ASSESSMENT OF NUTRITIONAL STATUS AND DIETARY INTAKE OF ADOLESCENTS STUDYING IN SCHOOLS OF KOHALPUR MUNICIPALITY, BANKE DISTRICT

by

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Assessment of Nutritional Status and Dietary Intake of Adolescents Studying in Schools of Kohalpur Municipality, Banke District

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

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Approval Letter

This *dissertation* entitled *Assessment of Nutritional Status and Dietary Intake of Adolescents Studying in Schools of Kohalpur Municipality, Banke District* by Madan Pandey 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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Madan Pandey

Abstract

Adolescents with good nutritional status would grow to become healthy adult with increased work productivity. Their dietary intake and dietary behaviour directly affects their nutritional status. Thus, a cross sectional survey was conducted to assess the nutritional status and dietary intake of adolescents studying in schools of Kohalpur municipality, Banke district. From randomly selected eight schools, 205 adolescents were chosen by random selection according to proportion. A well designed and pretested set of questionnaire was used to collect information regarding socio-economic condition, physical activity, dietary practices, and hygiene and sanitation conditions of the target population. Weight and height were measured by using digital weighing balance and stadiometer respectively. Dietary intake was assessed by 24 hour dietary recall and food frequency questionnaire. Data collected was analysed using WHO Anthroplus version 1.0.4, SPSS version 20 and Microsoft excel. Chi-square test and fisher exact were used to analyse the factors associated with nutritional status.

The prevalence of stunting, thinness and obesity were 21%, 5.9% and 7.8% respectively. The prevalence of insufficient intake of the nutrients as energy, protein, added fat, calcium, and iron was 85.37%, 41.95%, 92.20%, 77.56%, 76.58% respectively. Similarly of 79.02% of adolescent consume foods from at least 4 food groups out of 7. 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 for boys and also there were high dispersion among individual intakes of the subjects. Ethnicity ($p=0.016$), purification of drinking water ($p=0.004$), trying to gain weight ($p=0.031$) were found to be statically associated with stunting. Gender ($p=0.050$), family size ($p=0.002$), number of adolescents in family (0.028), sleeping hours ($p=0.027$), and perception about own body size ($p=0.000$), trying to lose weight ($p=0.001$) and frequency of consumption of fast foods (0.026) were associated with thinness or obesity. Proper intervention programmes should be implemented in order to correct the nutritional status nutrient intake and dietary habits of adolescent residing in Kohalpur.

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List of abbreviations

Abbreviations	Full forms
AED	Academy for Educational Development
BMI	Body Mass Index
BNF	British Nutrition Foundation
CFNI	Caribbean Food and Nutrition Institute
FAO	Food and Agriculture Organization of United Nations
FFM	Fat Free Mass
FM	Fat Mass
FSAU	Food Security Assessment Unit for Somalia
GoN	Government of Nepal
g	Gram
HDI	Human Development Index
ICMR	Indian Council of Medical Research
IFPRI	International Food Policy Research Institute
IOM	Institute of Medicine of National Academies
Kcal	Kilocalorie
KMO	Kohalpur Municipality Office
mg	Milligram
NAL	National Agricultural Library

NCHS	National Centre for Health Statistics
NCD	Non-communicable disease
NDHS	Nepal Demographic and Health Survey
NHRC	Nepal Health Research Council
NLM	National Library of Medicine
NNMB	National Nutrition Monitoring Bureau
SAT	Subcutaneous Adipose Tissue
SEAR	South East Asian Region
UCDAVIS	University of California, Davis
UNICEF	United Nations Children's Emergency Fund
USA	Unites States of America
USAID	United States Agency for International Development
VDC	Village Development Committee
WHO	World Health Organization

Part I

Introduction

1.1 Background of study

Adolescence is the period in human growth and development that occurs after childhood and before adulthood, from ages 10 to 19 years. It represents one of the critical transitions in the life span and is characterized by a tremendous pace in growth and change that is second only to that of infancy (WHO, 2015). Rapid physical, physiological, psychological and social development takes place during adolescence (John *et al.*, 2005).

Nutrition is defined as the science of food, the nutrients and other substances therein, their action, interaction and balance in relation to health and disease, and the processes by which the organism ingests, absorbs, transports, utilizes and excretes food substances (NLM and NAL, 1998). Nutritional status is the condition of the body resulting from the intake absorption and utilization of food (FAO, 1984). Nutrition related disorders can be caused by an insufficient intake of food or of certain nutrients, by an inability of the body to absorb and use nutrients, or by overconsumption of certain foods (WHO, 2016b). The dietary intake also ultimately affects the nutritional status because establishing healthy eating habits promotes young people's health, growth and intellectual development across the life course (WHO, 2016a).

Nepal is a landlocked country situated in South Asia between India and China (GoN, 2015). Population of Nepal as of the census day (June 22, 2011) stands at 2,64,94,504 with population of adolescents (10 – 19 year age group) 64,07,404 (CBS, 2012). Food is the fundamental right of the citizens according to the Constitution of Nepal. The country has been ranked at position 144 as medium HDI country among 188 nations (Jahan *et al.*, 2016). Kohalpur lies in north western part of Banke district (KMO, 2016). It is strategically located at the junction of the Ratna (north-south) and Mahendra (east-west) highways which provide important national transport links (Soloman *et al.*, 2013). It was declared municipality by combining former Rajhena and Kohalpur VDCs in B.S. 2071/1/25. The municipality has an area of 169.534 square km. Majority of the population are of *Tharu* ethnicity, but it consists of all other castes he population is 62,177 (KMO, 2016). The

number of adolescents is 15,753; among which 7893 are males and 7860 are females (CBS, 2014a).

In 2014, 71% of adolescent boys and 59 % of adolescent girls were malnourished in Nepal (Aryal *et al.*, 2016). A study done on adolescent girls of age 9 years to 16 years in Kavreplanchowk district has shown that prevalence of underweight, stunting and thinness was 31.98%, 21.08% and 14.94% respectively (Mansur *et al.*, 2015). Another study done Kaski district among the adolescents of age 16 to 19 years has shown that prevalence of obesity was 8.1%, of which 5.8% were overweight and 2.3% were obese (Acharya *et al.*, 2014). The dietary intake of schoolchildren and adolescents in developing countries is limited in diversity, mainly comprising plant-based food sources, but with limited intake of fruits and vegetables. There is a low energy intake and insufficient micronutrient intake (Ochola and Masibo, 2014). A study in Nepalese school children showed that fast foods (ready to eat snacks, chips etc.) were preferred by more than two-third of adolescents. Advertising, probably TV and magazines, influenced preferences in 80% of these Nepalese adolescents (Haider and Bhatia, 2006). From the study done in school going adolescent girls of Kathmandu by Tiwari and Seshadri (2000), it has been found that intake of energy, protein, calcium, iron, vitamin A and folic acid are found lower than RDAs.

1.2 Statement of the problem and justification

Adolescents considered being healthy but millions of them suffer chronic ill health and disablement that may remain a lifetime (WHO, 2001). The physiological changes and physical activity influence nutrient needs of adolescents (Thompson and Manore, 2012). Their dietary habits are influenced by peers, mass media, social and cultural norms, and lack of nutrition knowledge, while the influence of the family tends to decline (WHO, 2005). This ultimately affects the nutritional status. The foundations of health in adulthood and old age are laid during childhood and adolescence (WHO, 2003) so, the health and nutritional status during adolescence becomes more important.

Poorer nutritional status of women becomes apparent during adolescence, with a delay in maturation (WHO, 2005). Poor nutrition affects economic productivity both directly,

and indirectly (Horton and Steckel 2011). Adolescents have higher chance to increase consumption of fast foods which are nutritionally inadequate, follow self-imposed crash diets, skip meal (John *et al.*, 2005). Studies have found consumption of energy sources that provide no major vitamins or minerals is common during this period of life. Intervening during this time is important because the dietary patterns of adolescence often track into adulthood (St-Onge and Keller, 2014).

In most developing countries including Nepal, nutrition initiatives have been focusing on children and women, thus neglecting adolescents. Addressing the nutrition needs of adolescents could be an important step towards breaking the vicious cycle of intergenerational malnutrition, chronic diseases and poverty. Adolescent malnutrition is problem of Nepal (Aryal *et al.,* 2016; Acharya *et al.*, 2014; Haider and Bhatia, 2006). The review compiled by Haider and Bhatia (2006) on the nutritional status of adolescents in member countries of WHO's South-East Asia Region (SEAR) has identified that the adolescents too have nutritional problems. There are a very few studies done that provide data on nutritional status of adolescents in the SEAR (Haider and Bhatia, 2006). Very few studies are available in Nepalese context on adolescent nutrition.

Since no study on assessment of nutritional status and dietary intake of adolescents on Kohalpur municipality has been conducted till date, this study was done to assess the nutritional status and dietary intake of the adolescents studying in the secondary schools of Kohalpur municipality. It can be beneficial for policy makers at both local and national level.

1.3 Objectives of study

1.3.1 General objective

To assess nutritional status and dietary intake of adolescents studying in schools of Kohalpur municipality, Banke district.

1.3.2 Specific objectives

1) To assess the nutritional status of the adolescents of Kohalpur municipality by anthropometric measurement.

2) To collect information about dietary intake and dietary habits of adolescents residing in Kohalpur.

3) To identify the factors affecting nutritional status.

1.4 Research questions

1) What is the existing nutritional status of adolescents studying in schools of Kohalpur municipality, Banke district?

2) How is the dietary intake and dietary habits of adolescents of Kohalpur?

3) What are the different factors which influence the nutritional status of the adolescents?

1.5 Significance of the study

The study will be helpful to find out the magnitude and distribution of malnutrition among the school going adolescents in Kohalpur municipality and may be helpful in generalization at national level. Since it also includes assessment of dietary intake and dietary habit of adolescents it would be useful for implementing programmes to modify dietary habits of adolescents if needed. The study will also provide information on the factors associated with adolescent malnutrition and effect of nutrient intake and dietary behaviour on nutritional status. Thus it can suggest the corrective measure in order to uplift adolescent malnutrition considering the gender, caste, family economy basis, and dietary behaviour and nutrient intake. It can also provide information to governmental and non-governmental organizations about the nutrition situation and dietary behaviour of adolescents. The study may act as guideline for policy makers for making plans on adolescent malnutrition.

1.6 Framework of the study

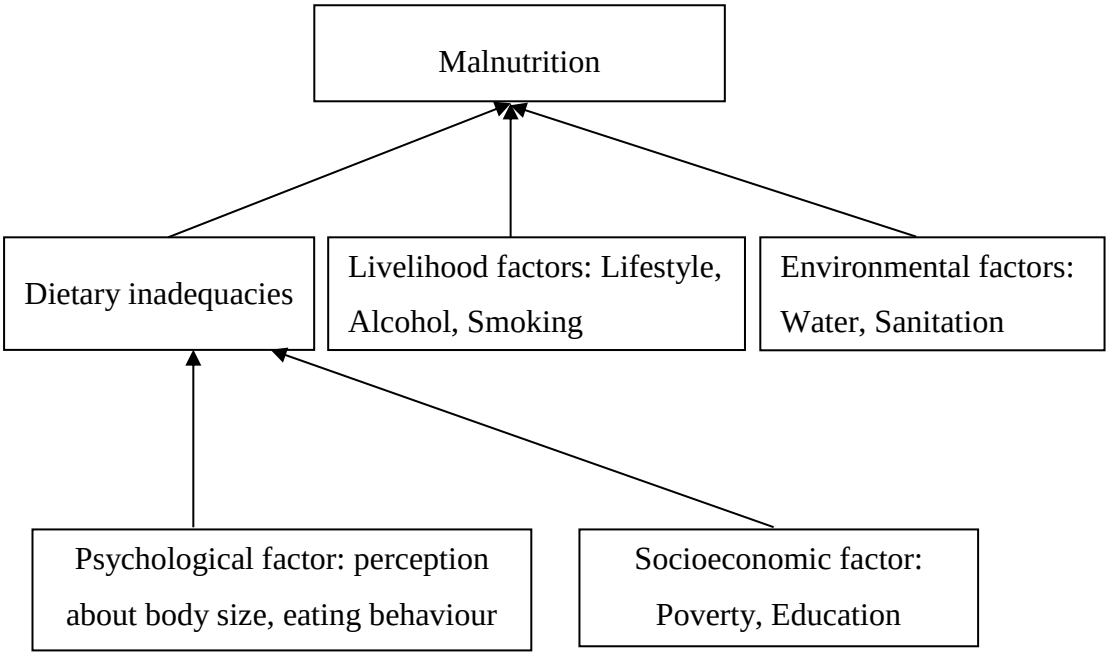

Figure 1.1 Framework of study

*Modified from:*UNICEF (1992);WHO (2005)

1.7 Limitations of the study

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

2) Seasonal variation could not be taken into account because it is cross-sectional survey.

