NUTRITIONAL STATUS AND IT'S ASSOCIATED FACTORS OF ADOLESCENT STUDENTS STUDYING AT GOVERNMENT SCHOOLS OF MIKLAJUNG RURAL MUNICIPALITY, PANCHTHAR

by

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Nutritional Status and It's Associated Factors of Adolescent Students Studying at Government Schools of Miklajung Rural Municipality, Panchthar

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This *dissertation* **entitled** *Nutritional status and it's associated factors of adolescent students studying at government schools of Miklajung rural municipality, Panchthar* **by Bishal Bhattarai has been accepted as the partial fulfilment of the requirements for the degree of Bachelor of Science in Nutrition and Dietetics.**

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Abstract

A cross sectional survey was conducted to assess the nutritional status and dietary intake of adolescents studying in government schools of Miklajung rural municipality, Panchthar. 175 adolescents were chosen by random selection according to proportion from 2 secondary schools. To obtain the required information, a carefully thought-out and pretested set of questionnaires was created. A computerized weighing balance was used to measure the subjects' weight and stadiometer was used to measure the height. Dietary intake was assessed by 24 hours dietary recall and food frequency questionnaire. Data collected was analyzed using WHO Anthroplus, SPSS version 25 and Microsoft excel. Pearson correlation test, independent sample t test and one-way ANOVA was used to analyze the factors associated with nutritional status at 95% significance level.

The prevalence of stunting, thinness and obesity were 38.8%, 6.9% and 3.4% respectively. The prevalence of insufficient intake of the nutrients as energy, protein and added fat, was 89.7%, 17.7% and 96.6% respectively. Skipping of meals was also common among the study group. Mean intake of nutrients by girls and boys of different age groups are insufficient except protein and also there were high dispersion among individual intakes of the subjects. Age, dietary diversity score, fat intake, birth order and alcohol consumption were found to be statically associated with height for age. Gender, caste, religion, water source, perception about own body size, practice to gain weight, practice to lose weight, consumption of pulses & legumes, consumption of meat and eggs, consumption of processed foods and adequacy of protein intake are associated with BMI for age.

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Abbreviations	Full forms
BMI	Body Mass Index
BAZ	Z score value for BMI for age
HAZ	Z score value for height for age
BNF	British Nutrition Foundation
FAO	Food and Agriculture Organization of United Nations
GoN	Government of Nepal
gm	Gram
HDI	Human Development Index
ICMR	Indian Council of Medical Research
IOM	Institute of Medicine of National Academies
Kcal	Kilo calorie
mg	Milligram
NCD	Non-communicable disease
NDHS	Nepal Demographic and Health Survey
NLM	National Library of Medicine
SEAR	South East Asian Region
UNICEF	United Nations Children's Emergency Fund

USA	Unites States of America
USAID	United States Agency for International Development
WHO	World Health Organization

Part I

1.Introduction

1.1.   Background to the study

Adolescence is the phase of life between childhood and adulthood, from ages 10 to 19. It is a unique stage of human development and an important time for laying the foundations of good health. Adolescents experience rapid physical, cognitive and psychosocial growth. Adolescents establish patterns of behaviour related to diet, physical activity, substance use, and sexual activity (WHO, 2024a).

Nutrition is the intake of food, considered in relation to the body's dietary needs. Good nutrition is essential to good health. Poor nutrition can lead to reduced immunity, increased susceptibility to disease, impaired physical and mental development, and reduced productivity. Nutrition impacts the development process at every stage of the life-cycle from conception to death (WHO, 2024d). The nutritional status of an individual can be defined as the result between the nutritional intake received and the nutritional demands, and should allow for the utilization of nutrients to maintain reserves and compensate for losses (Fernández-Lázaro and Seco-Calvo, 2023).

In numerous developing nations, adolescents often experience stunting, underweight, and micronutrient deficiencies due to insufficient nutrition and early childhood infections, compounded by a diet that fails to fulfill the substantial nutritional requirements during the rapid growth phase in adolescence (Cusick and Kuch, 2012). In 2021, a study conducted on Kathmandu metropolitan city showed the prevalence of underweight to be 9.1% while 23.7% are classified as overweight or obese (Singh *et al.*, 2021). According to study conducted at semi urban area of Pokhara metropolitan city, the proportion of obesity, overweight, underweight, and stunting among school going adolescents aged 9 – 17 years was 4%, 12%, 7%, and 17% (Hamann *et al.*, 2023).

1.2.   Problem Statement and Justification

While adolescence is commonly perceived as a healthy life stage, there is notable mark of occurrences of death, illness, and injury (WHO, 2024a). According to study conducted on Eating habits and factors affecting food choice of adolescents living in rural areas Body image concerns, dieting, education about food, parental control, maternal education level and eating with family and peers are factors that were found to affect food choices in adolescents (Bargiota et al., 2013). Findings from the global burden of diseases and injuries among children and adolescents suggest that protein-energy malnutrition is among the top 10 causes of death among children and adolescents, accounting for 225,906 deaths in 2013. Globally, around 34 deaths per 100,000 children and adolescents are attributed to malnutrition, and this number significantly varies between developing (38.5 per 100,000) and developed countries (0.2 per 100,000) (Kyu *et al.*, 2016) . Research indicates that adolescents commonly consume energy sources lacking significant vitamins or minerals. Intervening during this period is crucial as the dietary habits formed in adolescence tend to persist into adulthood (Ross *et al.*, 2020).

In the South East Asian (SEA) Region, a large number of adolescents suffer from chronic malnutrition and anaemia, which adversely impact their health and development. The high rate of malnutrition in girls not only contributes to increased morbidity and mortality associated with pregnancy and delivery, but also to increased risk of delivering low-birth-weight babies. This contributes to the inter-generational cycle of malnutrition (WHO, 2006). Indicators of over nutrition such as overweight and obesity in children and adolescents now occur simultaneously with underweight, stunting and wasting. The inconsistency of these two boundaries, repeatedly referred to as the "double burden of malnutrition" (Marriott *et al.*, 2012; Wells, 2012).

In many developing nations, such as Nepal, nutrition programs have predominantly concentrated on children and women, overlooking the nutritional requirements of adolescents (Cusick and Kuch, 2012). The current generation of youth is more extensive than ever, yet a significant number of them are not receiving the necessary support to fully exercise their rights. Challenges such as poverty, inequality, discrimination, climate change, economic disruptions, conflict, and displacement pose threats to the well-being of

adolescents. Unfortunately, policymakers frequently overlook or, in some cases, perceive adolescents as issues or risks (UNICEF).

Limited studies have explored the factors contributing to malnutrition among adolescents in Nepal. Since no study on assessment of nutritional status and dietary intake of adolescents on Miklajung rural municipality has been conducted till date, this study was done to assess the nutritional status and its associated factors among adolescents attending schools in the Miklajung rural Municipality of Panchthar district, Nepal. The study can aid for policy makers at both local and national level.

1.3. Objective of study

1.3.1. General Objective

To assess nutritional status and dietary intake of adolescents studying in government schools of Miklajung rural municipality.

1.3.2. Specific Objective

1) To assess the nutritional status of the adolescents of Miklajung rural municipality by anthropometric measurement.
2) To collect information about dietary intake and dietary habits of adolescents in Miklajung rural municipality
3) To identify the factors associated with nutritional status.

1.4. Conceptual framework
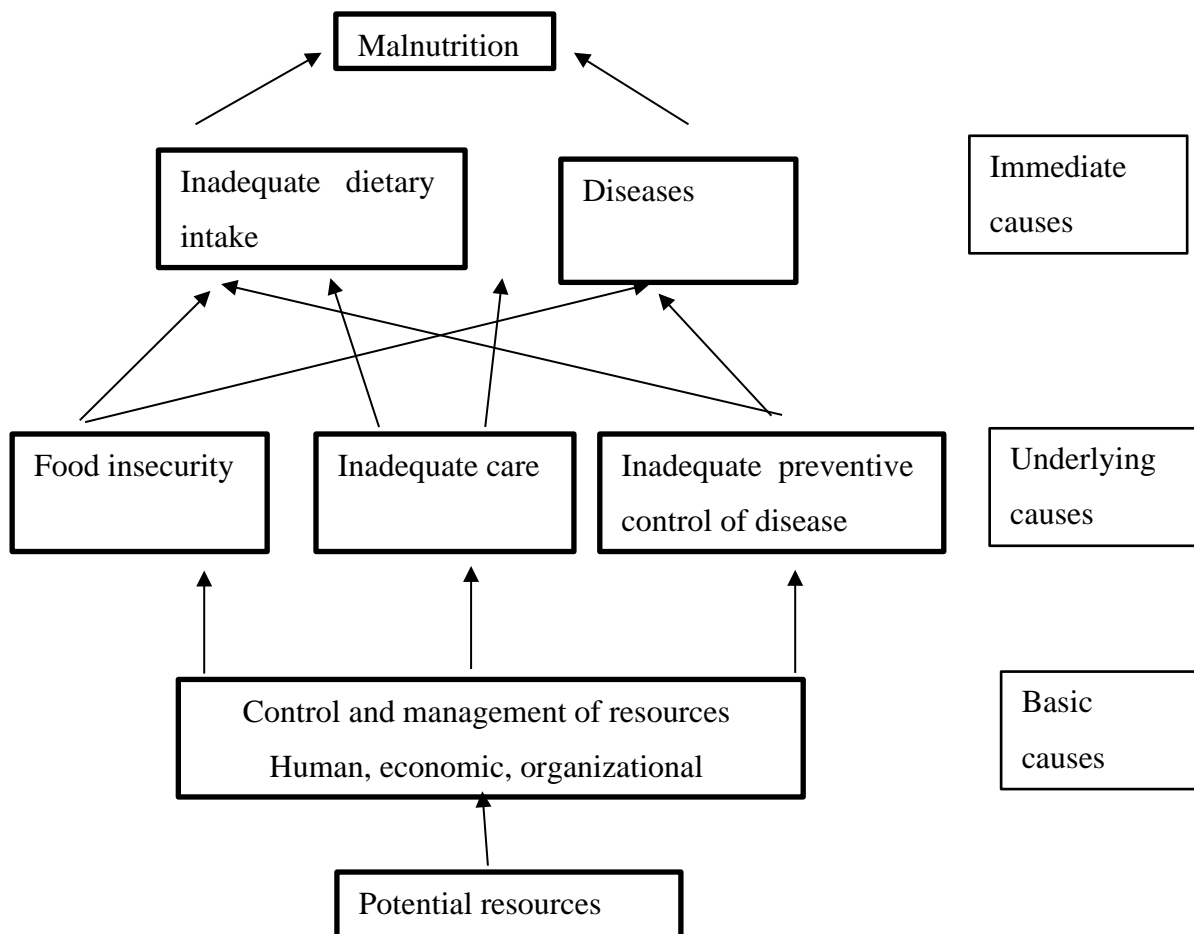
Figure 1.1 Conceptual framework of malnutrition

SOURCE: UNICEF (1998)

1.5. Research Questions:

a) What is the nutritional status of adolescents studying in government schools of Miklajung rural municipality, Panchthar?

b) How is the dietary intake and dietary habits of adolescents of Miklajung rural municipality, Panchthar?

c) What are the different factors which directly and indirectly influence the nutritional status of the adolescents?

1.6.   Significance of study

    a) The study uncovers the extent and distribution of malnutrition among adolescents attending government schools in Miklajung rural municipality offering insights that may have broader applicability at the national level.

    b) Identify people or groups who are at risk of being malnourished.

    c) The study provide valuable information on the factors associated with adolescent malnutrition, exploring the impact of nutrient intake and dietary behavior on their nutritional status.

    d) It can propose targeted corrective measures to address adolescent malnutrition, taking into consideration variables such as gender, caste, family economy, dietary behavior, and nutrient intake.

    e) The study is poised to furnish governmental and non-governmental organizations with essential insights into the nutrition situation and dietary behaviors of adolescents.

    f) Serving as a guideline for policymakers, the study may play a pivotal role in shaping plans and policies to tackle adolescent malnutrition.

1.7.   Limitations of The Study

    a) Biochemical and clinical assessment were not performed due to limitations of facilities.

    b) Seasonal variation could not be accounted because it is cross-sectional survey.

    c) Data cannot be generalized to other population.

1.8.   Assumptions:

In Miklajung Rural Municipality, the nutritional status of adolescent students is assumed to be at significant concern that requires immediate attention. Due to limited access to nutrient-rich foods, food security, poverty, economic insecurity, lack of education, awareness, inadequate healthcare facilities, poor water, sanitation, hygiene (WASH) conditions, cultural practices, dietary habits, climate-related factors, etc. Most of the adolescents are victim of chronic malnutrition. The rural context often introduces unique challenges related to dietary practices, socio-economic factors, and limited access to nutritional resources.

Despite the critical importance of adolescence as a formative period for physical and cognitive development, there is a lack of comprehensive research specifically addressing the nutritional well-being of students in Miklajung.

