)		
Diarrhea knowledge	Yes	27(24.1%)	85(75.9%)	0.002	0.967
	No	1(25.0%)	3(75.0%)		
Food during diarrhea	Soup	3(23.1%)	10(76.9%)	0.010	0.957
	As usual	10(24.4%)	31(75.6%)		
	No idea	15(24.2%)	47(75.8%)		
Water Purification	Yes	1 (16.7%)	5(83.3%)	0.193	0.661
	No	27(24.5%)	83(75.5%)		

*Statistically significant with wasting (P-value <0.05)

Factors Associated with Stunting:

Variables		HAZ		χ^2	P-value
		Stunted	Normal		
Sex	Male	14 (25.5%)	41(74.5%)	0.750	0.386
	Female	20 (32.8%)	41(67.2%)		
Colostrum Feedings	Yes	28(26.2%)	79(73.8%)	6.572	0.018*
	No	6(66.7%)	3(33.3%)		
Family types	Joint	20(43.5%)	38(74.5%)	7.385	0.007*
	Nuclear	14(20.0%)	56(80.0%)		
Annual Income	< 1 lakh	21(28.8%)	52(71.2%)	0.489	0.783
	1-2 lakh	10(33.3%)	22(66.7%)		
	>2 lakh	3(23.1%)	10(76.9%)		
Household food purchaser	Father	18(38.3%)	29(61.7%)	3.080	0.079
	Mother	16(23.2%)	53(76.8%)		
House structure	Concrete	28(27.2%)	75(72.8%)	2.005	0.197
	Mud	6(46.2%)	7(53.8%)		
Birth weight	≥ 2.5 kg	13(25.5%)	46(90.2%)	8.244	0.016*
	< 2.5 kg	13(52.0%)	11(44.0%)		
	No idea	8(20.0%)	32(80.0%)		
Mothers age at marriage	< 20 years	32(30.2%)	74(69.8%)	0.458	0.721
	≥ 20 years	2(20.0%)	8(80.0%)		
Mothers age at first pregnancy	< 20 years	31(31.6%)	67(68.4%)	1.644	0.200
	≥ 20 years	3(16.7%)	15(83.3%)		
Iron folate intake	Yes	31(30.1%)	72(69.9%)	0.275	0.753
	No	3(23.1%)	10(76.9%)		
Amount of food during pregnancy	More	8(25.8%)	23(74.2%)	0.299	0.861
	Less	9(32.1%)	19(67.9%)		
	As usual	17(29.8%)	40(70.2%)		

Frequency of intake during pregnancy per day	< 3 times	10(47.6%)	11(52.4%)	5.336	0.062
	3-4 times	21(29.2%)	51(70.8%)		
	>4 times	3(13.0%)	20(87.0%)		
Exclusive breastfeeding	Yes	18(25.4%)	53(74.6%)	1.384	0.239
	No	16(35.6%)	29(64.4%)		
Malnutrition knowledge	Yes	2(8.0%)	23(92.0%)	3.647	0.095
	No	32(35.2%)	59(64.8%)		
Child vaccination	Yes	30(27.5%)	79(72.5%)	2.785	0.192
	No	4(57.1%)	3(42.9%)		
Food during diarrhea	Soup	4(30.8%)	9(69.2%)	1.84	0.398
	As usual	15(36.6%)	26(63.4%)		
	No idea	15(24.2%)	47(75.8%)		
Baal vita knowledge	Yes	3(8.6%)	32(91.4%)	10.404	0.001*
	No	31(38.3%)	50(61.7%)		
Mothers Education	Primary	5(15.2%)	28(84.8%)	7.307	0.026*
	Secondary	2(15.4%)	11(84.6%)		
	None	27(38.6%)	43(61.4%)		
Water Purification	Yes	2(33.3%)	4(66.7%)	0.049	0.824
	No	32(29.1%)	78(70.9%)		

*Statistically significant with stunting (P-value <0.05)

Factors Associated with underweight:

Variables		WAZ		χ^2	P-value
		Underweight	Normal		
Sex	Male	21(38.2%)	34(61.8%)	0.975	0.323
	Female	18 (29.5%)	43(70.5%)		
Colostrum Feedings	Yes	38(35.5%)	69(64.5%)	2.215	0.269
	No	1(11.1%)	8(88.8%)		
Family types	Joint	19(41.3%)	27(58.7%)	2.017	0.166
	Nuclear	20(28.6%)	50(71.4%)		
Annual Income	< 1 lakh	22(30.1%)	51(69.9%)	1.712	0.425
	1-2 lakh	13(43.3%)	17(56.7%)		
	>2 lakh	4(30.8%)	9(69.2%)		
Household food purchaser	Father	19(40.4%)	28(59.6%)	1.639	0.200
	Mother	20(29.0%)	49(71.0%)		
House structure	Concrete	36(35.0%)	67(65.0%)	0.729	0.539
	Mud	3(23.1%)	10(76.9%)		
Birth weight	≥ 2.5 kg	11(21.6%)	40(78.4%)	11.137	0.004*
	< 2.5 kg	15(60.0%)	10(40.0%)		
	No idea	13(32.5%)	27(67.5%)		
Mothers age at marriage	< 20 years	35(33.0%)	7(67.0%)	0.200	0.731
	≥ 20 years	4(40.0%)	6(60.0%)		
Complementary feeding knowledge	At 6 months	5(14.3%)	30(85.7%)	8.396	0.004*
	Others	34(42.0%)	47(58.0%)		
Mothers age at first pregnancy	< 20 years	34(34.7%)	64(65.3%)	0.326	0.568
	≥ 20 years	5(27.8%)	13(72.2%)		
Iron folate intake	Yes	33(32.0%)	70(68.0%)	1.030	0.351
	No	6(46.2%)	7(53.8%)		
Amount of food during pregnancy	More	10(32.3%)	21(67.7%)	1.464	0.687
	Less	12(42.9%)	16(57.1%)		
	As usual	17(29.8%)	40(70.2%)		

Frequency of intake during pregnancy per day	< 3 times	11(52.4%)	10(52.4%)	6.029	0.049*
	3-4 times	24(33.3%)	48(66.7%)		
	>4 times	4(17.4%)	19(82.6%)		
Exclusive breastfeeding	Yes	26(36.6%)	45(63.4%)	0.738	0.390
	No	13(28.9%)	32(71.1%)		
Malnutrition knowledge	Yes	3(12.0%)	22(88.0%)	6.675	0.010*
	No	36(39.6%)	55(60.4%)		
Child vaccination	Yes	36(33.0%)	7(67.0%)	0.285	0.686
	No	3(42.9%)	4(57.1%)		
Food during diarrhea	Soup	6(46.2%)	7(53.8%)	2.520	0.284
	As usual	16(39.0%)	25(61.0%)		
	No idea	17(27.4%)	45(72.6%)		
Water purification	Yes	4(66.7%)	2(33.3%)	3.096	0.078
	No	35(31.8%)	75(68.2%)		
Mothers education	Primary	6(18.2%)	27(81.8%)	6.848	0.033*
	Secondary	3(23.1%)	11(76.9%)		
	None	30(42.9%)	43(57.1%)		

*Statistically significant with underweight (P-value <0.05)