Part II

Literature review

2.1 Adolescence

Adolescence is the time of life when growth is completed and individuals become sexually mature (Tuttle and Truswell, 2002). Biological processes drive many aspects of the adolescent growth and development, with the onset of puberty marking the passage from childhood to adolescence. The process of adolescence is a period of preparation for adulthood during which time several key developmental experiences occur. While adolescence is a time of tremendous growth and potential, it is also a time of considerable risk during which social contexts exert powerful influences. (WHO, 2015). UNICEF (2011) divides the second decade of life as below:

2.1.1 Early adolescence (10–14 years)

The age of 10 to 14 years can be considered as early adolescence. It is at this stage that physical changes generally commence, usually beginning with a growth spurt and soon followed by the development of the sex organs and secondary sexual characteristics. These external changes are often very obvious and can be a source of anxiety as well as excitement or pride for the individual whose body is undergoing the transformation. The internal changes in the individual, although less evident, are equally profound. The brain also undergoes a spectacular burst of electrical and physiological development. The number of brain cells can almost double in the course of a year, while neural networks are radically reorganized, with a consequent impact on emotional, physical and mental ability (UNICEF, 2011).

2.1.2 Late adolescence (15–19 years)

Late adolescence encompasses the ages of 15 and 19 years. The major physical changes have usually occurred by now, although the body is still developing. The brain continues to develop and reorganize itself, and the capacity for analytical and reflective thought is

greatly enhanced. Peer-group opinions still tend to be important at the outset, but their hold diminishes as adolescents gain more clarity and confidence in their own identity and opinions (UNICEF, 2011).

2.2 Changes during adolescence

2.2.1 Physical changes

Growth in physical size during adolescence is second to the growth that occurs in infancy (St-Onge and Keller, 2014). Generally, growth spurt begins at the age of ten or eleven for girls and twelve or thirteen for boys. It lasts for about two and a half years (Rolfes *et al.*, 2009a). More than 20% of total growth in stature and up to 50% in adult bone mass occurs during adolescence (WHO, 1995). Some physical changes during teenage are as below:

a. Body composition

During adolescence, boys' muscle mass increases and shoulders broaden, whereas girls increase their body fat and develop rounder hips and smaller waists. The pattern and rate of development in body composition differ in boys and girls. Girls attain peak height growth velocity at a younger age than boys, i.e. at 11.5 years of age but boys attain a maximal height growth velocity 13.5 years of age, which is higher than that for girls and height increases for a longer period of time (St-Onge and Keller, 2014).

Before puberty, males and females have similar proportions of fat (15% and 19% respectively), muscle and lean body mass. During puberty, the rate of linear growth increases to reach that of 2 year-old children. In girls, fat increases to 23% at age 20, while it decreases to 12% in boys (WHO, 2005). Girls gain fat mass (FM) steadily through age 16. Boys have an initial increase in FM between age 8 and 14 years, then a decline between ages 14 and 16 years. The distribution of FM also changes as: in boys, increased deposition of subcutaneous adipose tissue (SAT) occurs in the trunk area, whereas in girls, SAT is deposited in the gluteal–femoral region. Patterns of change in fat-free mass (FFM) also differ: Girls increase in FFM until age 15 years, and boys increase in FFM through age 18 years, with the most rapid increase occurring between 12 and 15 years. The composition of

FFM also changes during this time, from 80% water in young childhood to approximately 73% water by ages 10 to 15 years. The rise in density of FFM is caused by accretion of protein and minerals in the FFM compartment during growth(St-Onge and Keller, 2014).

b. Sexual maturity

The growth spurt is accompanied by sexual maturity. In girls there is development of breasts, auxiliary and pubic hair and menarche. In boys the pubertal changes include deepening of voice, broadening of shoulders, development of auxiliary and pubic hair, growth of penis and testicles (John *et al.*, 2005). Sexual maturation can be determined by evaluating pubertal development based on secondary sex characteristics: testicular and penile development and appearance of pubic hair in boys; breast development and appearance of pubic hair in girls which is known as tanner stage rating (St-Onge and Keller, 2014).

2.2.2 Psycho-social changes

Besides physical and sexual maturation, changes include movement toward social and economic independence, and development of identity, the acquisition of skills needed to carry out adult relationships and roles, and the capacity for abstract reasoning (WHO, 2015). As adolescence is a transition to adulthood, they try to develop self-identity. The desire to be accepted in their peer group changes their food habits, dressing and group conduct. This in turn brings psychological, emotional and social stress (John *et al.*, 2005). There is occurrence of transition towards greater autonomy from parents and their values, and a progressively more central role of peers as role models, advisors, friends, and determinants of interests and values (WHO, 2005).

2.3 Factors affecting adolescent nutritional status

Some factors that could affect the nutritional status of adolescents are as below:

2.3.1 Dietary adequacy

Adolescent growth and development is closely linked to the diet they receive during childhood and adolescence. Adequate nutrition of any individual is determined by two factors. The first is the adequate availability of food in terms of quantity as well as quality, which depends on socioeconomic status, food practices, cultural traditions, and allocation of the food. The second factor is the ability to digest, absorb, and utilize the food. This ability can be hampered by infection and by metabolic disorders (Haider and Bhatia, 2006). Dietary inadequacies might be caused by an inadequate supply of food or by mothers having too little time to prepare food (UNICEF, 1992).

In developing countries, the majority of rural households' diets is based on locally grown starchy staples, and often includes few or no animal products and only seasonal fruits and vegetables. Monotonous diets based on a very small number of foods contribute to under-nutrition, particularly among children from food insecure households. Gender disparities in availability and access to food and other resources may contribute to undernutrition mainly in settings where the female child is still considered less important than the male child (Maziya, 2014). In some countries of SEAR, because of the preference for sons, girls may receive less food and/or food inferior in quality. In some parts of India, girls' food consumption is limited for the fear that they will grow too rapidly and will have to be given in marriage soon. An Indian adolescent girl may need to observe a series of fasts once or twice a week for getting a good husband. (Haider and Bhatia, 2006). Socio-cultural influences affect adolescent eating patterns and behaviours (Escott - Stump, 2012). Studies of adolescent diet have shown that food consumed at home is related to socio-economic variables, while the food consumed outside home is independent of family background or social class groups but more a result of peer pressure (AL-Jaaly, 2012).

Many teens eat in hurry, skip meals, snack and select fast foods and convenience foods because they are inexpensive, are accessible, and taste good. (Thompson and Manore, 2012). The main concern with these foods is that they often are higher in calories, fat, saturated fat, trans-fat, cholesterol, sugar, and sodium; lower in vitamin A, vitamin C, folate, calcium, iron, and zinc than foods served at home. Teens generally eat less than the

recommended amounts of fruits and vegetables. This results insufficient nutrient intake (Byrd -Bredbenner *et al.*, 2009). Breakfast skipping is more prevalent in single-parent or low-income families. Several studies have reported that breakfast consumption is associated with lower BMI or protection against obesity (St-Onge and Keller, 2014).

Trends in beverage consumption affect the nutritional adequacy of adolescent diets. (St-Onge and Keller, 2014). Soft drinks, when chosen as the primary beverage, may affect bone density, partly because they displace milk from the diet. Adolescents who drink soft drinks regularly have a higher energy intake and a lower calcium intake than those who do not; they are also more likely to be overweight (Rolfes *et al.*, 2009a).

Poverty is considered the prime factor determining food consumption; however, some researchers suggest that cultural factors play a stronger role than socioeconomic conditions in determining allocation of food and nutritional adequacy. Even where food resources are adequate, the mean caloric intake of individual family members can fall below requirements. The most vulnerable are children under two, and adolescents (Haider and Bhatia, 2006).

2.3.2 Physiological condition and lifestyle

The risk of under-nutrition has been found to be more in non-menstruating girls (Choudhary *et al.*, 2008). Growth imposes additional nutritional requirements in adolescence. Athletes who need to maintain a certain weight for competition may resort to extreme weight-loss measures (diet pills, laxatives, starvation, etc.) that can impair both performance and health. Weight and dieting concerns of adolescent athletes place them at greater risk of eating disorders and low-energy diets are more likely to be inadequate in micronutrients such as calcium, iron, magnesium, zinc and vitamin B_6 (WHO, 2005).

Studies have shown the level of physical activity tends to fall significantly at the time of adolescence. Studies have reported that the average American college student fails to meet the current physical activity recommendations of the American College of Sports Medicine, which involve at least three times per week of vigorous activities for cardio respiratory endurance, a minimum frequency of three times a week for flexibility exercises,

and twice a week for strength/endurance activities (WHO, 2005). Physical inactivity is now identified as the fourth leading risk factor for global mortality. Levels of physical inactivity are rising with major implications for the general health of people worldwide. It has been shown that participation in regular physical activity reduces the risk of coronary heart disease and stroke, diabetes, hypertension, colon cancer, breast cancer and depression. Additionally, physical activity is a key determinant of energy expenditure, and thus is fundamental to energy balance and weight control (WHO, 2010). In low-income countries in contrast, adolescents' livelihoods may involve heavy physical work, which has a direct bearing on their energy requirements, and their weight status. The level of physical activity in adolescents is a predictor of subsequent adiposity and decreases in physical activity over the teenage years are associated with increases in a body mass index (WHO, 2005). Risk factors associated with cardiovascular disease in adolescence that includes overweight status, hypertension, increased blood lipids, and cholesterol are linked to physical inactivity (AL-Jaaly, 2012).

2.3.3 Psycho-social factors

Although parents can still be effective role models, adolescents are generally strongly influenced by their peers, their personal food preferences, and their own developing sense of which foods constitute a healthful and adequate diet (Thompson and Manore, 2012). Changes in eating patterns during adolescence are influenced by cognitive, physical, social, and lifestyle factors. Weight management and body image are topics of great importance, and interest in adolescence. Serious concerns about body image can cause some health consequences such as dietary disorders, and psychological discontent (AL-Jaaly, 2012). The search for identity, the struggle for independence and acceptance, and concern about appearance, are changes that may have a great impact on lifestyle, eating patterns and intakes of adolescents. Body image, and its disturbances, is a critical determinant of dietary practices and nutritional risk at adolescence, particularly among girls (WHO, 2005).

2.3.4 Food security

Access to food is necessary for adequate nutrition, but it does not guarantee it. Food security has three basic components- food availability, food stability and food access although food utilization can also be included. National food security means adequate food supplies through local production and food imports. Food insecurity may be caused by the unavailability of food, insufficient purchasing power, inappropriate distribution or inadequate use of food at the household level. Household food security requires special attention. Household food security also focuses on the family's capacity to produce and acquire food. In addition, explicit attention is paid to how food is produced, and how that food is distributed within the household. All of those factors have a direct effect on nutrition at the household level. Among chronically food insecure people, both macro- and micronutrient deficiencies are likely to be present. People may experience nutritional imbalances even when obtaining sufficient dietary energy (FSAU, 2005; UNICEF, 1992).

2.3.5 Health, water and sanitation

Practices that promote and maintain good health in the population are influenced by a number of factors including knowledge and environment. During ill-health, these practices include seeking health services from qualified personnel; access to health services; as well as control and treatment of communicable diseases. The poor health of individuals is normally associated with the inability to engage in meaningful productive activities, and higher expenditures on treatment at the expense of food items. Poor health increases vulnerability to food insecurity and therefore nutritional vulnerability. There is also a synergistic interaction between malnutrition and poor health status as one fuels the other (FSAU, 2005).