Part II

2. Literature Review

2.1. Nutrition

Nutrition focuses on the role of food in nourishing individuals, playing a crucial role in the growth and development of children and adolescents, as well as promoting health and well-being across all age groups. The connection between nutrition and health encompasses various dietary components(Contento, 2008).

2.2. Nutrition Status

Nutritional status is defined as the state of the body resulting from the intake, absorption and utilization of food (Sangroula and Uprety, 2020). Anthropometric measurements, including the weight-for-height index, triceps skin-fold thickness, and arm muscle circumference, along with the evaluation of circulating proteins such as albumin, transferrin, and prealbumin, serve as methods to assess nutritional status. This assessment is essential in shaping recommendations for nutrient intake (Elmadfa and Meyer, 2014).

2.3. Adolescence

Adolescence is the phase of life between childhood and adulthood, from ages 10 to 19. It is a unique stage of human development and an important time for laying the foundations of good health (WHO, 2024a). The foundation of adequate growth and development is laid before birth, during childhood, and is followed during adolescence (WHO, 2006).

2.3.1. Early Adolescence

Early adolescence typically spans from 10 to 15 years of age. During this period, secondary sexual characteristics emerge, individuals begin to employ concrete thinking, and there is often a lack of understanding regarding the consequences of current actions on their future. This stage is marked by frequent mood swings, arguments, and disobedient behavior (WHO, 2010b).

2.3.2. Middle Adolescence

Middle adolescence encompasses the age range of 14 to 17 years. During this phase, there is further development of secondary sexual characteristics, and individuals typically reach around 95% of their adult height. This period is marked by contemplation of impractical dreams, a heightened sense of personal power, the emergence of sexual drives, and the establishment of more stable interpersonal relationships (WHO, 2010b).

2.3.3. Late Adolescence

Late adolescence pertains to the age group of 16 to 19 years. In this phase, individuals progress toward physical maturity, experience the development of abstract thinking, and begin to make plans for the future. Additionally, they start to grasp concepts of morality and ethics, gaining a better understanding of right and wrong (WHO, 2010b).

2.4. Changes during Adolescence

Accelerated physical, biochemical and emotional development occurs during adolescent. Hormones have an extensive impact on the body and mind, causing numerous changes. This is the time when the last growth spurt, which results in weight and height gains, happens. Boys develop more slowly than girls do throughout their growth spurt (Srilakshmi, 2014). Quick changes in the body might be frightening, exhilarating, or perplexing. While some teenagers may mature early and others later, both situations might increase the stress of being different from the crowd. Given that adolescence is the prime developmental period for the desire to blend in with others, this can be very upsetting (Rathus, 2016).

2.4.1. Physical changes

The growth experienced during adolescence in terms of physical size is second only to the development in infancy. The maximum growth velocity occurs in the 10–13 age range for girls and 12–15 years for boys. Between the ages of 18 and 20, they reach adult height, but until they are 25 years old, their bone mass keeps growing (Srilakshmi, 2014). Some physical changes during teenage are as below:

Body composition:

Males and females have about similar amounts of muscle, lean body mass, and fat (19% and 15% respectively) before puberty. By the age of 20, fat increases to 23% in girls and drops to 12% in boys (Delisle, 2005).

Sexual maturity:

Alongside the development spurt comes sexual maturity. The growth of breasts, pubic and auxiliary hair, and menarche occur in girls. They develop rounder hips and smaller waists. A deeper voice, broader shoulders, the growth of auxiliary and pubic hair, and the development of the penis and testicles are all signs of pubertal changes in boys. The assessment of sexual maturation involves evaluating pubertal development through the examination of secondary sex characteristics, such as testicular and penile development, and the emergence of pubic hair in boys, as well as breast development and the appearance of pubic hair in girls. This assessment is commonly referred to as Tanner stage rating (St-Onge *et al.*, 2014).

2.4.2. Cognitive changes

Teenagers notice that they have more mental capacity, and this alters the way they view the world. Teenagers' perspectives about themselves, their families, and friends, as well as how they approach more general social and moral issues, are influenced by the cognitive changes that occur during adolescence (Rathus, 2016).

2.4.3. Psycho-Social changes

The emergence of abstract thinking, the developing capacity to take in and process other people's perspectives, the development of a sexual and personal identity, the establishment of a set of values, the growing autonomy and independence from family, the increasing significance of sometimes subcultural peer relationships, and the emergence of coping mechanisms and problem-solving skills are the most significant psychological and psychosocial changes that occur during the early stages of adolescence (Remschmidt, 1994). Self-esteem problems are frequently encountered by adolescents when they start to set themselves apart from others and go through physical changes. Adolescents experiences

with self-esteem can be complicated. While they may have strong self-esteem among their families, they may have low self-esteem among their peers or in their academic performance (Robert, 2008).

2.5. Malnutrition

Malnutrition refers to deficiencies or excesses in nutrient intake, imbalance of essential nutrients or impaired nutrient utilization. Undernutrition, obesity, and overweight are all parts of the double burden of malnutrition, which also includes noncommunicable diseases linked to diet (WHO, 2024d).

According to (WHO, 2024d) :

- Wasting is defined as low weight-for-height.
- Stunting is defined as low height-for-age. It is the result of chronic or recurrent undernutrition.
- Underweight is defined as low weight-for-age.
- Micronutrient deficiencies are a lack of vitamins and minerals that are essential for body functions such as producing enzymes, hormones and other substances needed for growth and development.

2.6. Assessment of Nutrition Status

Nutritional assessment involves analyzing data gathered from dietary, laboratory, anthropometric, and clinical studies. This process aims to evaluate the nutritional status of individuals or populations, considering the impact of nutrient intake and utilization. The methods for nutritional assessment were first outlined subsequent to a 1932 conference organized by the Health Organizations of the League of Nations (Lee, 2010).

The assessment of nutritional status of adolescents can be done by;

- Height for age
- BMI for age

2.7. Factors Affecting Nutritional Status of Adolescents

The nutritional status of adolescents in Nepal is intricately linked to a complex interplay of educational, socio-economic, cultural, and environmental factors. Economic disparities and poverty impact access to quality food and healthcare, with a significant population engaged in agriculture. Cultural beliefs shape dietary habits and health practices. Limited healthcare infrastructure, early marriage and pregnancies contribute to increased nutritional demands. Challenges in sanitation, hygiene, and climate change further affect food security. Some of the major factors affecting nutritional status of adolescents are given below:

2.7.1. Dietary adequacy

The bulk of rural households' diets in developing nations consist mostly of locally cultivated starchy staples, with few or no animal products and only seasonal fruits and vegetables. Undernutrition is a result of monotonous diets consisting of a relatively limited variety of foods, especially among children from households where food is scarce. Undernutrition may be caused by gender differences in the availability and access to food and other resources, particularly in situations where the female kid is still viewed as less significant than the male child (Maziya, 2014). Diet has an impact on adolescent health and development, which carries over into adulthood. Inadequate consumption of calories, macronutrients, or micronutrients throughout adolescence may have negative long-term consequences. Adolescent malnutrition can also result in disordered eating habits, such as dieting or restriction, negative body image, or a strained connection with food, which could so result in an even more inadequate diet (Evans and Docter, 2020). Individual family members' mean calorie consumption may be below the recommended levels even in situations where there are sufficient food supplies. Due to this, Adolescents and children under two are the most affected groups (WHO, 2006).

2.7.2. Physiological condition and lifestyle

The physiological determinants of adolescent health and nutrition are dietary consumption, physical activity, infection, and early pregnancy (Christian and Smith, 2018). Regular exercise is a major factor in determining long-term weight control and energy expenditure (Wier *et al.*, 2001). As of right now, the fourth most important risk factor for death

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worldwide is physical inactivity. The global population's overall health is significantly impacted by the increasing levels of physical inactivity. Regular physical activity has been demonstrated to lower the risk of depression, diabetes, hypertension, colon and breast cancer, and coronary heart disease and stroke. Furthermore, physical activity has a crucial role in determining energy expenditure, making it essential for maintaining energy balance and controlling weight (WHO, 2010a).

2.7.3. Psycho-social factors

According to American Psychological Association (APA), Psycho-social factors are social, cultural, and environmental phenomena and influences that affect mental health and behavior. Eating habits often alter during adolescence and early adulthood. This is due to social shifts that happen from school age to adolescent, such as the shift from eating mostly at home to eating with peers or on campus, but also as a time for identity exploration (Bhattarai and Bhusal, 2019). Although poverty is thought to be the main factor influencing food intake, other studies contend that cultural factors rather than socioeconomic conditions have a greater influence allocation of food and nutritional adequacy (WHO, 2006).

2.7.4. Food security

There seems to be a link between household food insecurity and a higher risk of stunting and underweight in children and adolescents. Furthermore, the likelihood of stunting or underweight in food-insecure homes may rise due to the severity of food insecurity and the growing ages of children (Moradi *et al.*, 2019). It is likely that individuals who experience chronic food insecurity also have shortages in both macro- and micronutrients. It is possible for individuals to have nutritional imbalances even when they consume enough food (UNICEF, 1991).

2.7.5. Health, water and sanitation

Malnutrition is linked to the standard of the healthcare facilities that are available, medical knowledge and procedures, water quality, and cleanliness habits (Danjin *et al.*, 2021). Since greater rates of open defecation are linked to stunting and a higher incidence of poverty generally in low- and middle-income countries. water, sanitation, and hygiene are crucial in reducing malnutrition (Soulichanh, 2019). The body needs more nutrients when it is ill or

infected, and malnutrition makes it harder for the body to process and absorb nutrients. This leads to a vicious cycle of illness, undernourishment, and occasionally even death. Children's mental and physical development is negatively impacted by recurrent infections and illnesses, and those with weakened immune systems are more susceptible to malnutrition (Maziya, 2014).

2.7.6. Socio-economic and political condition

Children from lower socioeconomic classes tend to have poorer health outcomes due to a number of major underlying variables, including poverty, low literacy rates, large families, food insecurity, food safety, and women's education. To increase nutritional status, improvements in the political, social, and economic spheres are necessary, in addition to personal growth through educational possibilities (Babar *et al.*, 2010).

Parents most likely distribute food and other resources differently for boys and girls based on gender. When it comes to the distribution of food in households, adolescent girls and women may be at a disadvantage, as evidenced, for example, in Nepal (Delisle, 2005).

2.8. Nutritional Requirement:

Human nutritional requirement depends upon the age and sex of the individual. An adult man requires nutrients for maintenance while infants, children and adolescent need them for both maintenance and growth. Nutrients requirement during childhood are proportional to the children's growth rate. There are inter individual differences in nutrient requirements even between individuals of the same age, sex and body weight (Srilakshmi, 2006).

The adolescent years are divided into three groups by (NIN and ICMR, 2020): 10–12 years, 13–15 years, and 16–18 years. While an Estimated Average Requirement (EAR) for energy is recommended, the current ICMR-NIN guidelines don't have Recommended Dietary Allowances (RDA) for energy requirements. Boys in the age ranges of 10–12, 13–15, and 16–18 have EARs of 2220, 2860, and 3320 kcal, respectively, while girls in the same age groups have EARs of 2060, 2400, and 2500 kcal, respectively. For adolescents, a minimum of 25% of their daily caloric intake should come from fat. It is advised that fat from invisible sources make up at least 10% of total energy. It is advised to reduce the amount of visible fat needed if the percentage of invisible fat rises. For males aged 10–12, 13–15, and 16–18,

the recommended daily allowances of visible fat are 35 grams, 45 grams, and 50 grams, respectively. In contrast, the recommended limits for girls in the same age range are 35, 40, and 35 grams per day, respectively.

Table 2.1 and 2.2 shows the RDA for adolescent boys and girls respectively.

Table 2.1 RDA of nutrients for boys (NIN and ICMR, 2020)

Nutrients	Age in years		
	10 -12 years	**13 -15 years**	**16 -18 years**
Protein (g)	32	45	55
Fat (g)	35	45	50
Calcium (mg)	850	1000	1050
Iron (mg)	16	22	26
Vitamin A (µg)	770	930	1000
Thiamine (mg)	1.5	1.9	2.2
Riboflavin (mg)	2.1	2.7	3.1
Niacin (mg)	15	19	22
Pyridoxine (mg)	2.0	2.6	3.0
Ascorbic Acid (mg)	55	70	85
Dietary folate (µg)	220	285	340
Vitamin B12 (µg)	2.2	2.2	2.2
Magnesium (µg)	240	345	440
Zinc (mg)	8.5	14.3	17.6

Table 2.2 RDA of nutrients for girls (NIN and ICMR, 2020)

Nutrients	Age in years		
	10 -12 years	13 -15 years	16 -18 years
Protein (g)	33	45	46
Fat (g)	35	40	35
Calcium (mg)	850	1000	1050
Iron (mg)	28	22	32
Vitamin A (µg)	790	930	860
Thiamine (mg)	1.4	1.9	1.7
Riboflavin (mg)	1.9	2.7	2.3
Niacin (mg)	14	19	17
Pyridoxine (mg)	1.9	2.6	2.3
Ascorbic Acid (mg)	50	70	70
Dietary folate (µg)	225	285	270
Vitamin B12 (µg)	2.2	2.2	2.2
Magnesium (µg)	250	345	380
Zinc (mg)	8.5	14.3	14.2

2.9. Nutritional problems in Adolescence:

2.9.1. Undernutrition (thinness and stunting)

Adolescent low body mass and short stature may be associated with concomitant functional impairment. Adolescents with short statures due to chronic undernutrition in the past are linked to lower lean body mass, weaker muscles, and less functional capacity. Adolescent undernutrition in girls may have a negative impact on their ability to reproduce as adults (WHO, 1995). While it is well acknowledged that genetics plays a significant role in stature, there is mounting evidence that environmental variables, like poverty and a high incidence of illnesses, have a significant impact on final stature. Under unfavorable circumstances, it has been proposed that environmental factors have a greater influence on size than heredity (Amigo *et al.*, 1994; Merchant *et al.*, 2003).