Sanitation issues like disposal of human waste, disposal of garbage and cleanliness of the household environment affect the health of a population. Sanitation is especially important in urban areas where people are relatively congested. Poor sanitation results in disease outbreaks and also interferes with food consumption and utilization. Water availability is also an important indicator of food security. Access to sufficient quality and

quantity of water is essential to nutritional security. Households require water for chores like cooking, cleaning clothes and drinking. This water must be safe for consumption and sufficient in quantity (FSAU, 2005).

Diseases and infections increase the body's nutrient requirements, while malnutrition weakens the body's ability to metabolize and absorb nutrients, thereby creating a vicious cycle of infection and undernourishment, worsened health, and sometimes mortality. Repeated episodes of infections and illness take a toll on children's mental and physical development, and children with compromised immune systems are particularly vulnerable to malnutrition (Maziya, 2014).

2.3.6 Socio-economic and political condition

The food security, availability of health services and general development of the country directly depend upon its political and economic condition. The socio-economic influences at national level are population characteristics, literacy levels of people, available natural resource their distribution and utilization; market conditions and modernization of agricultural sector. Allocation of resources and investment in the economy largely depends not on the political will but also on the political condition. At sub-national or regional level, cultural attitudes towards what to eat, what to own; the social institutions like family size, caste or ethnicity and relationships, livelihood systems (occupation) and household characteristics such as proportion of working adults affect food security (FSAU, 2005).

Causes of malnutrition in society relate to both the historical background of the society and factors external to the society such as external economic dependency, globalization of economy (UNICEF, 1992). As all these influences affect the community nutritional status, nutritional status of adolescents is also affected. From different studies done in Saudi Arabia, Tanzania, Ethiopia, India, (AL-Jaaly, 2012; Chen, 2012; Damie *et al.*, 2015; Gebremariam *et al.*, 2015; Khopkar *et al.*, 2014); it has been seen that the family economic status, parents' literacy could affect the nutritional status of adolescents. And it has also been seen that nutritional status of adolescents in urban areas is better than that of girls in

rural areas from the studies of Nepal, Tanzania and India (Acharya *et al.*, 2014; Chen, 2012; Vashist *et al.*, 2009).

It is likely that parents allocate food and other resources differently depending on whether the child is a boy or a girl. Adolescent girls and women may be at a disadvantage with respect to household food distribution, as observed, for instance, in Nepal (WHO, 2005).

2.4 Nutritional status and malnutrition

Nutritional status is defined as the health status of individuals or population groups as influenced by their intake and utilization of nutrients (Gibson, 2002). It reflects the degree to which physiologic needs for nutrients are being met (Srivastava, 2008). Malnutrition is as a pathological state resulting from a relative or absolute deficiency or excess of one or more of the essential nutrients in the diet (Jelliffe, 1966).

Jelliffe (1966) has categorized malnutrition into different forms as below:

1. Under-nutrition: It is a pathological state resulting from consumption of inadequate quantity of food over an extended period of time.

2. Over Nutrition: This is the pathological state resulting from the consumption of excessive quantity of food over an extended period of time.

3. Specific Deficiency: It is the pathological state resulting from a relative or absolute lack of an individual nutrient.

4. Imbalance: It is the pathological state resulting from a disproportion among essential nutrient with or without the absolute deficiency of any nutrient.

2.5 Major Nutritional problems in adolescence

2.5.1 Undernutrition (thinness and stunting)

Short stature and low body mass during adolescence may be determinants of concurrent functional impairment. Short statures in adolescents from prior chronic undernutrition are

associated with reduced lean body mass and deficiencies in muscular strength and working capacity. The future consequence of adolescent undernutrition in girls may be adverse reproductive outcome during adulthood (WHO, 1995). Short stature is often associated with small pelvises in women, and this is an important risk factor for obstructed labour (WHO, 2005).

From a study of Thapa *et al.* (2011), done in Humla and Mugu districts in children of 5 years to 15 years, the prevalence of thinness was found to be 21.13% and 20.12% respectively; stunting prevalence was 23.4% and 26.7% for respective districts. Similar, study done among adolescent girls of age 9 years to 16 years in Kavreplanchok district has shown that overall prevalence of underweight, stunting and thinness was 31.98%, 21.08% and 14.94% respectively. Underweight was highly prevalent (49.5%) among 11 years age girls, Stunting and thinness were highest (37.34% and 24.2% respectively) in age group of 9 years (Mansur *et al.*, 2015).

2.5.2 Iron deficiency anaemia

Anaemia, a condition in which the number of red blood cells (and consequently their oxygen-carrying capacity) is insufficient to meet the body's physiologic needs (WHO, 2011). Anaemia, whether or not the primary cause is iron deficiency, is generally recognized as the main nutritional problem in adolescents. Low iron intakes alone do not fully account for the high prevalence of anaemia. Other factors such as low vitamin C intakes and some aspects of lifestyle such as dieting for weight loss or untutored adoption of vegetarian diets are associated with increased risk. Iron deficiency is related to vitamin A status. Many studies suggest a direct interaction between vitamin A status and the utilization of dietary and stored iron for haemoglobin formation. Iron requirement may increase in adolescent girls due to infection, menorrhagia. Iron deficiency and anaemia may be common among adolescent athletes. Iron deficiency anaemia reduces physical work capacity, and also reduces stamina among athletes. Iron deficiency may alter cognitive function in children and even in adolescents and the effects may be only partly reversible in severe and prolonged deficiency (WHO, 2005).

From a study done in Nepalgunj Medical Collage, Kohalpur, Banke from March 2011 to December 2012; the prevalence of anaemia in 10 to 19 years adolescents was found to be 52%. (P. Singh *et al.*, 2013). Similar study done by Sinha *et al.* (2012) in Biratnagar has shown prevalence of iron deficiency anaemia among adolescent population was 56.3%.

2.5.3 Vitamin A deficiency disorder

Although the risk of vitamin A deficiency tends to decline with age, it is now apparent that it often extends in adolescence and early adulthood especially among women (WHO, 2005). Selected signs and symptoms of deficiency include xerophthalmia, anorexia, retarded growth, increased susceptibility to infections, obstruction and enlargement of hair follicles, and keratinisation of epithelial (mucous) cells of the skin with accompanying failure of normal differentiation. Vitamin A deficiency is associated with decreased iron incorporation into red blood cells and diminished mobilization of iron from stores (Gropper *et al.,* 2009).Studies conducted in different settings in Bangladesh showed that there is a high prevalence of sub-clinical vitamin A deficiency among adolescents (Haider and Bhatia, 2006).

2.5.4 Iodine deficiency disorders

Iodine deficiency disorders were widely prevalent in most populations until corrective measures were taken. Neuromotor and cognitive impairments of variable degrees are the most important consequences of iodine deficiency. Iodine deficiency is recognized as the most common cause of preventable mental retardation in the world. In iodine-deficiency areas, a downward shift of IQs has been reported as well as lower performance in school after controlling for confounding variables. In India, a study compared learning and motivation in male schoolchildren aged 9-15 years from severely iodine-deficient villages and from mildly iodine-deficient villages, after matching the groups for age, socio-economic status and formal education. The results suggested that children from severely deficient villages not only suffered neural impairment, but also lacked socio-psychological stimulation in the endemic sites, which explained learning disability, as well as low motivation to perform (WHO, 2005).

Thus, iodine deficiency, because of its lasting effects on survival and intellectual achievements, is a major obstacle to social and economic development. Iodine deficiency affects all age groups, but goitre primarily affects people aged 15-45 years, in particular women. Iodine deficiency is assessed by goitre and urinary iodine levels among schoolchildren, as these are captive groups. Some adolescents are 'captured' in these surveys, but evaluation or surveillance data are not reported separately for this group (WHO, 2005).

2.5.5 Other micronutrient deficiencies

Calcium requirements for skeletal development appear to be even greater during adolescence than childhood or young adulthood. Because maximum bone mass is acquired during adolescence, calcium deposited during that period determines the risk of osteoporosis in adulthood. Adverse effects of calcium deficiency have also been observed at adolescence. Calcium deficiency apparently increases the risk of bone fracture even among adolescents, as observed among those not meeting 60% of dietary allowance for calcium (WHO, 2005).

Girls are apparently twice as likely as boys to be deficient. Although factors other than diet, in particular exercise, also contribute to calcium status, adequate calcium intake, with supplementation when needed, is recommended in adolescents in the USA. However, calcium nutriture in developing countries and in populations other than Caucasians is poorly understood, and it is not known whether osteoporosis may be modulated by calcium intake during childhood and adolescence. Calcium-deficiency rickets (without vitamin D deficiency) has been reported in children in Africa and in Bangladesh. There are racial differences in the incidence of osteoporosis (WHO, 2005).

Evidence from supplementation trials suggests that marginal zinc nutriture may also accelerate skeletal growth in some infants, children and adolescents. In Guatemalan infants, zinc supplementation increased accretion of fat-free mass and enhanced linear growth in those that were stunted at baseline. Zinc deficiency, with retarded growth among other signs, was identified among adolescents from middle-eastern areas. Zinc-fortified

bread was tested on a small scale in a case-control study of Turkey school-age children with low serum zinc levels. Positive results suggesting satisfactory zinc bioavailability were reported. These studies provide further supportive evidence for the involvement of zinc deficiency in stunting, perhaps more so in boys. Zinc may also prevent bone loss, as suggested by observations in older women. Zinc has other physiological roles, including immunity, and it interacts with several micronutrients, notably with iron, and with vitamin A (WHO, 2005).

2.5.6 Overweight/Obesity

Obesity is increasing in most high-income countries, in developing countries undergoing nutrition transition, and even in poor countries with current food insecurity and undernutrition problems. Obesity and chronic malnutrition reflected in stunting often co-exist. They may even be interrelated, with more obesity among stunted people, which would tend to increased chronic disease risk among people having been exposed to malnutrition in early life. Adolescents who were growth-retarded at birth also tend to put on more weight during the growth spurt of adolescence. Adolescents are sensitive about body image and obese teenagers are especially vulnerable to social discrimination. Poor self-esteem and body image are consistently associated with obesity in adolescents. The major long-term health problems associated with adolescent obesity are its persistence in adult life and its association with cardiovascular disease risk in later life (WHO, 2005). The percentage of children with obesity in the United States has more than tripled since the 1970s. Today, about one in five school-aged American children (ages 6–19) has obesity (CDC, 2017). For 2010, the overall, overweight and obesity combined prevalence was 19.2% among Chinese children and adolescents aged 7–18 years (Sun *et al.*, 2014). Obesity amongst adolescents is responsible for carrying weight-related risks like cardiovascular diseases into adulthood. An Indian study has shown that obese adolescents are more likely to develop hypertension later in life as compared to their leaner counterparts (Haider and Bhatia, 2006). In India, NNMB data shows that overall prevalence of overweight and obesity among adolescents are be below 2% and 1%

respectively but the values are more than 5% in some states according to age groups (NNMB, 2012).

2.6 Nutritional requirements of adolescents

A requirement is an intake level, which will meet specified criteria of adequacy, preventing risk of deficit or excess (FAO and WHO, 2001). Adolescence is the period of increased nutritional requirement due to the rapid formation of new tissues and other changes (WHO, 1995). After puberty, there is difference in nutritional requirement of girls and boys. The reason for it includes earlier maturation of females and variations in physiological needs for some nutrients by sex e.g., difference in the requirement of iron. Besides differences in height and weight, boys gain proportionately more muscle mass than fat as compared to girls. They experience increased linear growth to produce a heavier skeleton and develop greater red blood cell mass than girls. Girls on the other hand have more fat than muscle tissues. These differences in body composition have important implications for nutritional needs of male and female adolescents (Haider and Bhatia, 2006).