According to report of NDHS 2022, 13.6% of boys and 5.2% of girls of aged 15-19 months were severely thin (Z-score value <-2) (MoHP. *et al.*, 2023). According to study conducted in eastern part of Nepal, 47.3% of school going adolescents have low BMI for age (Kafle *et al.*, 2020). According to a study conducted in the Kavreplanchok area among adolescent girls between the ages of 9 and 16, the overall prevalence of underweight, stunting, and thinness was 31.98%, 21.08%, and 14.94%, respectively. Girls aged 11 were much more likely to be underweight (49.5%), whereas the age group of 9 had the highest rates of stunting and thinness (37.34% and 24.2%, respectively) (Mansur *et al.*, 2015).

2.9.2. Iron deficiency anaemia

In the human body, iron transit, storage, and absorption are all in balance under physiological conditions. However, increased iron requirements, reduced external supply, and increased blood loss are three different risk factors that may interact to cause iron deficiency anemia (IDA) and ID (Hersko, 2006). The majority of disability-adjusted life years (DALYs) linked to micronutrient deficiencies (>2,500 DALYs per 100,000 adolescents) are caused by iron deficiency and iron deficiency anemia. Adolescent females are more likely than boys to suffer from iron insufficiency and iron deficiency anemia; this condition is more common in nations with lower social development indices (SDIs). The burden of micronutrient deficiencies is significantly increased by iodine insufficiency,

which is also more prevalent in female teenagers. In low SDI nations, the frequency is 3.4% among young adolescent girls and 4.6% among older female adolescents (15–19 years old) (Akseer *et al.*, 2017). According to study conducted in Morang, Iron deficiency anemia affected 65.6% of adolescents overall, with a distribution of 62.4% in rural areas, 70.0% in urban areas, 52.3% in males, and 78.3% in females (Baral and Onta, 2009). According to findings from a nationally representative cross-sectional survey among adolescents in Nepal, the overall prevalence of anemia was 31%, 38% in female and 24% in male (Chalise *et al.*, 2018).

2.9.3. Vitamin A deficiency disorder

In underdeveloped nations, vitamin A deficiency in children continues to be the primary cause of avoidable severe vision impairment and blindness. It also plays a major role in serious illnesses and fatalities, especially those caused by measles and diarrhea. A lack of vitamin A may also be a major cause of growth deficiencies in children and poor maternal performance during pregnancy and nursing. It may also make both mothers and children more susceptible to other disorders, such as iron-deficiency anemia (Underwood and Arthur, 1996). Adolescents in Bangladesh have a significant frequency of sub-clinical vitamin A insufficiency, according to studies done in various contexts (WHO, 2006).

2.9.4. Iodine deficiency disorders

There are numerous adverse effects of iodine shortage on growth and development. These conditions are known as iodine-deficiency disorders and are caused by insufficient thyroid hormone synthesis. Throughout the world, iodine deficiency is the most common cause of avoidable mental damage. The classic symptom of iodine deficiency is goiter, or enlarged thyroid, which is a biological response to long-term iodine shortage. (Zimmermann *et al.*, 2008).

2.9.5. Other micronutrient deficiencies

micronutrient deficiencies in childhood and adolescence leads to growth retardation, immunological dysfunction, decreased cognitive function, developmental delay, and metabolic abnormalities that raise the risk of obesity and hypertension in the future. Diets in developing countries tend to be low in micronutrient density and high in

phytate, which hinders vitamin absorption and increases the risk of micronutrient deficiencies. (Branca and Ferrari, 2002).

Adolescence seems to require much more calcium for skeletal development than childhood or early adulthood does. The risk of osteoporosis in maturity is determined by the amount of calcium deposited during adolescence, since that is when maximal bone mass is acquired. A shortage in vitamin D, whether or not accompanied by a calcium deficiency, can cause rickets in a infants or adolescent or osteomalacia and muscle weakness in an older kid or adolescent (Lips and van Schoor, 2011). A lack of vitamin D may also negatively affect a person's peak bone mass, resulting in poor bone mineral density during childhood and adolescence and the potential for osteoporosis in later life (Golden and Abrams, 2014).

Zinc is a multifunctional metal that promotes healthy growth and overall well-being (Chasapis *et al.*, 2012). It is well recognized to control growth, immunity, and neurological development. Deficits in it can impact the development of the heart, brain, lungs, bones, and kidneys, among other organs. It also interacts with a number of micronutrients, most notably iron and vitamin A (Maggini *et al.*, 2010). Zinc deficiency (ZnD) exacerbates renal problems and coexists with CKD. Besides, ZnD's harmful effects are linked to oxidative stress (Li *et al.*, 2017).

2.9.6. Overweight/Obesity

The prevalence of overweight and obesity in children and teenagers is increasing globally, making it a widespread and persistent health issue in this age group that often continues into adulthood (Lissau *et al.*, 2004).   The consequences of childhood and teenage obesity, including changes in metabolism and physiology, often follow an individual into adulthood, where they may raise their risk of illness, disability, and mortality (Wang *et al.*, 2010). During their adolescent growth spurt, adolescents who were growth-retarded at birth also have a tendency to gain greater weight. Teenagers are particularly sensitive to discrimination from society when it comes to their bodies, and they have sensitive body image issues. Adolescent obesity is regularly linked to low self-esteem and negative body image. Adolescent obesity's main long-term health issues include its enduring nature into adulthood and its link to a higher risk of cardiovascular disease in later life (Must and

Strauss, 1999). Adolescents' eating patterns and level of physical activity were also important contributors to overweight and obesity (Kadim *et al.*, 2023).

According to a cross-sectional study in a developing country, overweight and obesity were common among school going adolescents aged 16 to 17 (58.6%), with the majority of these individuals being male (56.4%) and attending public schools (86.7%). 14.4 percent of the sample's youngsters were obese, while 28.8% of the sample was overweight. Compared to girls, boys are more likely to be overweight or obese. 43% of teenagers attending public schools were either obese or overweight (Kadim *et al.*, 2023). According to report of NDHS 2022, the prevalence of overweight and obesity in adolescents aged 15-19 years are 4.0% & 2.5% respectively in male and 5.2% & 0.6% respectively in female (MoHP. *et al.*, 2023).

2.10. Dietary intakes and behaviours of adolescents

Dietary intake describes a person's regular eating habits, including the kinds of foods, calories, and amounts of each that are consumed. Teenage girls may be significantly more vulnerable to insufficient intakes due to a number of factors, such as early pregnancy, prejudice, dieting, and consuming less energy than boys. Still, ladies tend to eat healthier than boys do, and when given the option, they care more about eating healthily as long as dieting doesn't get in the way (WHO, 2005). In a study conducted in Ethiopia, it has been observed that consumption of vitamin A is a significant issue, and that intake of both macro and micronutrients is inadequate. It has also been discovered that the issue stems from teenagers' insufficient daily consumption of foods that are protective (fruits, green vegetables, and other vegetables) and body-building (like milk and pulses) (Semegn *et al.*, 2024). The study conducted among adolescent girls at a rural area of Puducherry**,** India showed the consumption of fruits, vegetables, and meals high in iron and calcium was insufficient and poor. Although, consumption of pulses and grains was satisfactory and adequate (Chandar *et al.*, 2020).

2.11. Nutritional assessment

Nutritional status is the current body status of a person or a population group, related to their state of nourishment (the consumption and utilization of nutrients). The principal aim of assessing the nutritional status of a community is, to map out the magnitude and

geographical distribution of malnutrition as a public health problem, to discover and analyze the ecological factors that are directly or indirectly responsible, and, where possible to suggest appropriate corrective measures, preferably capable of being applied with continuing community participation (Jelliffe, 1966). Poor nutritional status refers to an inadequate or even excessive intake or poor utilization of the nutrients to meet the body's requirement (Joshi, 2015).

Assessment of nutritional status involves two methods (Joshi, 2015) :

a) Direct Method

- Anthropometric method

- Biochemical methods

- Clinical examination methods

- Dietary procedures

b) Indirect Method

- Vital statistics

- Ecological factors

2.11.1. Direct method

i. **Anthropometric measurement:**
Anthropometric measurements include height, weight, skin-fold thickness, and circumference etc., It could detect the change of body composition to assess the nutritional status in specific population groups, including newborn, children under age of five and adults (Shrivastava *et al.*, 2014).

Advantages of anthropometry (Benjamin, 2014):

- To get information about growth patterns.
- To get information about fat composition and lean body mass.
- To predict index of morbidity and mortality concerning malnutrition.
- To evaluate the effect of nutrition therapy.

Table 2.3 Anthropometric indicators of nutritional status for adolescents (WHO, 2024c)

	Cut off	Indicators	
		Height for age	BMI for age
	Below -3 SD	Severely stunted	Severely thin
	-3 SD to -2 SD	Moderately Stunted	Moderately thin
	-2 SD to 1 SD	Normal	Normal
Z score	+1 SD to +2 SD	Normal	Overweight
	+2 SD to +3 SD	Normal	Obese
	Above +3 SD	May be abnormal	Severely Obese

ii. **Biochemical assessment:**

Biochemical assessment involves measurement of status of bodily secretions, fluids etc. against certain standard parameter. For instance, measurement of albumin, creatinine, immune function tests etc. (Benjamin, 2014).

iii. **Clinical examination:**

Clinical examination seeks out the symptoms of specific nutritional deficiency. Presence of two or more clinical signs increases the diagnostic significance (Shrivastava *et al.*, 2014)

iv. **Dietary intake assessment:**

Dietary intake assessment is done to assess the nutritional intake, questionnaire, recall or record method can be implied for performing intake assessment (Shrivastava *et al.*, 2014).

2.11.2. Indirect Method

i. **Vital statistics:**

Vitals statistics such as records related to birth and death of infants, death of mother etc. might be used to evaluate the prevalence rate, sort out the risk groups and has higher public health importance (WHO, 2024c)

ii. **Ecological factors:**

Ecological factors like socio-economic factors, health care facilities etc. are related to the occurrence of malnutrition. It is necessary assessment to find out which factor is affecting the nutritional status of the society (Shrivastava *et al.*, 2014).

2.12. 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. Dietary assessment can be done in different levels, from national to individual level (Dao *et al.*, 2019).

2.13. Methods for household dietary assessment

A household dietary survey is a type of research methodology that evaluates the nutritional intake and food consumption habits of members of a family. This kind of survey gathers information on the kinds and amounts of food that members of the family consume over a given time frame, usually a few days to a few weeks. Dietary surveys conducted among households yield important insights on a population's eating patterns, nutritional inadequacies, and general health. In order to improve nutritional quality and encourage better lifestyles, researchers frequently use this data to advise public health policy, create nutrition programs, and pinpoint areas that need to be addressed (Hoddinott and Yohannes, 2002).

2.14. Methods for individual dietary assessment

a) 24 hours dietary recall:

A 24 hours dietary recall is a means to assess an individual's intake over the previous 24 hours. Ideally, multiple 24 HRs on non-consecutive, random days would be collected (Casey *et al.*, 1999). It is relatively brief to administer (about 20 min) and can provide detailed information on specific foods, brand names, etc. (Block, 1989).

b) Estimated food recall:

An estimated record is a list of all foods eaten by an individual during a specified period (usually three to five days), given in terms of household measures or compared in size to food models (Hartog *et al.*, 2006).

c) Weighed food records

The weighing method assesses the cooked weights of the total portions of the meal served, the portion for each individual, and leftovers. Often the ingredients and amounts used in the preparation of dishes is also measured. Weighed intakes may be used as the comparison method with other dietary methods (Hartog *et al.*, 2006).

d) Dietary history:

This method does not refer to the assessment of diet at some time in the past, but to the assessment of an individual's intake over an extended period of current time such as the past year. The technique is based on the premise that people have a constant daily pattern in their food habits (Block, 1989).

e) Food frequency questionnaire:

FFQs assess usual intake over a specified period of time, generally a longer reference period, and query how frequently a person consumes food items, often combining multiple food items with similar nutrient profiles into a category. FFQs offer a more cost-effective alternative to the 24HR because the subject usually self-completes the tool and are generally used in research studies with for large sample sizes. FFQs do not assess the amount of food that is eaten, only the frequency; the most commonly consumed portion sizes are assumed,

reducing the quality of the data but this strategy also reduces participant burden (Heady, 1961).

f) Dietary diversity score:

The total of the various food categories ingested, or the dietary diversity score, can be used to evaluate the data obtained from the dietary diversity questionnaire. A straightforward tally of the food types that a family or an individual has ingested over the last 24 hours makes up the dietary variety scores (Kennedy *et al.*, 2011). Condiments, sugar and sugary meals, beverages, and other products that require family resources to obtain are included in the score of the household dietary diversity score (HDDS), which is intended to show the economic access of a household to food (Kennedy *et al.*, 2011).

The individual dietary diversity score (IDDS), gauges how adequate a diet is in terms of nutrients. The purpose of each score is to represent the diet's nutritional quality. The measuring of dietary variety is governed by rules established by the FAO (Kennedy *et al.*, 2011).

The seven food groups given (WHO, 2024b) by includes:

    i.   Grains, roots and tubers
   ii.   Legumes and nuts
  iii.   Dairy products (milk, yogurt, cheese)
  iv.   Flesh foods (meat, fish, poultry and liver/organ meats)
   v.   Eggs
  vi.   Vitamin-A rich fruits and vegetables
 vii.   Other fruits and vegetables

Using these food groups, the minimum dietary diversity indicator is calculated by using formula below:

$$\frac{\text{No. of subjects consuming minimum 4 food groups} \times 100}{\text{Number of total subjects}}$$

2.15. Physical activity for adolescents

Physical exercise is defined as any skeletal muscle-driven movement that involves the use of energy. Any movement, whether it be for recreation, transportation to and from locations, or employment, is considered physical exercise. Physical activity, whether at a moderate or high intensity, is beneficial to health (WHO, 2022). The study suggested that, engaging in physical activity can improve cardiovascular and respiratory fitness, avoid obesity, improve metabolic and cardiovascular health, build muscle and bone strength, and generally increase general well-being (FSEM., 2022).

2.15.1. Cut off point of physical activity for adolescents

It is advised that adolescents engage in moderate-to-intense physical exercise for at least 60 minutes a day, with at least five to ten minutes of intense physical activity thrown in. Brisk walking, which is 140 beats per minute or 70% of HRmax, is about comparable to moderate physical activity, while jogging, which is 160 beats per minute or 80% of HRmax, is roughly equivalent to vigorous physical activity (WHO, 2024e). the similar recommendation was provided by FSEM (2022) and (Benítez-Porres *et al.*, 2016).

Part III

3. Material and Methods

3.1. Research Method

A cross sectional descriptive study was conducted among the students studying at government schools of Miklajung rural municipality. The study involved collection of data within a short period of time to determine the current status with respect to dietary intake and nutritional status of that population. This was followed by anthropometric measurements, and interview schedule based on the prepared questionnaire.

3.2. Study Location

The study was conducted at government schools of Miklajung rural Municipality, Panchthar, Koshi Province, Nepal.

3.3. Target Population

The target population consisted adolescent students studying at government schools of Miklajung rural municipality, Panchthar.

3.4. Sampling

Convenient random sampling method was used for sampling. First, two government schools of secondary level were selected from ward no. 3 of Miklajung rural municipality. Then units of sample were selected according the population proportions of schools.

3.5. Sample size calculation:

The calculation of sample size was done by using the statistical formula:

Sample size$(n_o) = \dfrac{z^2 pq}{e^2}$

Source: Kothari (2004); Singh, M.L. (2005)

Where,

z = confidence interval at 95 % (standard value of 1.96)

p = estimated prevalence of malnutrition in project area,

q = 1-p

e = margin of error (7 %)

Here, as the prevalence rate of malnutrition is taken as $34.7 \approx 35$ % (Pandey, 2018)

i.e. p =0.35 & (1-p) = 0.65

Now, $n_o = \dfrac{z^2 pq}{e^2} = \dfrac{(1.96)^2 * 0.35 * 0.65}{(0.07)^2}$

$= 178.36 \approx 178$

According to Education section of Miklajung Rural Municipality, number of adolescents studying in class 6 to 12 in Miklajung rural municipality is 2185. So, we have, formula for finite population:

$$n = \dfrac{no}{1 + (\dfrac{no - 1}{N})}$$ Source: Kothari (2004); Singh, M.L. (2005)

[n is sample size for finite population; N is population size]

$$= \dfrac{178}{1 + (\dfrac{178 - 1}{2185})}$$

$= 164.66 \approx 165$

With addition of non-response rate of 5 %, sample size becomes,

$165 + 8.25 = 173.25 \approx 175$

3.6. Criteria for sample selection

a. **Inclusion criteria**:

Adolescent of age 10 – 19 years within the chosen government schools of Miklajung rural Municipality.

b. **Exclusion criteria**:

The participants who were:

i.   Seriously ill

ii.   Absent during the time of survey

iii. Reluctant to give consent for the study

3.7. Research Instruments

The following instruments will be used during the research:

1. Stadiometer: stadiometer with least count of 0.1 cm and measuring up to 200 cm to assess the height.
2. Digital weighing balance: A digital weighing balance with least count of 0.1 kg.
3. Questionnaire: Well designed and pretested set of questionnaires to collect information on demographic variables, socio-economic condition, dietary practices and related habits, environmental conditions.
4. Food frequency questionnaire and 24-hour dietary recall data sheet: Food frequency table along with 24-hour dietary recall sheet to study the food consumption pattern and nutrient intake of the adolescents.
5. Standardized utensils (glass and bowls) and photos of different foods.

3.8. Data Collection

Primary data were collected using semi-structured questionnaire and anthropometric measurement. Interview was done with the children to fill the questionnaire. Height and weight were measured by using stadiometer and digital weighing balance as below:

Height: In order to measure height subject was first asked to stand straight without shoes on horizontal platform with heels together and hanging the arms loose. Head was made at Frankfurt plane, buttocks and shoulder blades in contact with vertical surface of stadiometer. He was asked to take deep breath and stand tall to aid the straightening of the spine and shoulders relaxed. Movable headboard was lowered until it touches crown of head. Height measurement was taken at maximum inspiration, with examiner's eyes in level with headboard to avoid parallax error. Reading was taken to nearest millimeter. For reading falling between two values, lower reading was recorded. The same process was repeated for 3 time for more accurate observations (WHO, 2019).

Weight: After emptying the bladder and wearing very little clothing, the measurement was made. The scale was set to zero and the balance was set down on a firm, level surface. The subject was instructed to stand alone in the middle of the platform, look straight ahead while remaining calm and motionless. Weight was measured to the closest 0.1 kg. The same process was repeated for 3 time for more accurate observations (WHO, 2019)

Food frequency and dietary recall: Data on dietary intake was gathered using the 24-hour recall method and a food frequency questionnaire. The types of foods and frequency of consumption of those foods by the respondents were ascertained through the use of the food frequency questionnaire. In the 24-hour recall, participants were asked to list every meal and beverage they had had throughout the preceding 24 hours, or the day before, starting with their first meal of the day and ending with their last meal before bed. Pictures of standardized amount of different foods items and locally used equipment like bowl, spoon, glass etc. were used to obtain the information about the amount of foods.

3.9. Data analysis

Data were analyzed by using SPSS and WHO Anthro plus. Verified test parameters were used for relationship between the variables and nutritional status.

3.10. Research variables

The different variables of the study are shortly described as below.

    1. Dependent variable: Stunting, thinness

    2. Independent variables:

a. Socio-economic and demographic variables: Caste, family size, family type, income, occupation, birth order, number of siblings, number of adolescents in family, parent's occupation, family income, literacy of parents, source of food

b. Individual/sample characteristics: Age, education, sleeping pattern, physical activity.

c. Anthropometric characteristics: Height, weight, BMI for age, Height for age.

d. Hygiene and Sanitation practices: Source and treatment of drinking water, use of toilet facilities.

e. Dietary practices: Food frequency, food habit related variables (vegetarian/non-vegetarian, skipping of meal, fast food consumption, food choices etc.), nutrient intake.

3.11. Pre-testing

The tools used in the study were pre-tested among mentioned age group children from a selected area under sampling procedure. The pre-testing was conducted to establish accuracy of questions and clarity and to check for consistency in the interpretation of questions and to identify ambiguous items. After review of instruments all suggested revisions was made before being administered in the actual study.

3.12. Ethical consideration

The research was proceeded after receiving approval from Miklajung rural committee. Respondents were asked for their consent, and the study's purpose was explained to them. I assured that any data collected will be kept confidential and won't be shared with unauthorized individuals outside the study team.

Part IV

4. Results and Discussion

Our research investigates the nutritional status and dietary intake of adolescents in government schools of Miklajung. The study analyzes various factors such as socio-economic and demographic variables, adolescent characteristics, dietary behaviors, and environmental conditions associated with nutritional status. The data collection took place from 12th magh to 20th magh and the results are outlined below:

4.1. Adolescents characteristics

When the study participants' ages were analyzed, the age group between 15 and 16 years old had greatest percentage of participants (18.9 %%). The age group of 15 to 16 years old was followed by the participants group 12 to 13 years old with 18.3% of the participants. Ages 18 to 19 were the participants group with the lowest proportion (4 %).

Table 4.1 Percentage distribution of age group and gender of study population

Age group	Sex		Total
	Male	**Female**	
10 - 12	(14.3 %) 25	(15.4 %) 27	(29.7 %) 52
13-15	(27.4 %) 48	(20.6 %) 36	(48 %) 84
16-18	(9.7 %) 17	(12.6 %) 22	(16.6 %) 39
Total	(51.4 %) 90	(48.6 %) 85	(100 %) 175

Note: Values in the parentheses represent frequency distribution of sample

Of total 175 adolescents, 48.6 % (85) were females, 51.4 % (90) were males as shown in table 4.1. Similarly, 29.7 % (52) were at early adolescence, (48 %) 84 were at middle adolescence and (16.6 %) 39 were at late adolescence.

Table 4.2 Frequency distribution of adolescent characteristics

Variables	Frequency	Percentage
Number of siblings		
0	4	2.3 %
1	53	30.3 %
2	46	26.3 %
3	32	18.3 %
4 or more	40	22.9 %
Number of adolescents in family		
1	56	32.0 %
2	70	40.0 %
3	35	20.0 %
4 or more	14	8 %
Birth order of student		
1	55	31.4
2	54	30.9
3	30	17.1
4	23	13.1
More than 4	13	7.4

As shown in table 4.2, 53(30.3%) of adolescents had one sibling, followed by adolescents with two siblings 46 (26.3%). 53 (18.3 %) of them had than 2 siblings and 4 (2.3 %) didn't

had any sibling. 40 (22.9 %) of them had 4 or more than 4 Siblings. There are two adolescents in maximum of the families (40.0 %), followed by one adolescent (32.0 %) and three adolescents (20.0 %). Three or more adolescents made up the families of 8 % of the individuals. 31.4% of the adolescents surveyed were the eldest among their siblings, while 30.9% were the second child, with 17.1% being the third and 13.1% the fourth. Those with a birth order beyond the fourth child constituted 7.4% of the total.

4.2. Demographic characteristics

Table 4.3 illustrates that nearly half of the sample, accounting for 49.7%, comprised adolescents belonging to the *Limbu* caste group. Among the total adolescents, 16.6% were identified as *Tamang*, 12.6% as *Rai*, 12% as *Brahman/Chhetri*, 3.4% as *Dalits*, and other caste groups constituted 5.1 %. Similarly, 60 % of students belonged to Kirat religion, 20.6 % represented Buddhism, 16.6% of the adolescents belonged to Hindu religion, while remaining 2.9 % of them were Christians. 56.6 % of adolescents in the sample were from nuclear family and 43.4 % from joint family. The family size of 23.4 % students was below national average (4.33), while that of 76.6 % was above the average as shown below in table 4.3.

Table 4.3 Frequency distribution of demographic characters of study population

Characteristics	Frequency	Percentage
Caste/ Ethnicity		
Brahmin / Chhetri	20	12 %
Rai	22	12.6 %
Limbu	87	49.7 %
Tamang	29	16.6 %
Dalit	6	3.4 %
Others	10	5.1 %

Religion		
Kirat	105	60 %
Buddhist	36	20.6 %
Hindu	29	16.6 %
Christian	5	2.9 %
Family type		
Nuclear	99	56.6 %
Joint	76	43.4 %
Size of family		
Below national average (4.33)	41	23.4 %
Above average family size of Nepal (4.33)	134	76.6 %

4.3. Socioeconomic characteristics

Table 4.4 Average and dispersion of family members of studied population

Variables	Minimum	Maximum	Mean	Std. Deviation
Family members	3	13	6.01	1.87
No. of children in family	0	3	0.67	0.77
No. of adolescents in family	1	5	2.06	0.96
Number of siblings	0	7	2.42	1.44

The study population exhibited an average family size of 6.01 ± 1.87 individuals, ranging from a minimum of 3 to a maximum of 13, as detailed in Table 4.5. Within these families,

the number of adolescents varied from a minimum of 1 to a maximum of 5, with an average of 2.06 ± 0.96 adolescents per family. Furthermore, the average number of siblings per adolescent ranged from 0 to a maximum of 8, with an average of 2.98 ± 1.21 siblings per adolescent.