Recommended Dietary Allowance (RDA) is the average daily dietary nutrient intake level sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) healthy individuals in a particular life stage and gender group (ICMR, 2010). ICMR has calculated the nutrient requirements considering all adolescents as moderately active. The recommended Daily allowance as provided by ICMR in 2010 is given as below:

Table 2.1 Energy and nutrient requirements of boys

Nutrients	Age (in years)								
	10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Energy *(kcal)*	2030	2180	2370	2580	2760	2890	2980	3060	2730
Protein *(g)*	36.3	39.6	43.7	49.8	54.7	58.2	60.8	62.2	60
Visible fat *(g)*	35	35	35	45	45	45	50	50	30
Calcium *(mg)*	800	800	800	800	800	800	800	800	600
Iron *(mg)*	21	21	21	32	32	32	28	28	17
Vitamin A *(µg)* **Retinol**	600	600	600	600	600	600	600	600	600
β-carotene	4800	4800	4800	4800	4800	4800	4800	4800	4800
Thiamine *(mg)*	1.1	1.1	1.1	1.4	1.4	1.4	1.5	1.5	1.4
Riboflavin *(mg)*	1.3	1.3	1.3	1.6	1.6	1.6	1.8	1.8	1.6
Niacin equivalent *(mg)*	15	15	15	16	16	16	17	17	18
Pyridoxine *(mg)*	1.6	1.6	1.6	2	2	2	2	2	2
Ascorbic Acid *(mg)*	40	40	40	40	40	40	40	40	40
Dietary folate *(µg)*	140	140	140	150	150	150	200	200	200
Vitamin B12 *(µg)*	0.2-1	0.2-1	0.2-1	0.2-1	0.2-1	0.2-1	0.2-1	0.2-1	1
Magnesium *(µg)*	120	120	120	165	165	165	195	195	340
Zinc (*mg)*	9	9	9	11	11	11	12	12	12

Table 2.2 Energy and nutrients requirements of girls

Nutrients	Age Groups (in *years*)								
	10	***11***	***12***	***13***	***14***	***15***	***16***	***17***	***18***
Energy *(kcal)*	1880	2010	2140	2260	2340	2390	2430	2450	2230
Protein *(g)*	36.8	40.0	44.5	49.0	52.8	53.8	54.9	56.0	55
Visible fat *(g)*	35	35	35	40	40	40	35	35	25
Calcium *(mg)*	800	800	800	800	800	800	800	800	600
Iron *(mg)*	27	27	27	27	27	27	26	26	21
Vitamin A Retinol	600	600	600	600	600	600	600	600	600
(µg) **β-carotene**	4800	4800	4800	4800	4800	4800	4800	4800	4800
Thiamine *(mg)*	1	1	1	1.2	1.2	1.2	1	1	1.1
Riboflavin *(mg)*	1.2	1.2	1.2	1.4	1.4	1.4	1.2	1.2	1.3
Niacin equivalent *(mg)*	13	13	13	14	14	14	14	14	14
Pyridoxine *(mg)*	1.6	1.6	1.6	2	2	2	2	2	2
Ascorbic Acid *(mg)*	40	40	40	40	40	40	40	40	40
Dietary folate *(µg)*	140	140	140	150	150	150	200	200	200
Vitamin B12 *(µg)*	0.2-1	0.2-1	0.2-1	0.2-1	0.2-1	0.2-1	0.2-1	0.2-1	1
Magnesium *(µg)*	160	160	160	210	210	210	235	235	310
Zinc (*mg)*	9	9	9	11	11	11	12	12	10

Note: These tables reflect the energy requirement of adolescents who have a moderate activity level. Requirements of age group 18-19 is as that of moderately active adult

2.7 Dietary intakes and behaviours of adolescents

Dietary intake refers to the daily eating patterns of an individual, including specific foods and calories consumed and relative quantities. Adolescent girls may be even more at risk of inadequate intakes for various reasons: dieting, discrimination, early pregnancy, lower energy intake than boys. And yet, girls usually have better eating habits than boys and they are more concerned about healthy eating when they can exert their choice, and provided dieting does not interfere (WHO, 2005). From the study done in school going adolescent

girls of Kathmandu by Tiwari and Seshadri (2000), it has been found that the intake of fats and oils, sugars and roots and tubers exceeded 60% of the amounts recommended by the ICMR, whereas intake of protective foods such as pulses, green leafy vegetables and fruits were less than 50% of the suggested balanced diet. Mean intake of nutrients such as fat, niacin, ascorbic acid and phosphorus exceeded the RDAs, whereas intake of energy, protein, calcium, iron, vitamin A and folic acid are found lower than RDAs.

According to the studies done in India by Deka *et al.* (2015) and Choudhary *et al.* (2010), it has been seen that the intake of both macro and micronutrients is insufficient and intake of vitamin A is a major problem. And it has been found that the problem is related to inadequate intake of body building (viz. pulses and milk) and protective (viz. fruits, green vegetables and other vegetables) foods are rarely consumed on daily basis by adolescents. From studies done in adolescent girls of South Africa & Tanzania, it have been seen that insufficient intake of calcium, folate, zinc are major problems (Chen, 2012; Silangwe, 2012). A report of the "National Diet and Nutrition Survey (NDNS) rolling programme Years 1-4"published by public health England in 2014 has shown that the intake of non-milk extrinsic sugars (NMES), sodium, total fats and saturated fats exceeded the recommendations. And they are not getting enough dietary fibre, calcium, iron vitamins and other minerals. Intake of Vitamin A, zinc, iodine is concern of some adolescents. While for girls, intake of folate is also a matter of concern (BNF, 2015).

A very low daily consumption of fruit and vegetables in has been found in Saudi Arabian adolescent girls as shown by study of AL-Jaaly (2012). Also the study showed skipping meals particularly breakfast was the problem. Also an Indian study by Kotecha *et al.* (2013) showed skipping of breakfast is also not unusual among adolescent boys and girls. Same study found chocolate, soft drinks and fast food consumption is common.

From an Australian study, high fat and sugar pattern is found to be positively associated with being male, the vegetables pattern is positively associated with rural region of residence, and the fruit, salad, cereals, and fish pattern was inversely associated with age. The fruit, salad, cereals, and fish pattern was inversely associated with diastolic blood pressure. Dietary patterns are not associated with socioeconomic indicators. (McNaughton

et al., 2008). But a study in Brazil showed that the consumption of low nutritional quality foods was positively associated with family income, (de Pinho *et al.*, 2014). While a German study has showed that healthier pattern is associated with higher socio-economy of family (Richter *et al.*, 2012). Overweight adolescents usually do not consume foods from the ‘‘healthy’’ pattern (de Pinho *et al.*, 2014).

2.8 Nutritional assessment

Nutritional Assessment can be defined as the process through which the nutritional health of an individual is evaluated, specific nutrient needs is estimated and plans for nutrition intervention are determined (FIVIMS, 2004). The assessment of nutritional status of individual member of a community is carried out by anthropometric, biochemical, biophysical and clinical examinations. To determine the nutritional status of any community or its section, techniques should be applied to all members of community, or in such a way that the sample is representative to all ages, sexes and socioeconomic group of community (WHO, 1963).

According to Jelliffe (1966) the assessment of nutritional status can be done by direct or indirect method as below:

Direct method: Deals with the individual and measures objective criteria. Direct method of nutritional survey are summarized as ABCD

a) Anthropometric method

b) Biochemical and laboratory method

c) Clinical examination

d) Dietary evaluation method

Indirect method: Use community indices that reflect the community nutritional status or need. Indirect method of nutritional survey can be summarized as:

a) Vital health statistics such as: Age specific Mortality rates; mortality and morbidity rates related to malnutrition and nutritionally relevant diseases like diarrhoea, measles parasitic infestation etc.

b) Ecological factors can be classified as: conditioning infections, food consumption, cultural influences, socio-economic factors, food production, and medical & educational services.

2.9 Anthropometric assessment

Anthropometry is concerned with the measurement of the variation in the physical dimensions and the gross composition of the human body at different age levels and degree of nutrition (Jelliffe, 1966). It is used widely to measure the nutritional status of individuals or populations. Anthropometric studies can help identify nutritional problems such as undernutrition and over-nutrition and pinpoint groups with specific nutritional and health needs to be addressed in policy development and programming. The application of anthropometric measurements in the assessment of child growth, and investigations of the relation between malnutrition and mortality are well documented. Increasingly, attention is being directed to the use of anthropometry in the assessment of overweight, obesity and body fat distribution and the risk of chronic diseases (CFNI, 2004a).

Advantages of anthropometry (Srivastava, 2008)

a) Simple, non-invasive,

b) Some equipment are inexpensive, portable,

c) Relatively unskilled personnel can perform measurements,

d) Methods are reproducible,

e) Measures long term nutritional history,

f) Quickly identifies mild to moderate malnutrition,

Limitations of anthropometry (CFNI, 2004a)

a) Relatively insensitive to short term nutritional status,

b) Cannot identifies specific nutrient deficiencies,

c) Inability to pinpoint the cause of malnutrition

2.10 Anthropometric indicators of nutritional status of adolescents

Anthropometric assessment of adolescents is more complex than children's because of the transition in body composition, and of the variable timing of the growth spurt. Anthropometric assessment allows to detect adolescents exposed to undernutrition, and to screen adolescent girls who will likely be at risk when they are pregnant because of low stature. With adolescents, in contrast to under-five children, weights and heights alone are less specific indicators of nutritional status (WHO, 2005).

Anthropometric data can help identify stunting, underweight, overweight and obesity. For the determination of stature, traditional cut-offs of height for age are used but the assessment of obesity and adiposity level is more difficult in adolescents than in adults because of rapid changes in body composition. Weight for height indicator has great advantage since it does not require chronological age but weight/height ratio changes dramatically with age during adolescence so it may be confusing and even misleading. But BMI for age incorporates age along with height and weight (WHO, 1995, 2005). The results of a validation study of BMI against other measures of body fat in children and adolescents supports the use of BMI as a measure of adiposity, provided age is taken into account (WHO, 2005). At 19 years, the BMI values at +1 standard deviation (SD) are 25.4 kg/m² for boys and 25.0 kg/m² for girls. Similarly, the +2 SD value (29.7 kg/m² for both sexes) compares closely with the cut-off for obesity (> 30.0 kg/m²). As these values closely align with the recommended adult cut-offs for overweight and obesity at 19 years (de Onis *et al.*, 2007), BMI can be a suitable measure for measurement of thinness or obesity. The following are specific WHO recommendations for adolescent anthropometry:

Table 2.3 Anthropometric indicators of nutritional status for adolescents

	Cut-offs	Indicators	
		Height for Age	**BMI for Age**
Z-score range	**Below -3 SD**	Severely stunted	Severely thin
	-3 SD to -2 SD	Moderately Stunted	Moderately thin
	-2 SD to 1 SD	Normal	Normal
	+1 SD to +2 SD	Normal	Overweight
	+2 SD to +3 SD	Normal	Obese
	Above +3 SD	Normal	Severely Obese

(Blössner *et al.*, 2009; de Onis, 2015; de Onis *et al.*, 2007)

Waist circumference and waist-hip ratios are also used as measures of body fat distribution, and provide indicators of metabolic disease risk. However, their usefulness is limited in the absence of validated cut-off points (WHO, 2005).

2.11 Dietary assessment

Attempts have been made to obtain reliable estimation of food and nutrient intakes in order to relate them to the health of individuals and groups. The methods can be divided into two types: a) quantitative method and b) the qualitative method (CFNI, 2004b).

A quantitative survey provides data on the amounts of various foods consumed by individuals and or populations; qualitative research provides information on the kind of foods consumed, food preparation procedures, food preferences, cultural influences and attitudes towards foods. No single method of dietary assessment is entirely satisfactory, and it is therefore a combination of both methods based upon the type and purpose of information required is better to use (CFNI, 2004b). Dietary assessment can be done in different levels, from national to individual level (Hartog *et al.*, 2006).

2.11.1 Methods for household dietary assessment

For the assessment at household level, household budgetary surveys are used to get information about food purchased. Food consumption data is collected at least by four methods *viz.* Food account method, Food inventory method, List-recall method, and Household record (weighing) method (Hartog *et al.*, 2006). And these are the quantitative methods. Household dietary diversity Score (HDDS) method can be used as qualitative method for the assessment (Kennedy *et al.*, 2010).

2.11.2 Methods for individual dietary assessment

At individual level, different qualitative and quantitative methods can be used. Quantitative methods are helpful assessing both present and past intakes. Some of these methods are as below:

a) 24-hour recalls

The 24-hour recall method aims to ascertain the food intake of an individual during the immediately preceding 24 hours or for the preceding day by means of detailed questions. Food intake is usually assessed in terms of household measures. If possible the quantities can also be written in standard values such as grams, millilitres otherwise graduated food models are used. This method estimates the food actually eaten, as recalled from memory. Sometimes there is a checklist at the end of the interview with foods or snacks that might be easily forgotten. The greatest value of the 24–hour recall method is its ability to estimate nutrient intakes of population groups. The major limitation of recalls is that they are seldom representative of usual intake. This method is used widely to compare nutrient intakes with specific dietary recommendations (CFNI, 2004b; Gibson, 1993c; Hartog, *et al.*, 2006).

b) Estimated food records

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. Details overlooked or omitted reduce the accuracy with which measurements

can be converted to mass. The advantage of this method is that it provides detailed dietary intake data that are more representative of usual intake than a single 24-hour recall. The disadvantages are that a high degree of respondent cooperation is necessary, and the act of recording may alter the usual diet (CFNI, 2004b; 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 are also measured. According to the cooperation and capacity of the participants, this method requires varying degrees of supervision. A compromise must be reached between close supervision with consequent interference in the home routine and very little supervision so as not to upset the home pattern. Weighed intakes may be used as the comparison method with other dietary methods. The disadvantage of this method, however, is that it is costly in both time and money, and requires highly motivated subjects with high levels of literacy (CFNI, 2004b; Hartog *et al.*, 2006).

d) Dietary history

The dietary history method estimates usual food intakes of individuals over a relatively long period lasting several weeks or months. The technique is based on the assumption that people have a constant daily pattern in their food habits. If an individual does not have a constant eating pattern, a dietary history cannot be compiled. The logic behind this method is that long-term food habits may yield clinical and laboratory signs and findings So, the obtained data on all nutrients can be correlated with biochemical measures. Current intake may not reflect usual intake and so may have less value in evaluating nutritional status. The dietary history interview technique requires highly trained interviewers with a nutritional background. The amounts are recorded in common household measures. The major limitations are the necessity for a lengthy interview process (and a corresponding respondent burden) and the difficulty and expense of coding the data gathered. The dietary history, including a checklist of foods and a cross check of all foods actually consumed in a

3-day period, may be appropriate in the assessment of nutritional status and is not a great burden for the participant (CFNI, 2004b; Hartog *et al.*, 2006).

e) Food frequency questionnaire

Food-frequency questionnaire (FFQ) assesses habitual dietary intakes. The underlying principle of the food-frequency approach is that the average long-term diet intake (over weeks, months or years) is a more important than short-term intakes. FFQs may be un-quantified, semi-quantified or completely quantified. The un-quantified questionnaire does not specify serving sizes, whereas the semi-quantified tool provides a typical serving size as a reference amount for each food item. And quantitative methods, the respondents estimate portion size with the help of different measurement aids, such as photographs, drawings or household measures. The questionnaire should consist of simple, clearly defined questions which can be used by untrained staff or can be completed by respondents (CFNI, 2004b; FAO, 2008; Hartog *et al.*, 2006).

2.11.3 Dietary diversity Score

Dietary diversity is a qualitative measure of food consumption that reflects household access to a variety of foods, and is also a proxy for nutrient adequacy of the diet of individuals. The dietary diversity questionnaire represents a rapid, user-friendly and easily administered low-cost assessment tool. Scoring and analysis of the information collected with the questionnaire is straightforward. The dietary diversity scores consist of a simple count of food groups that a household or an individual has consumed over the preceding 24 hours. The data collected can also be analysed to provide information on specific food groups of interest (Kennedy *et al.*, 2010).

The household dietary diversity score (HDDS) provides a brief look to the economic ability of a household to access a variety of foods. Studies have shown that an increase in dietary diversity is associated with socio-economic status and household food security (household energy availability). Individual dietary diversity scores (IDDS) aim to reflect nutrient adequacy. Studies in different age groups have shown that an increase in

individual dietary diversity score is related to increased nutrient adequacy of the diet (Kennedy *et al.*, 2010).

Scores are found to be positively correlated with adequate micronutrient density of complementary foods for infants and young children and macronutrient and micronutrient adequacy of the diet for non-breast-fed children, adolescents and adults. Some of these validation studies refer to only one country while others have attempted to validate dietary diversity scores for several countries. Nevertheless, research is on-going and there is currently no international consensus on which food groups to include in the scores at the individual level for different age/sex groups (Kennedy *et al.*, 2010).

The seven food groups are provided by WHO *et al*. (2010) includes

a) Grains, roots and tubers

b) Legumes and nuts

c) Dairy products (milk, yogurt, cheese)

d) Flesh foods (meat, fish, poultry and liver/organ meats)

e) Eggs

f) Vitamin-A rich fruits and vegetables

g) Other fruits and vegetables

Using these food groups, the minimum dietary diversity indicator is calculated by using formula below (WHO *et al.*, 2010):

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

2.12 Cut-offs of physical activity for adolescents

WHO (2010) has provided ‘Global Recommendations on Physical Activity for Health’ which focuses on prevention of NCDs through physical activity at population level. The

document includes physical activity recommendations for three age groups: 5–17 years old, 18–64 years old and 65 years old and above. The recommendations provided by WHO (2010) for 5 to 17 years children are as below:

1. Children and youth aged 5–17 should accumulate at least 60 minutes of moderate- to vigorous intensity physical activity daily.

2. Amounts of physical activity greater than 60 minutes provide additional health benefits.

3. Most of the daily physical activity should be aerobic. Vigorous-intensity activities should be incorporated, including those that strengthen muscle and bone, at least 3 times per week.

Part III

Materials and Methods

3.1 Research design

A cross sectional survey was conducted to assess the nutritional status and dietary intake of adolescents studying in eight selected schools of Kohalpur municipality. It included semi structured questionnaires and measurement of anthropometric variables.

3.2 Study area

Study was done in four private and four government school of Kohalpur municipality. Kohalpur lies in Banke district north western part of Banke district. It is 16 km away from district headquarter, Nepalgunj. According to the municipality data, it has thirteen wards and lies between longitude 81^0 49' 51.6" E to 81^0 38' 2.4" E and 28^0 18' 54" N to 28^0 7' 12" N latitude (KMO, 2016).

3.3 Study variables

a) Dependent variables

Anthropometric indices: Height for age, BMI for age

b) Independent variables

1. Socio-economic and demographic variables: Caste, family size, family type, Number of siblings, number of adolescents in family, parent's occupation, family income, literacy of parents, source of food
2. Adolescent's characteristics: Age, sex, physical activity, sleeping hours
3. Dietary habit: Food frequency, food habit related variables (vegetarian/non-vegetarian, skipping of meal, fast food consumption etc.), nutrient intake
4. Environmental condition: Source of water, toilet facility

3.4 Target population

Adolescent girls and boys studying in class 6 to 12 in selected schools of Kohalpur.

3.4.1 Selection criteria

Inclusion criteria: The participants with following criteria were included in study:

1. Must be adolescent (10 to 19 years).
2. The students studying in selected school.
3. Students, whose permanent residence is Kohalpur.
4. Students who willingly signed consent forms.

Exclusion criteria: The population with any one of the following characters are excluded from the study:

1. Students below 10 years and above 19 years of age.
2. Students, whose permanent residence is outside Kohalpur.
3. The student who is absent in school or who is seriously ill during the survey.
4. Students not interested in the study.

3.5 Sample size

The sample size was determined by using simple proportional formula assuming rate of prevalence of malnutrition to be 50% and margin of error 8%. Confidence interval was taken 95% with non-response rate 5%.

Mathematically,

$$n_0 = \frac{z^2 pq}{e^2}$$

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

Here, n_0 is sample size for infinite population; z is critical value at given level of confidence; p is estimated prevalence of malnutrition; q= 1 – p; e= margin of error.

So,

$$n_0 = \frac{1.96^2 \times 0.5 \times (1 - 0.5)}{0.07^2}$$

$$= 196$$

From the data taken from schools, number of adolescents studying in class 6 to 12 in Kohalpur is 11845. So, N = 11845 and using formula for finite population we have,

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$ [n is sample size for finite population; N is population size]

Source: Singh, M.L. (2005)

$$= \frac{196}{1 + \frac{(196 - 1)}{11845}}$$

$$= \frac{196}{(1 + 0.016)}$$

$$= 192.91$$

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

$192.91 + 9.64 = 202.55 \approx 203$

3.6 Sampling technique

For sampling, probability proportional to size (PPS) method was used. First four private and four government schools were selected randomly out of thirty five schools (teaching above class 5). Units of sample were selected proportionally from each school as below:

Table 3.1 Slected schools and respective sample size

S.N.	School's Name	Total Students above class 5	Students included in sample
1.	Gorkha United Public Higher Secondary School	539	30
2.	Shree Sagarmatha Gyanpunja Uchha Madhyamik Vidhyalaya	708	33
3.	Shree Laxmi Uchha Madhyamik Vidhyalaya	842	42
4.	Dynamic Higher Secondary School	915	46
5.	Shree Siddartha Nimna Madhyamik Vidhyalaya	111	6
6.	Green Peace Secondary School	262	14
7.	Shree Bal Jyoti Secondary School	197	11
8.	Shree Nepal Rastrya Madhyamik Vidhyalaya	401	22
	Total	3975	205

3.7 Research instruments

Instruments used for the research work were:

a) Stadiometer: A well calibrated stadiometer, measuring up to 200 cm with least count of 0.1 cm, to assess the height of participants.

b) Digital weighing balance: A digital weighing balance (microlife WS50), measuring up to 180 kg with least count of 0.1 kg.

c) Questionnaire: Well designed and pretested set of questionnaire to collect information on demographic variables, socio-economic condition, dietary practices and related habits, environmental conditions of the targeted participants.

d) Food frequency questionnaire and 24-hour dietary recall data sheet: A well designed food frequency table along with 24-hour dietary recall sheet to study the food consumption pattern and nutrient intake of the adolescents under study.

e) Standardized utensils (glass and bowls) and photos of different foods

3.8 Pre-testing

The prepared sets of questionnaire and anthropometric instruments were pre-tested among few adolescents. Pre-testing was conducted in order to maintain accuracy and clarity of questionnaire, to check the consistency in interpretation of questions by respondents and to identify ambiguous item. After pre – testing all the ambiguous, misleading and wrongly interpreted questions was omitted and questionnaire was revised in accordance with the findings of pre-testing and suggestions.

3.9 Validity and reliability of the research

To ascertain the degree to which the data collection instruments measure what they are purposed to measure, the instruments were validated. Validity of weighing balance was ascertained by comparing the data provided by our weighing balance with standard weights. Validity of stadiometer was ascertained by comparing the measurement from our stadiometer and UNICEF's stadiometer.

Before data collection, detailed study was done to know whether the research instruments and questionnaires are in line with the objectives of the study. The questionnaire was also pre-tested prior to data collection to ascertain validity. Questionnaire and the food frequency questionnaire were checked daily for completeness, consistency and clarity as mentioned earlier.

3.10 Data collection techniques

Primary data was collected using semi-structured questionnaire and anthropometric measurement. Interview was done with the children to fill the questionnaire. Height and weight was 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 millimetre. For reading falling between two values, lower reading was recorded (Gibson, 1993a).

Weight: Measurement was taken after bladder was emptied and minimal clothing. The balance was placed on hard, flat surface and the scale was made zero. Subject was asked to stand unassisted, in the centre of the platform and look straight ahead standing relaxed but still. Body weight was recorded to nearest 0.1 kg (Gibson, 1993b).

Food frequency and dietary recall: Dietary intake data was collected using a food frequency questionnaire and the 24- hour recall method. The food frequency questionnaire was used to obtain information on the type of foods usually consumed by the respondents and the frequency of consumption of those foods. The 24-hour recall involved asking the participants to report on all the foods and drinks consumed in the previous 24 hours (the previous day), from the first foods in the morning to the last foods before going to bed. Probing allowed us to obtain information on forgotten foods.