Table 4.5 Frequency distribution of education level of parents

Education level	Frequency	Percentage
Education of father		
Higher secondary	14	8.0
Secondary	45	25.7
Basic	74	42.3
Informal	30	17.1
Illiterate	12	6.9
Education of mother		
Higher secondary	18	10.3
Secondary	27	15.4
Basic	60	34.3
Informal	39	22.3
Illiterate	31	17.7

From the table 4.5, it can be seen that fathers of 8 % students had got higher level education (bachelor and above). Similarly, 25.7 % of them were educated up to secondary level (class 9 to 12), 42.3 % had got basic level of education (up to class 8). Of total, 17.1 % were informally educated, 6.9 % were illiterate. While taking about mother's education level,

highest number (34.3 %) of mothers was educated up to basic level only, whereas only 10.3 % of mothers had got university level education. Of total, 15.4 % of mothers were educated up to secondary school, and 22.3 % had got informal education as shown in table 4.5.

Table 4.6 Frequency distribution of economic characteristics of studied families

Variables	Frequency	Percentage
Family income		
Less than 30,000	119	68.0 %
More than 30,000	56	32.0 %
Occupation of father		
Agriculture	101	57.7 %
Service	10	5.7 %
Labour	24	13.7 %
Business	8	4.6 %
Foreign Employment	29	16.6 %
Dead or other	3	1.7 %
Occupation of mother		
Agriculture	45	25.7 %
Service	11	6.3 %
Business	6	3.4 %
Housewife	107	61.1 %
Foreign Employment or other	6	3.4 %

According to Table 4.6, 32.0% of families of surveyed adolescent children had a monthly income exceeding Rs. 30,000 and 68.0% had monthly income below Rs. 30,000. Based on Table 4.7, the primary occupations of fathers were agriculture (57.7%), foreign employment (16.6%), laborer roles (13.3%), social service (5.7%), and business or trade (4.6%). fathers of (1.7%) of respondents were dead. Conversely, the majority of mothers were homemakers (61.1%), followed by those engaged in farming (25.7%), business or trade (3.4%), service occupations (6.3%), and foreign employment or other (3.4%).

4.4. Environmental condition

Table 4.7 Frequency distribution of environmental characters of studied families

Variables	Frequency	Percentage
Source of drinking water		
Tap water	123	70.3 %
River	19	10.9 %
Pond	33	18.9 %
Purification of drinking water		
Yes	71	40.6 %
No	104	59.4 %
Toilet facility		
yes	175	100 %
No	0	

According to table 4.7, Tap water was the main source of water in 70.3% of the adolescent sample's homes. Overall, 18.9% of families got their primary drinking water from ponds,

and 10.9% got water from rivers. According to the surveyed adolescents 59.4 % of them use water without purifying and 40.6 % of them use purified water. All of the respondents have toilet facilities at their home.

4.5.   Physical activity level

WHO (2010) recommended for at least 60 minutes of moderate- to vigorous intensity daily physical activity for adolescents but among the study subjects, more than 70 % of them had not achieved the required physical activity level.

Table 4.8 Frequency distribution of physical activity level of studied adolescents

Activity level	Frequency	Percentage
Below recommendation	123	70.3
Equal to or above recommendation	52	29.7

4.6.   Dietary habits and behaviour

143 (81.7 %) of adolescents were found to skip meal. Of the 143 participants who skipped meals, 88.8% generally skipped breakfast, 4.2% usually skipped midday, and 7.0% of the adolescents skipped dinner. Additionally, among those who skip meals, 35.4% did so once or twice a week, 24.0% did so five or more times a week, and 22.3% did so three or four times a week as shown below in table 4.9.

Table 4.9 Behavior of meal pattern of adolescents

Behavioural factors	Frequency	Percentage
Skipping of meal		
Yes	143	81.7 %
No	32	18.3 %
Meal skipped (n=143)		
Breakfast	127	88.8 %
Lunch	6	4.2 %
Dinner	10	7.0 %
Frequency of meal skipped weekly (n=143)		
1-2 times	62	35.4 %
2-3 times	39	22.3 %
More than five	42	24.0 %

83.4 % of the adolescents eat their meal in kitchen, while 16.6 % of them consume meals watching TV. None of the adolescents were vegan, ovo-vegetarians and lacto-vegetarian. 91.4% of them were non-vegetarian and 8.6 % of them were pure vegetarians. 9.1% of adolescents have pocket money every day, 24.6% have it five to six days a week, 36% have it three to four times a week, and 30.3% have it less than twice a week. 9.1% of adolescents have pocket money every day, 24.6% have it five to six days a week, 36% have it three to four times a week, and 30.3% have it less than twice a week. as shown below.

Table 4.10 Frequency distribution of diet related behaviours of study population

Variables	Frequency	Percentage
Eating place of student		
Kitchen	146	83.4 %
In front of tv	29	16.6 %
Eating nature of student		
Vegetarian	15	8.6 %
Non-vegetarian	160	91.4 %
Consumption of water per day		
One glass	22	12.6
2 to 4 glass	99	56.6
5 to 7 glass	51	29.6
8 or more glass	3	1.7
Days of Pocket money available per week		
7 days	16	9.1 %
5 – 6 days	43	24.6 %
3 – 4 days	63	36 %
Less than 2 days	53	30.3 %
Consumption of alcohol	7	4 %

Table 4.11 Frequency of behaviors related to other food habits and body weight

Variables	Frequency	Percentage
Food brought during school hours		
Biscuit	4	2.3 %
Chatpate	129	73.7 %
Noodles	26	14.9 %
Others	16	9.1 %
Perception about body weight		
Overweight	12	6.9
Right weight	141	80.6
Thin	22	12.6
Monitor weight		
Yes	2	1.1
No	173	98.9
Tried weight gain		
Yes	37	21.1
No	138	78.9
Tried weight loss		
Yes	21	12.0
No	154	88.0

According to table 4.11, all of the respondents rely on canteen/shops near schools for snacks. 73.7 % of adolescents mostly buy *chatpate*, 14.9 % of them mostly buy noodles, 2.3 % of them mostly buy biscuit and 9.1 % of them buys other foods. 80.6 % of the adolescents feel having right weight but 6.9 % of them feel they were overweight and 12.6 % of them feel they were thin. 98.9 % of adolescents doesn't monitor their weight regularly and only 1.1 % of them monitor their weight regularly. 88 % of the adolescents have never tried losing weight, and 21.1 % of them have never tried gaining weight.

4.7. Food frequency questionnaire

Table 4.12 Frequency of weekly consumption of different food groups

Food groups	Daily	4-5 times a week	2-3 times a week	Once a week	Once in 15 days or less	Never
Cereals	100 %	-	-	-	-	-
Pulses & legumes	36 %	28 %	34.3 %	1.7 %	-	-
Milk and milk products	26.9 %	12.0 %	28.6 %	10.3 %	5.1 %	17.1 %
Green leafy Vegetables	40 %	30.9 %	27.4 %	1.7 %	-	-
Other vegetables	21.7 %	22.9 %	52 %	3.4 %	-	-
Fruits	6.9 %	16 %	46.9 %	18.9 %	11.4	-
Egg, meat, Fishes	1.1 %	4.6 %	42.9 %	31.4 %	11.4 %	8.6 %
Tea / coffee	43.4 %	13.1 %	17.7 %	9.2 %	-	16.6 %
Processed food	93.7 %	2.3 %	4.0 %	-	-	-

It was observed that all adolescents used to consume cereals and their products daily. Only 36 % of them told they consume pulses or legumes daily. Only 26.9 % of the study subjects were found to consume milk or its products on daily basis and this may result deficit of calcium in diet of others who do not consume milk products daily because milk and milk products are major source of calcium. Among them, only 1.1 % told that they consume meat, fish or poultry products daily. Table 4.12 shows that 40.0 % of participants consume green leafy vegetables on daily basis and 30.9 % of them said that they consume it four to five times a week. Also, 27.4 % of them were consuming green leafy vegetables 2-3 times a week. Other vegetables were consumed by 38.05% of adolescents in daily basis and 58.05% of them consume it frequently. Just 6.9 % of the adolescents reported that they consume fruits on daily basis. 16.0 % of them consume fruits four to five times a week, 46.9 % of them consume fruits two to three times, 18.9 % consumed fruits once a week and 11.4 % consume fruits in 15 days or less. Production of fruits and vegetables at home is the primary source of consumption. Therefore, seasonal variations could impact consumption.

43.4 %, 13.1 %, 17.7 % and 9.2 % of the adolescents reported that they drink tea or coffee on daily basis, 4-5 times a week, 2-3 times a week and once a week or less respectively. 93.7% of the adolescents consume processed foods daily while 6.3% of them frequently consumed fast foods. According to a study conducted on schoolchildren in Nepal, over two-thirds of adolescents chose fast food (chips, ready-to-eat snacks, etc.); advertising had an impact on these adolescents' preferences (WHO, 2006).

4.8. Dietary diversity score

The mean dietary diversity score of the adolescents was found to be 3.15 ± 0.67 with minimum of 2 and maximum 5 out of 7 food groups. Thus, participants were consuming more than 3 different types of food on average each day. Furthermore, it was found that 13.71 % (24) of the adolescents had only consumed meals from 2 dietary groups.

4.9. Dietary intakes

According to the survey, the mean calorie intake of adolescents was found to be 1897.2 ± 382.4 kcal. The mean intake of carbohydrate, protein, fat and added fat was found to be 289.9 ± 66.0 gm, 58.5 ± 14.0 gm, 49.1 ± 12.0 gm and 23.9 ± 4.8 gm respectively

The following table shows the average nutrient intake of studied population based on their age group.

Table 4.13 Mean nutrient intake of surveyed adolescents

Age group	Calorie (gm)	CHO (gm)	Protein (gm)	Visible fat (gm)
10-12	1914.5 ± 400.9	281.6 ± 69.7	59.6 ± 15.3	25.1 ± 5
13-15	1903.9 ± 397.4	293.7 ± 66.8	58.5 ± 13.9	23.7 ± 4.5
16-18	1871.9 ± 322.7	293.4 ± 60.0	57.3 ± 12.6	23.2 ± 5.0

The average nutrient intake of adolescent based on the gender is presented below:

Table 4.14 Mean nutrient intake of Boys

Age group	Calorie (gm)	CHO (gm)	Protein (gm)	Visible fat(gm)
10-12	2056.68 ± 402.4	312.5 ± 64.1	64.1 ± 15.2	24.6 ± 4.3
13-15	1920.9 ± 446.5	295.7 ± 74.7	59.6 ± 14.3	23.6 ± 4.7
16-18	1996.8 ± 248.5	321.4 ± 51.1	61.3 ± 9.3	22.4 ± 5.0

Table 4.15 Mean nutrient intake of Girls

Age group	Calorie (gm)	CHO (gm)	Protein (gm)	Visible fat (gm)
10-12	1782.9 ± 358.2	253.2 ± 63.3	55.4 ± 14.4	25.6 ± 5.6
13-15	1881.2 ± 325.3	291.0 ± 55.4	57.0 ± 13.3	23.8 ± 4.4
16-18	1770.8 ± 345.3	270.7 ± 58.1	54.0 ± 14.2	23.8 ± 5.0

According to the study, the average intake of calorie and protein was found to be higher in boys and the average intake of visible fat was found to be higher in girls. According to a British study, median energy consumption of adolescent females was 1662 kcal (Whitton *et al.*, 2011), which is slightly lower than the results from our study.

4.10. Adequacy of nutrient intake

Table 4.16 Adequacy of nutrient intake

Variables	Frequency	Percentage
Adequacy of Energy intake		
Below RDA	157	89.7
Above RDA	18	10.3
Adequacy of protein intake		
Below RDA	31	17.7
Above RDA	144	82.3
Adequacy of added fat intake		
Below RDA	169	96.6
Above RDA	6	3.4

Table 5.13 shows the results of the comparison between the participants' dietary intakes and the recommended daily allowances (RDAs) supplied by NIN and ICMR (2020). According to this survey, the majority of adolescents did not consume enough nutrients. Among the adolescents, just 10.3 % consumed sufficient energy for their age and sex. The lower intake of nutrients might be due to lower socioeconomic status of

According to (Ochola and Masibo, 2014), the majority of school-age children and adolescents in developing nations did not consume enough calories from their diets. Table 4.13 revealed that around 82.3% of research participants had insufficient protein intake. According to report by (Ochola and Masibo, 2014) the majority of study participants found that protein was sufficient. According to our study, 96.6 % of adolescents were not consuming enough added fat from their diet. Ochola and Masibo discovered that adolescents living in urban environments consumed more fat than was necessary, but our study found that adolescents living in rural areas consumed less fat.

4.11. Prevalence and distribution of malnutrition

According to the study, the prevalence of thinness, stunting and overweight among adolescents was 6.9%, 38.8% and 3.4%, respectively. The prevalence of malnutrition among the adolescents is presented in the figure below:
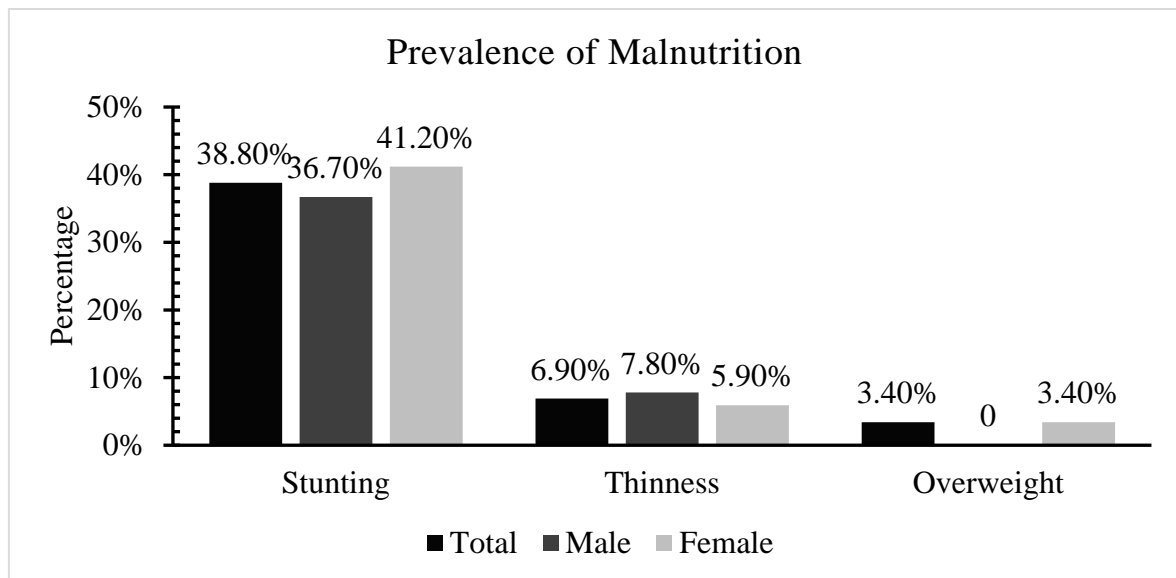
Figure 4.1 Prevalence of malnutrition based on gender

According to the similar study conducted stunting among adolescents in Nepal was 29.9%,thinness was 10.2% and overweight/obesity was 5.76% (van Tuijl *et al.*, 2021). Study conducted at semi-urban area of Nepal showed the prevalence of obesity, overweight, underweight, and stunting among school going adolescents was 4%, 12%, 7%, and 17%, respectively (Hamann *et al.*, 2023).

According to study conducted in Sinamangal area, 14.3 % of the adolescents were found to be underweight, 22.9 % of them were overweight and 14.2 % were stunted (K C *et al.*, 2021). According to study conducted at Gorkha, 31.9% were underweight, 51.9% were stunted, and 2.9% were wasted (Semegn *et al.*, 2024).

The prevalence of malnutrition among adolescents in Nepal varies significantly across different regions, as evidenced by the findings of several studies. While one study conducted in a semi-urban area reported relatively low rates of obesity (4%) and overweight (12%), another study in Sinamangal found a higher prevalence of overweight (22.9%) but a lower prevalence of underweight (14.3%). These variations may be attributed to factors such as differences in socio-economic status, access to healthcare, and dietary habits among the study populations. Additionally, temporal trends in the prevalence of malnutrition indicators are evident, with some studies showing increases over time. For example, while a study conducted in 2021 reported a stunting prevalence of 29.9%, a more recent study in 2024 found a higher prevalence of stunting at 51.9% in a different region. These trends highlight the dynamic nature of nutritional status among adolescents and underscore the need for ongoing monitoring and targeted interventions. From a public health perspective, these findings emphasize the importance of tailored interventions to address the specific nutritional needs of adolescents in different regions of Nepal. Regions with high prevalence of stunting may require interventions focused on improving access to nutritious foods and healthcare services, while areas with high prevalence of overweight may benefit from programs promoting healthy eating habits and physical activity. However, it is important to acknowledge the limitations of the studies reviewed, such as limitations in data collection methods. Future research should focus on longitudinal studies to track changes in nutritional status over time and qualitative studies to explore the socio-cultural factors influencing dietary behaviors among adolescents in Nepal. By addressing these gaps in knowledge, policymakers and public health practitioners can develop more effective strategies to combat malnutrition and improve the overall health and well-being of adolescents in Nepal.

4.11.1. Stunting (Height for age)

According to our study, the prevalence of stunting was found to be 38.8 %. 9.7% were severely stunted and 29.1 % were moderately stunted. Demographic Health surveys of Nepal had shown that prevalence of stunting among under five children was 57%, 49%, 41%, 36% and 25% respectively in 2001, 2006,2011, 2016 and 2022 (MoHP. *et al.*, 2023). The result obtained from the study was quite higher than the result obtained in NDHS report. This might be due to lack of awareness about diet and nutrition among people of Miklajung

rural municipality and lower calorie intake among adolescents due to different socioeconomic and demographic factors.

Table 4.17 Z score value for height for age (HAZ) of studied population

Category	HAZ	Frequency	Percentage
Severely stunted	< -3	17	9.71
Moderately stunted	-2 to - 3	51	29.14
Mildly stunted	- 2 to -1	71	40.57
Normal	> -1	36	20.57

Table 5.18 and 5.19 represents the gender wise distribution of Z score value of height for age of adolescents.

Table 4.18 HAZ of male adolescents

Category	HAZ	Frequency	Percentage
Severely stunted	< -3	9	10
Moderately stunted	-3 to - 2	24	26.7
Mildly stunted	-2 to - 1	37	41.1
Normal	> -1	20	22.2

Table 4.19 HAZ of female adolescents

Category	HAZ	Frequency	Percentage
Severely stunted	< -3	8	9.4
Moderately stunted	-3 to - 2	27	31.8
Mildly stunted	-2 to - 1	34	40
Normal	> -1	16	18.8

According to the study, 10% of the male population had severe stunting and 26.7% had moderate stunting. The prevalence of moderate and severe stunting in females were 31.8% and 9.4%, respectively

The curve for distribution of HAZ compared to WHO reference curve is shown below :
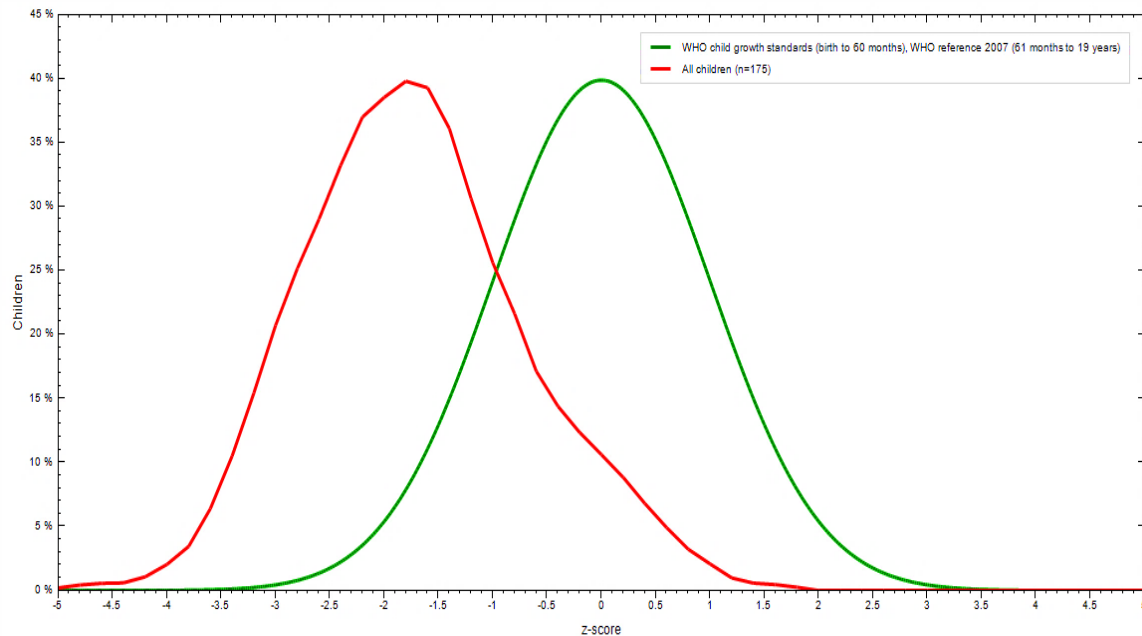
Figure 4.2 Distribution of HAZ

When comparing the HAZ distribution curve to the WHO reference curve as shown in figure 4.3, it is skewed to the left. This is due to the fact that the curve's mean, median, and mode Z-scores are, respectively, -1.71, -1.78, and -1.84, which are lower than the WHO reference curve's average of zero. Moreover, the curve has more peaks than a typical curve. As a result, it may be concluded that most Z-scores are lower than the WHO mean and that more values are centred around the sample mean. More individuals have heights for age z-scores that are less than zero, while very few patients have z-scores that are more than zero. This suggests that the majority of the individuals were shorter in stature, which could be related to past stunting, infection, or insufficient food intake.

The curve for gender wise distribution of HAZ compared to WHO reference curve is shown below in in the figure 4.3:
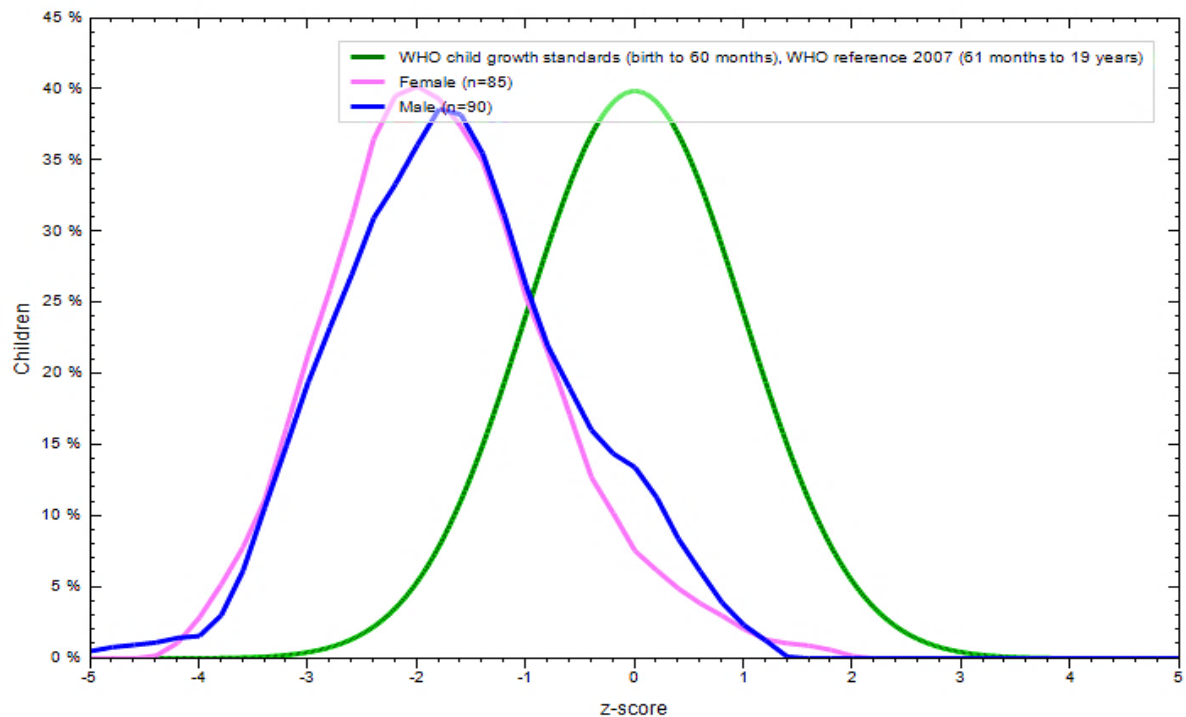
Figure 4.3 Gender wise distribution of HAZ

4.11.2. Thinness (BMI for age)

Table 4.20 Z score value for BMI for age (BAZ) of studied population

Category	BAZ	Frequency	Percentage
Severely wasted	< -3	2	1.2
Moderately wasted	-3 to - 2	10	5.7
Mildly wasted	-2 to - 1	45	25.7
Normal	-1 to 1	112	64
Overweight	1 - 2	6	3.4

According to similar study conducted at malangwa municipality, sarlahi, the prevalence of underweight and obesity was found to be 37.6% and 2.5% (Dhobi and Giri, 2022).