Amount of ingredient required to prepare a piece or plate of food such as *mo:mo:, samosas, pakoda, chowmin* etc. were estimated by asking with the local shopkeepers in Kohalpur and Dharan. The nutrient contents of packaged foods consumed were estimated by using information provided by manufacturers. A range of standardized local household utensils: glasses and bowls were used for estimating the amount of foods and beverages consumed by the respondents. The utensils were standardized by measuring the weight of cooked food that they can hold. Weight of cooked foods that a bowl or glass hold or per piece were as listed below:

Table 3.2 Weights of foods per serving

Food	Serving size	Raw weight
Cooked Rice	1 big bowl (300 ml)	100 g
Chapati medium	1 medium piece	30 g
Dal thick	1 big bowl (350 ml)	40 g
Dal thin	1 small bowl (350 ml)	20 g
Green leafy vegetables	1 small bowl (150 ml)	200 g
Vegetables	1 small bowl (150 ml)	175 g
Milk/yogurt	1 glass/bowl (300 ml)	300 g
Meat	1 small bowl	50 g
Egg	1 piece	50 g

3.11 Data analysis

First of all, the data was checked for completeness and consistency. Then, it was edited, organized, coded and entered into statistical software IBM Statistical Package for Social Science (SPSS) version 20 and into WHO Anthroplus version 1.0.4. The collected data was analysed by using both descriptive and inferential statistics using these software. The nutritional status was measured with reference to WHO Standards and anthropometric indices classified according to standard deviation units (z-scores), based on the WHO criteria.

From the data collected from dietary recall, gram equivalents of those foods consumed were first calculated which were converted into nutrient intake by using 'Food composition table for Nepal 2012'. Energy and nutrient intake of the adolescents were compared with requirements for adolescents as provided by ICMR (2010). Nutrient intake data was

analysed by using Microsoft excel 2010. The chi-square test and fisher – exact test were applied to test the association between the nutrition status and its associated factors.

3.12 Logistic and ethical considerations

Permission to take materials required and conduct survey was first taken from department of Nutrition and Dietetics, Central Campus of Technology. Ethical clearance was obtained from Nepal Health Research Council (appendix – B) and permission to conduct survey in Kohalpur municipality was obtained from the office of Kohalpur municipality. Written consent from school administration and from study subjects was obtained and the objective of the study was explained clearly to them. Privacy and confidentiality of collected information was ensured at all level.

PART IV

Results and discussion

The study explores nutritional status and dietary intake of adolescents studying in schools of Kohalpur. Further, socio-economic and demographic variables; adolescent characteristic factors, dietary behavior factors, environmental condition factors associated with nutritional status were analysed. It was conducted from 22 November, 2016 to 04 December, 2016 and the results are presented below:

4.1 Adolescent characteristics

While analysing the ages of study participants, adolescents of age between 16 to 17 and 13 to 14 years have same and highest percentage of participants (15.61%). They were followed by age group of 14 to 15 years with 11.71% of participants. Study subjects of age between 10 to 11 years had lowest proportion (2.44%) as shown in table 4.1.

Table 4.1 Percentage distribution of age and gender of study population (n=205)

Age of students in years	Gender		Total
	Female	Male	
10-11	2.44% (5)	0.00% (0)	2.44% (5)
11-12	4.88% (10)	2.44% (5)	7.32% (15)
12-13	4.39% (9)	6.34% (13)	10.73% (22)
13-14	6.34% (13)	9.27% (19)	15.61% (32)
14-15	5.36% (11)	6.34% (13)	11.71% (24)
15-16	5.36% (11)	9.76% (20)	15.12% (31)
16-17	9.76% (20)	5.85% (12)	15.61% (32)
17-18	7.32% (15)	6.34% (13)	13.66% (28)
18-19	1.95% (4)	5.85% (12)	7.80% (16)
Total	47.80% (98)	52.20% (107)	100.0% (205)

Note: Values in the parentheses represent frequency distribution of sample

Of total 205 adolescents, 47.80% (98) were females, 52.20% (107) were males in sample as shown in table 4.1 while there are 49.90% of females and 50.10% of males among adolescents in Kohalpur (CBS, 2014a). Similarly, 47.8% (98) were early adolescents while 52.2% (107) were late adolescents as shown in table 4.2. According to the census 2011, 54.20% of adolescents of Kohalpur belong to 10 to 14 years group and 45.80% of them are of age group 15 to 19 years.

Table 4.2 Percentage distribution of age group and gender of study population (n=205)

		Categorization of age (in months)		**Total**
		10 to 14 years	**15 to 19 years**	
Gender	**Female**	23.41% (48)	24.39% (50)	47.80% (98)
	Male	24.39% (50)	27.81% (57)	52.20% (107)
Total		47.80% (98)	52.20% (107)	100.00% (205)

Note: Values in the parentheses represent frequency distribution of sample

Table 4.3 shows that most of the families (42.4%) consisted 2 adolescents followed by 1 adolescent (28.8%) and 3 adolescents (24.9%). Families of 3.9% of the subjects consisted more than 3 adolescents.

Table 4.3 Frequency distribution of adolescent characteristics (n=205)

Variables	**Frequency**	**Percentage**
No. of adolescents in family		
1	59	28.8
2	87	42.4
3	51	24.9
More than 3	8	3.9
No. of siblings		
0	11	5.4
1	69	33.7
2	71	34.6

More than 2	54	26.3
Birth order of the adolescent		
1	85	41.5
2	61	29.8
3	36	17.6
Above 3rd	23	11.2

As shown in table 4.3, 34.6% of adolescents had two siblings, followed by adolescents with one sibling (33.7%) and 26.3% (54) of them had more than 2 siblings. But 5.4% of adolescents had no siblings. Most of the adolescents (41.5%) were first child of their parents, followed by second (29.8%), third (17.6%) and 4th (5.9%). Children having birth order above 4th were 5.4%.

4.2 Demographic characteristics

Out of total 205 adolescents, 49.8 % of them were from private schools and 50.2% were from government schools. Table 4.4 shows sample included 67.3% adolescents from *Brahman/kshetri/thakuri* caste group. Of total subjets, 23.9% of them were *Janajati* with most of them *Tharu* and *Magar*. *Dalits* and other caste group consisted same percentage (4.4%) of sample. However, the study of population data of Kohalpur municipality (former Kohalpur and Rajhena VDCs) provided by CBS (2014a) showed 49.3% of people belong to *Brahman/kshetri/thakuri,* 35.2% are *Janajatis,* 10.9% people are *Dalits* and remaining 4.6% belong to others group. Similarly, 95.6% of the adolescents belonged to Hindu religion, 1% represented Islam, 2.4% represented Buddhism while remaining 1% of them were Christians. Analysis of census 2011 data provided by CBS showed that 78.42% people were Hindu, 18.98% are Islam, 1.14% were Buddhists, 1.31% were Christian by religion in Banke district.

Table 4.4 Frequency distribution of demographic characters of study population (n=205)

Variables	Frequency	Percentage
Type of school		
Private	102	49.76
Government	103	50.24
Caste/ Ethnicity		
Brahman/kshetri/thakuri	138	67.3
Janajati	49	23.9
Dalit	9	4.4
Others	9	4.4
Religion		
Hindu	196	95.6
Islam	2	1.0
Buddhist	5	2.4
Christian	2	1.0
Family type		
Nuclear	151	73.7
Joint	54	26.3
Family size		
Below average family size of Nepal	61	29.8
Above average family size of Nepal	144	70.2

Of the students, 73.7% were from nuclear family, 26.3% were from joint family. The family size of 29.8% students was below national average (4.88), while that of 70.2% was above the average as shown in table 4.4. Average family size of study population was 5.58 ± 2.64 with minimum family size 2 to maximum 32. As shown in table 4.5, minimum number of adolescents in families was 1 to maximum 7 with an average 2.07 ± 0.95. Least number of siblings was 0 to highest 8 with average 2.98 ± 1.21.

Table 4.5 Average and dispersion of family members of studied population (n= 205)

Variables	Minimum	Maximum	Mean	Std. Deviation
Number of family members	2	32	5.58	2.64
Number of adolescents in family	1	7	2.07	.95
No. of siblings	1	8	2.98	1.21

4.3 Socio-economic characteristics

Table 4.6 Frequency distribution of education level of parents (n=205)

Variables	Frequency	Percentage
Education of father		
University	27	13.2
Secondary	59	28.8
Basic	77	37.6
Informal	15	7.3
Illiterate	3	1.5
Not Aware/dead	24	11.7
Education of mother		
University	14	6.8
Secondary	46	22.4
Basic	71	34.6
Informal	24	11.7
Illiterate	29	14.1
Not Aware/absent	21	10.2

From the table 4.6, it can be seen that fathers of 13.2% students had got university level education (bachelor and above). Similarly, 28.8% of them were educated up to secondary level (class 9 to 12), 37.6% had got basic level of education (up to class 8). Of total, 7.8% were informally educated, 1.5% were uneducated. 10.7% (24) adolescents were unknown about their father's education level or their fathers were dead. While taking about mother's

education level, highest number (37.6%) of mothers was educated up to basic level only, whereas only 6.8% of mothers had got university level education. Of total, 22.4% of mothers were educated up to secondary school, and 7.3% had got informal education. 14.1% of mothers were illiterate and 11.7% students were unaware about their mothers' education level or their mothers were dead or absent as shown in table 4.6. The national census data showed that 33.6% of adult males, and 53.2% of adult females are illiterate in Banke. Of total population, 2.29% of people in Banke has got informal education, 38.30% has got basic level of education, 13.88% has got secondary education, 2.24% of them has got university level of education (CBS, 2014a).

Family income was divided as below or above Rs.30000 per month since average income of Nepalese families was approximately Rs.30000 (NRB, 2016). Table 4.7 shows 73.7% (151) families had monthly income less than Rs.30000 and 26.3% family had monthly income more than Rs.30000.

Foreign employment and service were major occupations of the fathers. Similarly, 20.5% of fathers were involved in business or trade, 20% of fathers were farmer and 10.7% of them worked as labourer. Fathers of 3.4% students were dead. From the table below, it can be seen that majority of mothers were housewife, 22% of them were farmers while 15.1% of mothers had their occupation as business or trade. Only 7.8% of mothers were service workers, 4.4% were employed as labourer and 2.4% (5) were employed in foreign countries. Mothers of 1.5% of the subjects were dead or absent. National census 2011 had found that 50.3% of economically active males and 73.5% of females are involved in agriculture (CBS, 2014b).

Table 4.7 Frequency distribution of economic characteristics of studied families (n=205)

Variables	Frequency	Percentage
Monthly family income		
Below Rs.30000	151	73.7
Above Rs.30000	54	26.3
Occupation of father		
Agriculture	41	20.0
Service	46	22.4
Labour	22	10.7
Business/ Trade	42	20.5
Foreign Employment	47	22.9
Dead	7	3.4
Occupation of mother		
Housewife	96	46.8
Agriculture	45	22.0
Service	16	7.8
Labour	9	4.4
Business/Trade	31	15.1
Foreign Employment	5	2.4
Dead or Absent	3	1.5

4.4 Environmental condition

Major source of water in the houses of sampled adolescents was tube well with 79.5% of them using it. Of total, 20% of households were using drinking water tap as major source of drinking water and 0.5% were using other source (jar water) for drinking purpose as shown in table 4.8 and no families use river or well water.

From census data, it has been seen that 13.78% of families in Kohalpur use drinking water tap water and 82.49% use tube well water (CBS, 2014a). Among 205 families, 32.2% used

to purify water while 67.8% did not. All families had toilet in their home but census data shows 27.26% of households in Kohalpur do not have toilet (CBS, 2014a).

Table 4.8 Frequency distribution of environmental characters of studied families (n=205)

Variables	Frequency	Percentage
Source of drinking water		
Tube well	163	79.51
Drinking Water Tap	41	20.0
River	0	0.00
Well	0	0.00
Others	1	0.59
Purification of water		
Yes	66	32.20
No	139	67.80
Toilet facility in home		
Yes	205	100.0
No	0	0.00

4.5 Physical activity level

WHO (2010) recommendeds for at least 60 minutes of moderate- to vigorous intensity daily physical activity for adolescents but among the study subjects, more than 64% of them had not achieved the required physical activity level as shown in table 4.9. A study showed that 73% of Scottish children (0 to 15 years) were physically active (Scotland, 2015).