According to similar study conducted at solukhumbu, the rate of underweight and overweight was found to be 27.6 % and 7.3 % (Sherpa AT *et al.*, 2019).

Table 4.21 BAZ of male adolescents:

Category	BAZ	Frequency	Percentage
Severely wasted	< -3	2	2.2
Moderately wasted	-3 to - 2	5	5.6
Mildly wasted	-2 to - 1	29	32.2
Normal	-1 to 2	54	60
Overweight	2 - 3	0	0
Obese	> 3	0	0

Table 4.22 BAZ of female adolescents:

Category	BAZ	Frequency	Percentage
Severely wasted	< -3	0	0
Moderately wasted	-3 to - 2	5	5.9
Mildly wasted	-2 to - 1	16	18.8
Normal	-1 to 2	64	75.3
Overweight	2 - 3	0	0
Obese	> 3	0	0

The distribution curve of BMIZ is skewed significantly to the left when compared to the WHO reference curve, as shown in figure 4.17. The reason for this is that the mean, median, and mode Z-scores are, respectively, -0.62, -0.55, and -1.15, which are lower than the zero average of the WHO reference curve. Moreover, the curve has fewer peaks than a typical curve. It can be concluded that the majority of Z-scores are less than zero and that fewer values are centered around the sample mean. The bulk of the participants, therefore, have BMIs for age z-scores that are less than zero.
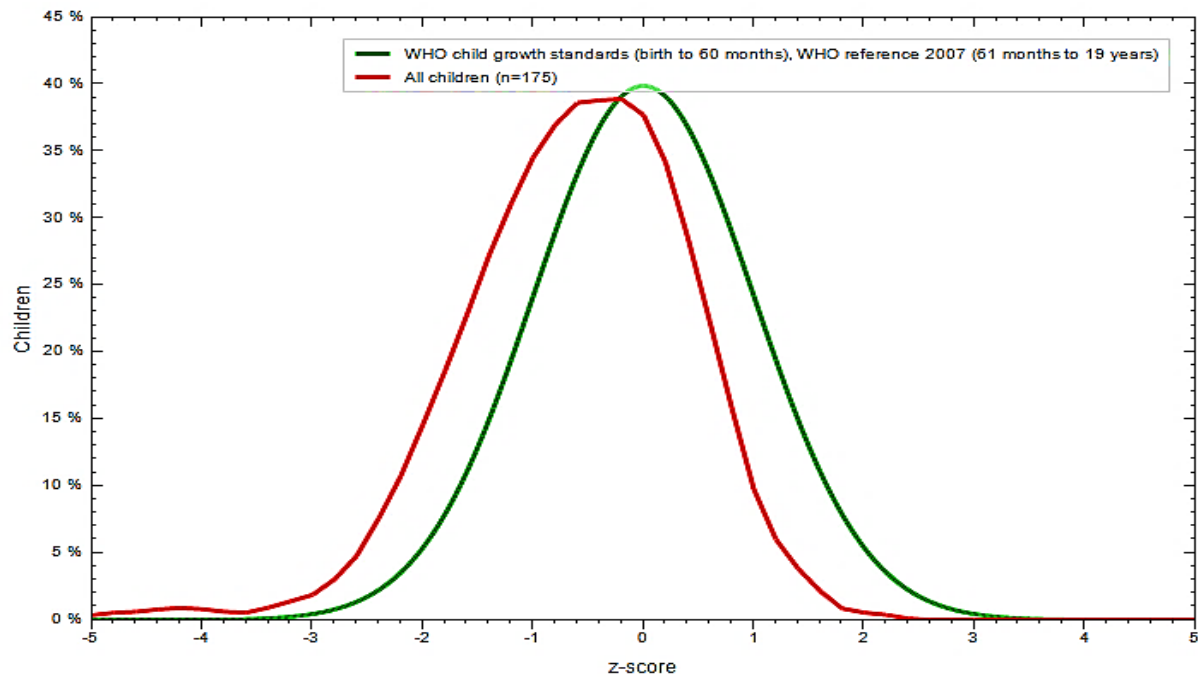
Figure 4.4 Distribution of BAZ of adolescents
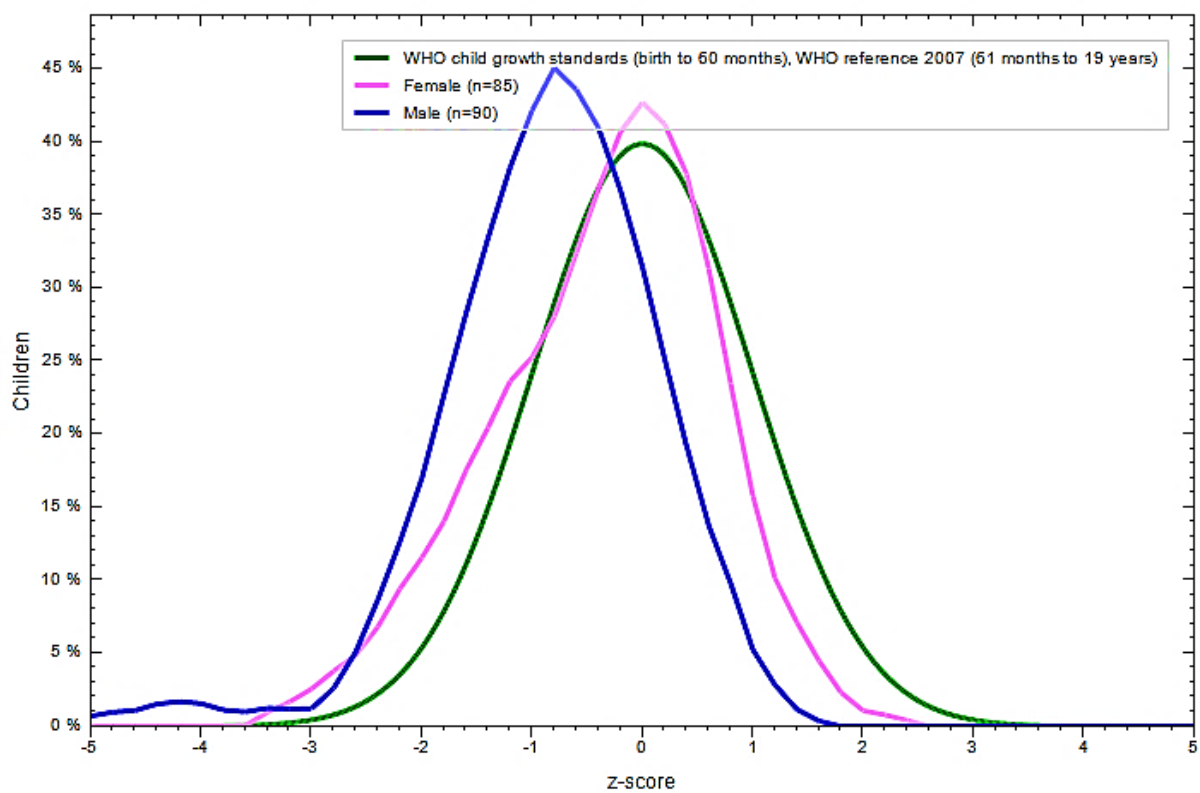
Figure 4.5 Gender wise distribution of BAZ

4.12. Factors associated with malnutrition

4.12.1. Factors associated with stunting

Pearson's correlation test, independent sample t-test and one-way analysis of variance (ANOVA) test were conducted with Z score value for height for age (HAZ) and P-value was calculated using SPSS version 26 software. The statistically significant values associated with HAZ are presented below:

Table 4.23 Pearson correlation test for factors associated with stunting:

Factor	Pearson's correlation value	P-Value
Age	- 0.315	<0.001
Diversity score	0.172	0.023
Fat intake	0.179	0.018
Birth order	- 0.168	0.026

Table 4.24 Independent sample t-test for factors associated with stunting:

Category	Df	t value	P-value
Alcohol consumption	173	- 2.287	0.023

Among the adolescent characteristics, age (p<0.001) and birth order (p=0.026) were found to be statically associated with Height for age (Stunting) of the adolescents. Among the dietary pattern of food consumption, dietary diversity score (p=0.023), fat intake(p=0.018), and alcohol consumption (p=0.023) were found to be statically associated with Height for age of the adolescents.

According to the similar study conducted at Gorkha, education of father, education of mother, number of children in family, treatment of drinking water and households food insecurity were the factors found to be associated with stunting (Shrestha *et al.*, 2020).

4.12.2. Factors associated with Underweight / Overweight:

Pearson's correlation test, independent sample t-test and one-way analysis of variance (ANOVA) test were conducted with Z score value of BMI for age (BAZ) and P-value was calculated using SPSS version 26 software. The statistically significant values associated with BAZ are presented below:

Table 4.25 Independent sample t-test for factors associated with BMI for age:

Category	Df	t value	P-value
Gender	173	- 3.363	0.001
Tried losing weight	173	3.935	< 0.001
Tried gaining weight	173	- 4.066	<0.001
Fast food consumption	173	2.142	0.034
Adequacy of protein intake	173	- 2.544	0.012

Table 4.26 One-way ANOVA test for factors associated with underweight/ overweight:

Category	Df (between group, within groups)	F value	P-value
Caste	4, 170	11.075	< 0.001
Religion	2, 172	19.826	< 0.001
Water source	2, 172	3.186	0.044
Perception of body size	2, 172	28.332	< 0.001
Consumption of pulses	2, 172	3.240	0.042
Consumption of meat	4,170	2.826	0.026

Among the adolescent characteristics, gender (p= 0.001), caste (p < 0.001) and religion (p < 0.001) were found to be statically associated with BMI for age of the adolescents (Underweight/ overweight). Among the dietary pattern of food consumption, dietary diversity score (p=0.023), adequacy of protein intake(p=0.018), consumption of pulses (p = 0.042), consumption of meat (p = 0.026) and fast food consumption (p=0.034) were found to be statically associated with Height for age of the adolescents. Similarly, perception about their own weight (p < 0.001), trying to gain weight (p< 0.001) and trying to lose weight (p<

54

0.001) were statistically associated with BMI for age. Among the environmental condition, sources of drinking water (p = 0.044) was found to be associated with BMI for age.

According to the similar study conducted at Gorkha, number of children, education of mothers, education of fathers, purification of water children and households food insecurity were the factors found to be associated with underweight (Shrestha *et al.*, 2020).

According to the study conducted in Nepal, malnutrition (both stunting and thinness) is associated with age, caste, gender, religion, parental education, occupation and income of family and geographical area (van Tuijl *et al.*, 2021).

Part V

5. Conclusions and recommendations

5.1.   Conclusions

Following conclusions were drawn from the study:

a) Stunting is common undernutrition problem of adolescents of Miklajung while over-nutrition is also emerging.

b) Dietary energy and nutrients intake of majority of the adolescents is insufficient. Except protein intake, mean intake of nutrients of different age groups are insufficient and also there were high dispersion of intake among individual.

c) In Miklajung, adolescents often display a pattern of consuming limited food varieties, frequently skipping meals, and irregularly incorporating essential food groups like fruits, green leafy vegetables, pulses, legumes, meat, fish, poultry, milk, and dairy products into their diets.

d) Age, dietary diversity score, fat intake, number of siblings, birth order and alcohol consumption were found to be related to HAZ (stunting).

e) Gender, religion, water source, perception about own body size, trying to lose weight, practice to gain weight, frequency of consumption of pulses & legumes, and meat products & eggs were associated with BAZ (thinness or obesity).

5.2.   Recommendations

Following recommendations can be provided on the basis of the study in order to improve the nutritional status and nutrient intake of the adolescents:

a) Adolescents should be suggested to avoid skipping meals and eat more frequently to meet their energy and nutrient needs for healthier weight gain.

b) Adolescents should be encouraged to consume a variety of nutrient-rich, energy-dense foods including fruits, vegetables, pulses, legumes, meat, fish, poultry, milk, and dairy products for optimal nutrition.

c) The rural municipality should make plans and carry out programs with schools and families to follow the recommendations mentioned earlier.

d) The governing bodies should advocate for policies that restrict the marketing of unhealthy foods and beverages targeted at adolescents, particularly in schools and areas with high youth traffic

e) The federal and state governments can conduct similar studies in various localities to assess the overall national and state-wise nutritional status and dietary behaviors of adolescents.

Recommendations for future researches:

a) It is possible to carry out similar studies in different regions of the nation.

b) Adolescent obesity, dietary variables, degree of physical activity, nutrient intake, and nutritional status, as well as their relationships with one another, can all be thoroughly studied.

c) Biochemical parameters like hemoglobin can be assessed.

d) Iron, fiber and other micronutrients intake can also be studied.