Table 4.9 Frequency distribution of physical activity level of studied adolescents (n=205)

Activity level	Frequency	Percentage
Below recommendation	133	64.88
Equal to or above recommendation	72	35.12

An Australian study had found that just one third (32%) of the adolescents meet the daily minimum physical activity level (CSIRO *et al.*, 2008). British study showed that only 14% of boys and 8% of girls aged 13 to15 years were found to meet physical activity recommendations (BNF, 2015). The documented health benefits include increased physical fitness, reduced body fatness, favourable cardiovascular and metabolic disease risk profiles, enhanced bone health and reduced symptoms of depression (WHO, 2010) but the result of the study are not satisfactory.

4.6 Dietary habits and behaviour

From the study, it was seen that meal of the 13.17% (27) of the adolescents is affected by presence of other people. The table 4.10 shows that 53.66% of participants skip meal. Study done in urban Baroda, India had revealed 38.8% of adolescents skip breakfast (Kotecha *et al.*, 2013). Similar result was found in the study of Balan V. (2016) in Thiruvananthapuram, Kerala. A study done by Torun and Yildiz (2013) in Turkey had shown that 37.6% of 10 to 14 years' boys do not skip meal. The table 4.10 also shows among the meal skippers, 68.18% of them used to skip meal once or twice a week, while 14.14% of them used to skip meal three to four times weekly and 26.36% of them skip meal five or more times weekly. Above mentioned study of Kotecha *et al.* had shown that 87.9% of meal skippers skip the meals once or twice weekly and remaining skip three to four times weekly. As dietary requirements of adolescents are high, skipping of meals can cause the unfulfilled RDAs. Frequent skipping of meals reduces the regularity of consumption of vegetables and pulses which obviously have negative impact on nutritional status.

Of the 110 participants skipping meal, morning meal was usually skipped by 48.18%, mid-day meal was usually skipped by 36.36% and dinner was usually skipped by 15.46% of the adolescents. Same study by Balan V. (2016) found that among meal skippers, 54.7% of them skip breakfast, 8.3% of them skip lunch, and 33.1% of them skip dinner. Above mentioned study by Torun and Yildiz (2013) also showed that of total, 16.6% (44.1% among meal skippers) of study subjects skipped breakfast. Irregular morning meal

consumption probably increases the snacking which can lead to energy dense food consumption having very little amount of micronutrients (WHO, 2016a). Odds of dietary inadequacy are higher in the adolescents who skip meals than who eat breakfast (Story and Stang, 2005b).

Table 4.10 showed that 80.97% of the subjects eat meal in kitchen or dining room, while 2.93 % of them eat in bed room, and 16.10% of them watch TV. Study by Coon *et al.* (2001) has revealed that watching TV during food consumption reduces the consumption of fruits and vegetables while it may increase the consumption of salty and processed foods resulting higher intake of saturated fats. Study by Temple *et al.* (2007) TV viewing during eating may increase energy intake which can lead to obesity.

None were vegan, lacto-ovo vegetarian, or ovo-vegetarians but 5.39% of the subjects were lacto-vegetarian and 95.61% of them were non-vegetarian. In the study of Balan V. (2016), 96.3% of subjects were non-vegetarian and 3.7% of them were pure vegetarian. Since the subjects are either non-vegetarian of lacto-vegetarians they might not have much difference in calcium intake but iron intake might have been affected because plant sources have less bioavailable iron.

Table 4.10 Frequency distribution of diet related behaviours of study population

Behavioural factors		**Frequency**	**Percentage**
Effect on size of meal in presence of	Yes	27	13.17
others	No	178	86.83
Skipping of meal	Yes	110	53.66
	No	95	46.34
Type of meal usually skipped (n=110)	Morning meal	53	48.18
	Mid-day meal	40	36.36
	Dinner	17	15.46
Frequency of meal skipped weekly	1-2 times	75	68.18
(n=110)	3-4 times	29	14.14
	5 or more	6	26.36

Place to eat in home	Kitchen	166	80.97\
	Bed room	6	2.93
	Watching TV	33	16.10
Veg/Non-veg Eating Behaviour	Vegetarian	0	0.00
	Lacto-Vegetarian	9	4.39
	Lacto-ovo-vegetarian	0	0.00
	Non-Vegetarian	196	95.61
Consumption of water per day	Inadequate	172	83.90
	Adequate	33	16.10
Have daily pocket money	Yes	65	31.71
	Sometimes	110	53.66
	No	30	14.63
Buy foods from canteen/vendor/shops	Yes	167	81.46
	No	38	18.54
Feeling about figure	Overweight	45	21.95
	Right Weight	132	64.39
	Thin	28	13.66
Ever tried losing weight	Yes	36	17.56
	No	169	82.44
Ever tried gaining weight	Yes	23	11.22
	No	182	88.78
Watch weight regularly	Yes	169	82.44
	No	36	17.56

For boys of 9 to 13 years and 14 to 18 years, 1.8 litres and 2.6 litres of total fluid intake is recommended respectively. Similarly for girls, 1.6 and 2.3 litres are recommended for 9 to 13 years and 14 to 18 years (IOM, 2005). While determining adequacy of water intake according to this criteria, it was found that majority (82.44%) of the adolescents had inadequate water intake. An analysis done by Guelinckx *et al.* (2015) using the data from

thirteen countries has shown that mean intake of plain water by adolescents was 813 ± 600 ml and 740 ± 560 ml for boys and girls respectively and daily water intake ranged from 296 mL/day (17% of total fluid intake) in Poland to 1516 mL/day (76% of total fluid intake) in Indonesia. As, total fluid intake is associated with some chronic diseases like gall stone and kidney stone, cancers of bladder colon and other organs, urinary tract infections and it also plays role on maintaining the weight (IOM, 2005), it is one of the factors for determination of healthy life . Since, beverage consumption is not frequent in the studied subjects; the intake of plain water becomes important. It has been found that that most (81.46%) of the adolescent students rely on school canteen/ nearby shops / vendors for school tiffin. As shown in table 4.10, 64.39% of the adolescents feel that they were of right weight but 21.95 % of them feel they are overweight and 13.44% of them feel they were thin. Most of the study subjects (82.44%) have never tried losing weight, and 11.22% of them have ever tried gaining weight. Out of 205 students, 82.44% of them watch their weight regularly. None of the participants had said they smoke but 0.98% of them drink alcoholic beverage. Different studies showed more than fifty percentages of adolescents were alcohol consumers (Granville-Garcia *et al.*, 2014; Naude, 2012). The study by Naude (2012) also showed that adolescents with alcohol use disorder had risk of higher intake of energy dense nutrient poor foods, unhealthy fats, cholesterol, and sodium.

4.7 Dietary diversity score

The mean dietary diversity score of the participants was 4.15 ± 0.959 with minimum of 2 and maximum 6 out of 7. Thus, in an average participants were getting more than minimum 4 types of foods daily. From table 4.11, it can be concluded that 20.9% of the adolescents were consuming less than four food groups. This means remaining are consuming varieties of foods thus the result can be concluded satisfactory. Also the analysis had shown that still 6.8% (14) of the adolescents had eaten the foods from only 2 food groups. This means they are mainly eating the foods rich in macronutrients and micronutrients are lacking in their diet. About 41% of them were eating foods from just 4 food groups and just about 5% of subjects were found to be consuming 6 food groups. This result cannot be considered as good because it signifies that there is not sufficient variation

in diet and it can be thought that this result is due to improper economic access of the families to the foods.

Table 4.11 Frequency distribution of IDDS categories of studied population (n=205)

IDDS categories	Frequency	Percentage
Below 4	43	20.97
Equal to or more than 4	162	79.02

4.8 Consumption of food groups

From the table 4.12, it can be seen that all adolescents used to consume cereals and their products daily. Seventy percentages of them told they consume pulses or legumes daily but others do not. Since plant sources are major source of protein in Nepal, irregular consumption of pulses and legumes might cause insufficient supply of protein. Only 47.80% 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.

Table 4.12 Frequency of weekly consumption of different food groups (n=205)

Variables	Frequency	Percentage
Consumption of cereals and its products		
Daily	205	100.00
Consumption of pulses and legumes		
Daily	144	70.24
Two to five times a week	58	28.29
Once a week or less	3	1.47
Consumption of milk and milk products		
Daily	98	47.80
Two to five times a week	68	33.17
Once a week or less	37	18.05
Don't eat	2	0.98

Consumption of meat, eggs & fish		
Daily	18	8.78
Two to five times a week	138	67.31
Once a week or less	40	19.52
Don't eat	9	4.39
Consumption of green leafy vegetables		
Daily	0	0.00
Two to five times a week	172	83.90
Once a week or less	32	15.61
Don't eat	1	0.49
Consumption of other vegetables		
Daily	78	38.05
Two to five times a week	119	58.05
Once a week or less	8	3.90
Consumption of fruits		
Daily	6	2.93
Two to five times a week	156	76.10
Once a week or less	43	20.97
Consumption of tea/coffee		
Daily	125	60.98
Two to five times a week	34	16.58
Once a week or less	33	16.10
Don't drink	13	6.34
Consumption of fast foods		
Daily	192	93.65
Two to five times a week	13	6.35

Among them, 8.78% told that they consume meat, fish or poultry products daily but 67.31% of them consume these products frequently. This result can be considered satisfactory in context of Nepal since economy of Nepali people is not still well. A review by Ochola and Masibo (2014) on dietary intake of school children and adolescents in

developing countries reported that school-age children were consuming mainly plant-based diets which are predominantly from cereals, roots and tubers with limited animal source foods. It also reported that the intake of milk and dairy products by only 50% of schoolchildren. Cereals and snacks were the most important sources of energy among schoolchildren of 6–12 years in Taiwan. In Bangladesh it was found that 33% did not consume milk, 38% did not consume small fish, 21% did not consume large fish and 23% did not consume dark green leafy vegetables during the study (Ochola and Masibo, 2014). Table 4.12 shows none of study subjects were found to consume green leafy vegetables on daily basis but 83.90% of them said that they consume it two to five times a week. Also, 0.49% of them were not found to eat green leafy vegetables. Other vegetables were consumed by 38.05% of adolescents in daily basis and 58.05% of them consume it frequently. Just 2.93% of the adolescents reported that they consume fruits on daily basis but more than 76% of them eat fruits two to five times a week. Consumption of fruits and vegetables mainly relies on the home production of them. So, seasonal variation may affect the consumption. Ochola and Masibo (2014) also reported fruit and vegetables were eaten rarely by 56% and 48% of adolescents in Ghana, respectively. It also reported a high intake of fruits rich in vitamin C, which might be related with seasonal variability of vitamin C-rich food sources. Only one fourth of schoolchildren had a daily consumption of vegetables and fruits in Bahrain.

More than 60% of the adolescents reported that they drink tea or coffee on daily basis but 6.34% of them do not. More than 93% of the study subjects were daily consumers of fast foods while 6.35% of them frequently consumed fast foods. A study in Nepalese school children showed that fast foods (ready to eat snacks, chips etc.) were preferred by more than two-third of adolescents; advertising influenced preferences of fast foods among Nepalese adolescents (Haider and Bhatia, 2006). Study by Ochola and Masibo (2014) also showed increasing trend towards the consumption of processed foods, especially in urban settings. In Malaysia, around 60% to 70% of school children and adolescents were found consuming fast foods and high-energy foods weekly. Study of Rouhani *et al.* (2012) found that fast food consumption was associated with poor diet quality and lower consumption of different vitamins so, fast food consumption should be taken in concern.

4.9 Dietary intakes

Dietary intakes of the participants were compared with RDAs provided by ICMR (2010) and divided as adequate and inadequate as in table 4.13. This study revealed that the nutrient intake of majority of adolescents was insufficient. Only 14.63% of the adolescents had sufficient intake of energy according to their age and sex. The review by Ochola and Masibo (2014) on dietary intake of school children and adolescents in developing countries indicated that there was inadequate of energy among majority of school children and adolescents.