PART VI

6. Summary

An individual experiences rapid growth and change during adolescence, which is the only period of life when it does not surpass infancy. Additionally, it necessitates consuming more nutrients and energy. Families no longer have as much of an influence on their eating habits and intakes as different social and psychological elements do. The nutritional status is ultimately impacted by this. The health and nutritional status of adolescents become more crucial at this time since these years lay the groundwork for future health in adulthood and old age.

A cross sectional survey was conducted to assess the nutritional status and dietary intake of adolescents studying in schools of Miklajung rural municipality, Panchthar. Among 8 wards of Miklajung, ward no.3 was selected and 175 adolescents were chosen by random selection according to proportion from 2 secondary schools. To gather data on the target population's nutritional status, dietary habits, socioeconomic status, and sanitation and hygiene conditions, a carefully thought-out and pretested set of questionnaires was created. A computerized weighing balance (measuring up to 180 kg and least count 0.1 kg) was used to measure the subjects' weight and stadiometer was used to measure the height. Dietary intake was assessed by 24 hours dietary recall and food frequency questionnaire. Data collected was analysed using WHO Anthroplus version 1.0.4, SPSS version 25 and Microsoft excel. Pearson correlation test, independent sample t test and one-way ANOVA was used to analyze the factors associated with nutritional status.

The prevalence of stunting, thinness and obesity were 38.8 %, 6.9% and 3.4 % respectively. The prevalence of insufficient intake of the nutrients as energy, protein and added fat was 89.7%, 17.7 % and 96.6 % respectively. Age ($p<0.001$), dietary diversity score ($p=0.023$), fat intake($p=0.018$), birth order ($p=0.026$) and alcohol consumption ($p=0.023$) were found to be statically associated with Height for age (Stunting).

Gender ($p=0.001$), caste ($p<0.001$), religion ($p<0.001$), water source ($p=0.044$), perception about own body size ($p<0.001$), practice to gain weight ($p<0.001$), practice to lose weight ($p<0.001$), consumption of pulses & legumes ($p=0.042$), consumption of meat

and eggs (p=0.026), consumption of fast foods (0.034) and adequacy of protein intake (0.012) are associated with BMI for age (thinness or obesity).

It was observed that the nutritional status, nutrient intake, and eating behaviors of adolescents living in Panchthar should be corrected through the implementation of appropriate intervention programs.

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Appendices

7. Appendix A: Approval letter

" कृषि, पर्यटन र पुर्वाधार, सम्वृद्ध मिक्लाजुङको आधार "

स्थानीय सरकार

मिक्लाजुङ गाउँपालिका

गाउँ कार्यपालिकाको कार्यालय

रवि, पाँचथर

प.सं. : २०८०/०८१

च.नं. : ८८८

मिति :२०८०।१०।२५

श्री विशाल भट्टराई
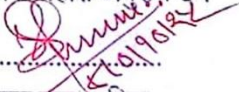
मिक्लाजुङ- ३ ।

विषय :- सहमति प्रदान गरिएको बारे ।

उपरोक्त सम्बन्धमा मिक्लाजुङ गाउँपालिका वडा नं.-३ बस्ने निवेदक केन्द्रीय प्रविधि क्याम्पस धरानमा स्नातक तह अध्यनरत विद्यार्थीले "Nutritional Status and its associated factors of adolescent students studying at government school of Miklajung Rural Municipality ,Panchthar." विषयमा अध्ययन गरी तथ्यांक संकलन गरी थेसिस लेखनका लागि यस गाउँपालिकाबाट सहमति प्रदान गरिएको व्यहोरा अनुरोध छ ।

अमर राज माखिम

(अध्यक्ष)

मिक्लाजुङ गाउँपालिका, रवि पाँचथर

अमरराज माखिम

अध्यक्ष

8. Appendix B: Consent form

Namaskar! As part of my dissertation research for my Bachelor of Science in Nutrition and Dietetics, I, Mr. Bishal Bhattarai, enrolled in the Central Campus of Technology, Dharan, will be doing my studies in the Miklajung rural municipality.

The topic for the study is **"NUTRITIONAL STATUS AND ITS' ASSOCIATED FACTORS OF ADOLESCENT STUDENTS STUDYING AT GOVERNMENT SCHOOLS OF MIKLAJUNG RURAL MUNICIPALITY, PANCHTHAR"**

The nutritional status, dietary status-influencing factors, and dietary pattern of adolescents between the ages of 10 and 19 will be surveyed as part of this study.

Thank you for being chosen to participate in the survey. A few broad inquiries about your family, financial situation, food habits, level of physical activity, and social condition will be made. We'll measure your weight and height as well. Certain inquiries may be private. The respondent's privacy won't be compromised. It matters that you take part in the study. If any of the questions feel sensitive or personal to you, you are free to leave out any or all of them. I'm hoping you'll help. Would you like to participate in the study?

Yes, I provide written consent for the participation in the study and permit to ask necessary questions and take necessary measurements required for the study.

Signature of participant: _____   *Signature of surveyor: _____*

Date: Date:

Place: Place:

9. Appendix C: Questionnaire

A. GENERAL INFORMATION

School's Code: Date (B. S.):

Y	M	D

Student's Code No: Class:

1. Name of child: _____

2. Age (in years):_____ Date of birth (B.S.):

Y	M	D

3. Address: Miklajung rural municipality   Ward no: _____   Tole:_____

4. Gender:

   a) Male   b) Female   c) Other

5. Caste/Ethnicity:

   a) Brahmin   b) Chhettri   c) Rai   d) Magar

   e) Limbu   e) Tamang   f) Others: _____

6. Religion:

   a) Hindu   b) Christian   c) Kirat   d) Buddhist

   e) Others: _____

B. ANTHROPOMETRIC INFORMATION

	Reading 1	Reading 2	Reading 3	Average
Hight (cm)				
Weight (kg)				

C. FAMILY INFORMATION

1. Type of family:

   a) Nuclear   b) Joint

2. Number of family members: _____

3. Number of male members:____

4. Number of female members: _____

5. Number of children (0-10 years) _____

6. Number of adolescents (10-19 years) _____

7. How many siblings do you have (siblings from same parents)?

         Total: _____ Brothers: _____ Sisters:_____

8. Your sequence among siblings (from the eldest): _____

9. Occupation of father:

   a) Agriculture   b) Service   c) Labor

   d) Business   e) Foreign employment   f) Others: _____

10. Occupation (of mother):
    a) Agriculture   b) Service   c) Labor   d) Business
    e) Foreign employment   f) house wife   g) Others_____

11. Family income:

    a) Less than Rs. 30000 monthly   b) Equal to or more than Rs. 30000 monthly

12. Father's Education level

    a) Higher secondary or above   b) Secondary   c) primary   d)
    Informal   e) Illiterate

13. Mother's education level:

a) Higher secondary or above   b) Secondary   c) Primary d) Informal

e) Illiterate

14. Which is your main source of drinking water in your family?

a) water tape   b) River   c) pond   d) other _____

15. Is the water purified?

a) yes   b) no

16. Do you have toilet facility in your house?

a) yes   b) no

17. What is the main source of food for your family?

a) Own production   b) Purchased from market   c) Both   d) Others_____

D. PHYSICAL ACTIVITIES

1. On an average, how many hours do you sleep in a day?

   a) 5 or less hours   b) 6 hours   c) 7 hours   d) 8 or more hours

2. Which form of transport do you normally use when travel to and from school and apart from your journey to and from school?

   a) Private vehicle   b) Cycle   c) Public/school transport   d) Walk

3. How many hours per day do you spend on doing your homework?

   a) None   b) less than 1 hours   c) 1-2 hours   d) more than 2 hours

4. What do usually do at school breaks?

a) Sitting down (talking, reading or eating)   b) Standing or walking around

c) Running or playing game

5. Do you normally play games or perform physical activities outside school?

   a) Yes   b) No

➤ If yes, what type?

   a) Play games   b) Aerobics/ Zumba   c)Swimming   d) Gym

   e) Running/jogging   f) Walking   g) Yoga

➤ In a day, how much time do you do such activity? _____ Hours/Minutes

➤ How frequently in a week? _____

6. Do you help your parents in doing domestic activities?

   1) Yes   2) No

If yes, how much time in a day do you involve in domestic activities? _____ Hrs

E. **DIETARY INTAKE AND FOOD HABITS**

1. Is your meal size affected by the presence of friends or family members?

   a) Yes   b) No

2. Do you skip any meal?

   a) Yes   b) No

➤ If yes, which meal does you skip?

a) Breakfast   b) Lunch   c) Dinner

3. How often do you skip this meal?

    a) 1 – 2 time a week   b) 3 –4 times a week   c) 5 or more days

4. At home, where do you usually eat?

    a) Dining room/Kitchen   b) Bedroom   c) In front of the TV

    d) Other places _____

5. What are you?

    a) Vegan   b) Vegetarian   c) Non-vegetarian

6. How many glasses (300 ml) of water do you drink/day?

    a) 1   b) 2-4   c) 5-7   d) 8 or more

7. Do you have daily pocket money?

    a) Yes   b) No   c) Sometimes (_____times a week)

8. Do you buy food from school canteen/ shops /vendor?

    a) Yes   b) No

    If yes, what do you usually buy? _____

9. How do you feel about your figure?

    a) Overweight   b) Right weight   c) Thin

10. Have you ever tried losing weight?

    a) Yes   b) No

11. Have you ever tried gaining weight?

    a) Yes   b) No

12. Do you monitor your weight?

    a) Yes   b) No

13. Do you smoke?

    a) Yes   b) No

14. Do you drink alcoholic beverages?

    a) Yes   b) N0

F. **FOOD FREQUENCY TABLE**

Food groups	Daily	4-5 times a week	2-3 times a week	Once a week	Once in 15 days or less	Never
Cereals						
Pulses & legumes						
Milk and milk products						
Green leafy Vegetables						
Other vegetables						
Fruits						
Egg, meat, Fishes						
Tea / coffee						
Fast food						

G. **24 HOUR DIETARY RECALL**

Timing	Description of food	Serving	Amount
6-9 am			
9 – 11 am			
1 – 5 pm			
7-9 pm			

10. Appendix D: Photo gallery

11. Appendix E: Survey site
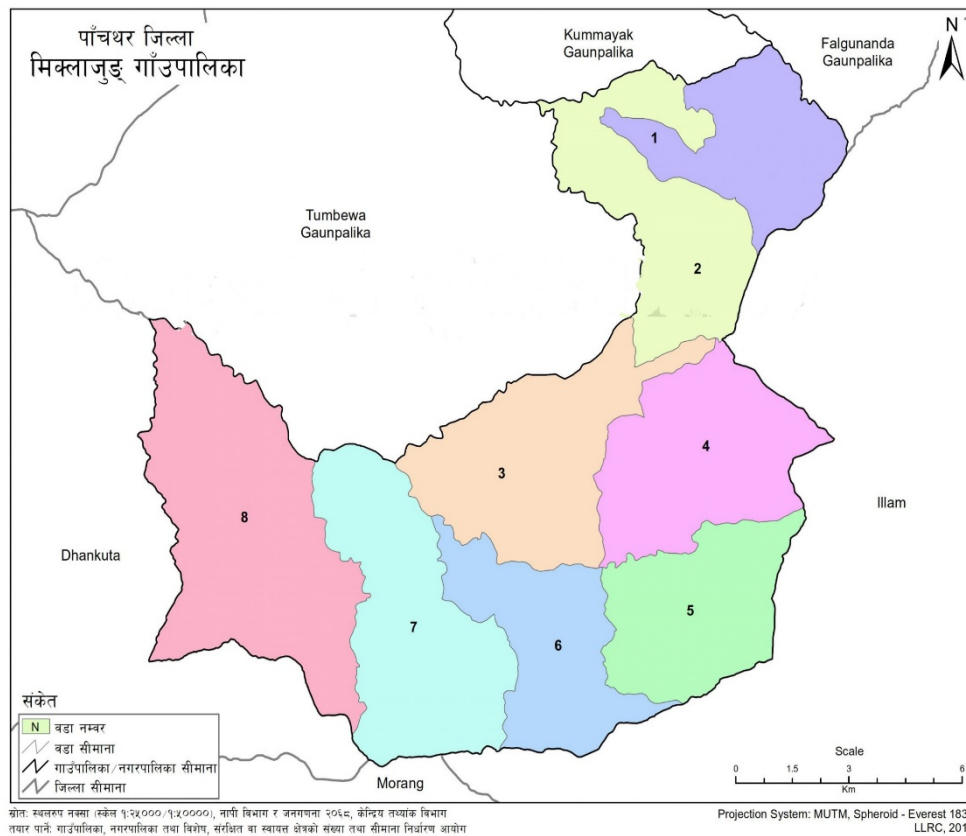
Survey site was located in ward number 3 shown in the map of Miklajung rural municipality