Table 4.13 Adequacy of nutrient intake

Variables	Frequency	Percentage
Adequacy of Energy intake		
Below RDA	175	85.37
Above RDA	30	14.63
Adequacy of protein intake		
Below RDA	86	41.95
Above RDA	119	58.05
Adequacy of added fat intake		
Below RDA	189	92.20
Above RDA	16	7.80
Adequacy of calcium intake		
Below RDA	159	77.56
Above RDA	46	22.34
Adequacy of iron intake		
Below RDA	157	76.58
Above RDA	48	23.42

Table 4.13 showed intake of protein was inadequate for about 42% of study subjects. Same study by Ochola and Masibo (2014) also found protein was sufficient for majority of study subjects and also protein intake was found to be up to 2.5 folds higher than

requirements. Our study found more than 92 percentages of adolescents were not getting sufficient amount of added fat from their food. Ochola and Masibo found that adolescents of the urban settings had higher fat intake than requirement but those from rural settings had insufficient intake. Table 4.13 also showed only 22.34% of the adolescents had sufficient intake of calcium and it may be related with the irregular and insufficient consumption of milk and its products. A study done by Leal *et al.* (2010) in São Paulo, Brazil has shown that 93% of the adolescents have insufficient calcium intake. Insufficient intake of calcium intake was found in more than 98% of 11 to 13 years age and 96% of 14 to 17 years adolescents of China (Wang *et al.*, 2017). This study showed iron intake of 23.42% of adolescents was insufficient. Same study by Leal *et al.* had also shown that 26% of the respondents had an insufficient iron intake. The study by Wang *et al.* also found that ion intake was insufficient for more than 23% of 11-13 years age and more than 18% of 14 to 17 years adolescets in China.

Average daily energy and nutrient intakes of the respondents were calculated according to age and sex and compared to ICMR (2010) as below:

4.9.1 Mean energy intake

Figure 4.1 shows average energy intake of girls according to age group. Average energy intake of 10 year girls was 1784.5 ± 600.83 Kcal which is insufficient by about 100 Kcals. While intake of 11 year girls was 1717.5 ± 320.30 Kcal. It should be increased up to about 300 Kcals to meet their requirement. Intake had been slightly increased up to 1948.4 ± 447.31 Kcals along with requirement of 2140 Kcals while reaching the age 12 years. An Indian study found the intake of mean energy intake among 10 to 12 years girls was 1401 ± 529Kcal (NNMB, 2012). The intake had been drastically decreased to 1531.9 ± 412.31 Kcals for 13 years age girls and it is lagging behind the requirement by about 730 kcals. Again intake of 14 years girls had been decreased slightly and reached 1513.1 ± 280.97 Kcals. For 15 years age girls, intake was 1611.6 ± 386.81 Kcals while requirement was 2390 Kcals. The NNMB's study also found that intake of energy among 13 to 15 years girls was low with mean being 1554 ± 541 Kcal. Intake of 16 years age girls was 1870.0 ± 435.27 Kcals which is 560 Kcals lower than their requirement. The daily energy

consumption of 17 years girls was 1908.1 ± 286.54 Kcals but requirement was 2450 Kcals. In India, the mean intake of energy by 16 to 17 years girls was 1656 ± 584 Kcal. The energy requirement of 18 years age girls was reduced than 17 years girls, along with that intake was also reduced to 1746.6 ± 488.29 Kcals. The overall energy intakes of the girls always lower than their requirement but that of 10 to 12 years girls was nearer to requirement. It may be because of unnecessary dieting or with increase in age, the physical activities of girls might have been decreased which could have reduced energy intake.

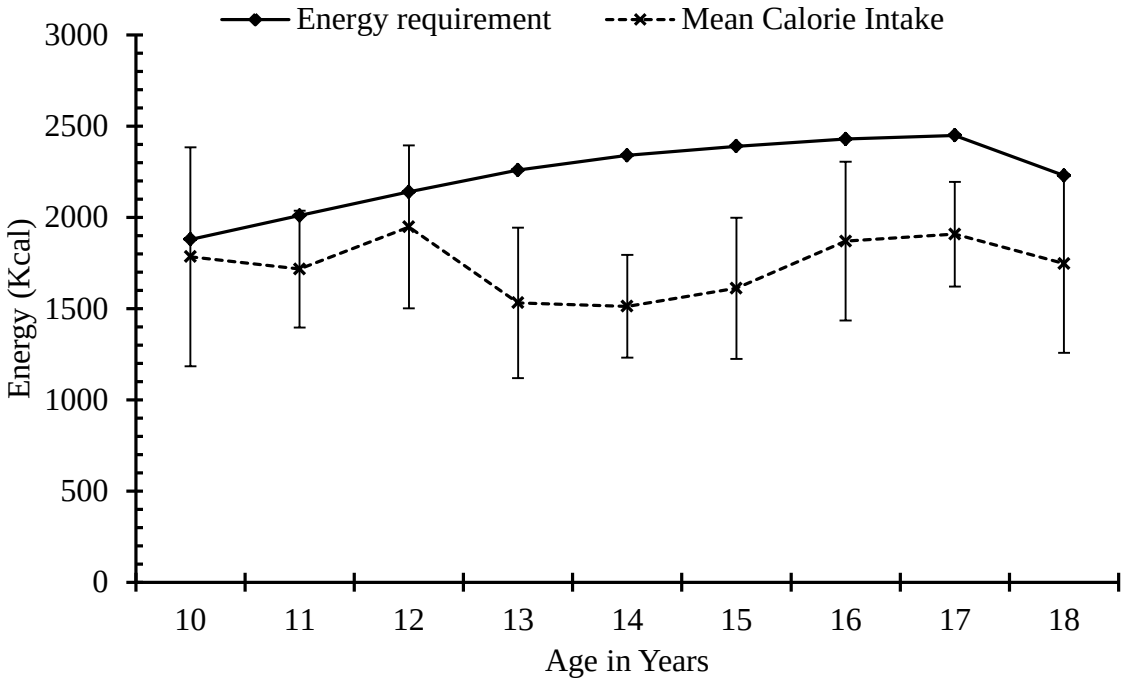

Figure 4.1 Mean energy intake of surveyed girls

Note: Vertical error bars represent standard deviation of values from mean.

A British study had revealed that median energy intake of adolescent girls was 1662 Kcal with first and third quartiles being 1379 and 1915 Kcal respectively (Whitton *et al.*, 2011). But the energy intake of Australian girls was found to be 1953 Kcal for 19 to 13 years group and 2018 Kcal for 14 to 16 years age group (CSIRO *et al.*, 2008). The adolescent growth spurt is sensitive to energy and nutrient deprivation. Chronically low energy intakes can lead to delayed puberty or growth retardation (Story and Stang, 2005a) so intake of energy must be considered. The energy intake of adolescents should be

increased, together with an increase in energy expenditure through physical exercise which helps to increase the utilization of dietary protein and improve skeletal development. A larger total intake of food can better provide necessary substrates, vitamins, and minerals. For an adolescent who eats less than about 1800 kcal per day, it is difficult to consume enough vitamin B_6, copper, magnesium, and iron, which are present in low concentrations in most foods (Meredith and Dwyer, 1991).

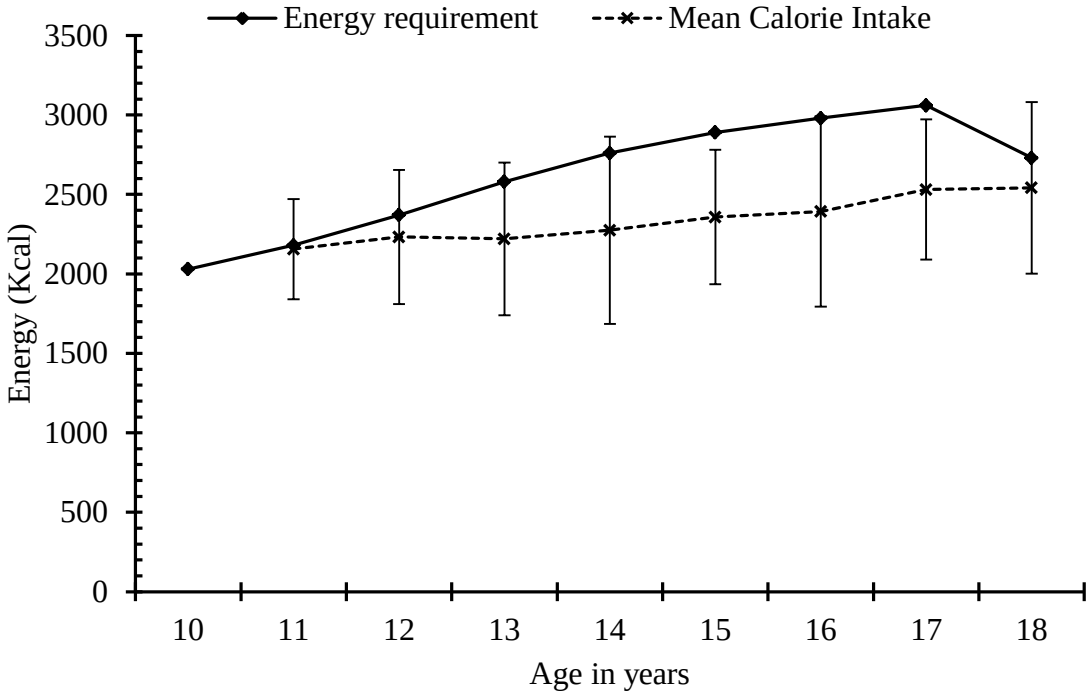

Figure 4.2 Mean energy intake of surveyed boys

Note: Vertical error bars represent standard deviation of values from mean.

Intake of 11 year boys was 2155.8 ± 314.57 Kcals as shown in figure 4.2. It was closer to the requirement of 2180 Kcals. Intake had been slightly increased up to 2232.6 ± 422.42 Kcals along with requirement of 2370 Kcals while reaching the age 12 years. In NNMB survey, it was found that the mean intake of energy was 1462 ± 527 Kcal 2190Kcal, among 10 to 12 years boys. The intake had been slightly decreased to 2220.1 ± 479.72 Kcals for 13 years age boys and it is lagging behind the requirement by about 360 kcals. Intake of 14 years boys had been increased slightly and reached 2274.6 ± 588.85 Kcals. For 15 years age boys, intake was 2357.1 ± 422.79 Kcals while requirement was 2890 Kcals. The mean

intake of energy among rural Indian boys of age 13 to 15 years was 1659 ± 571 (NNMB, 2012). Intake of 16 years age boys was 2392.7 ± 599.40 Kcals which is about 590 Kcals lower than their requirement.The daily energy consumption of 17 years boys was 2530.6 ± 440.68 Kcals but requirement was 3060 Kcals. The NNMB survey showed mean intake of energy among 16 to 17 years boys was 1839 ± 657 Kcal. The energy requirement of 18 years age boys was lower than 17 years boys, but the intake was increased slightly to 2541.7 ± 540.06 Kcals. The overall energy intakes of the boys always lower than their requirement but that of 11 and 12 years boys was nearer to requirement. It might be because of with increase in age, the physical activities of boys might have been decreased which could have reduced energy intake. The Australian study has found that the mean energy intake of the 9 to 13 years boys was 2308 kcal and that of 14 to 16 years boys was about 2775 kcal (CSIRO *et al.*, 2008). But the British study showed energy intake among adolescent boys was 2092 Kcal along with first and third quartiles being 1782 Kcal and 2447 Kcals respectively. An analysis of Chinese national health surveys by Cui and Dibley (2012) showed energy intake of 11 to 13 years adolescents was 1821 Kcal and that of 14 to 17 years adolescents was 2028 kcal.

4.9.2 Mean protein intake

Protein intake of girls fluctuated too much. Intake of 10 year girls was 44.2 ± 18.35 g which is higher than the requirement of 36.8 g. Requirement of 11 years girls was 40 g but their intake was 47.2 ± 11.13 g. Similarly, intake of 12 years girls was higher i.e. 57.2 ± 18.8 g than requirement of 44.5 g. The NNMB survey showed mean intake of protein among 10 to 12 years girls was 38.6 ± 18.7 g and that of 13 to 16 years girls was 42.4 ± 20.1 g. But the intake of 13 years girls reduced drastically and reached 43.1 ± 13.61 g which is lesser by about 6 g than their requirement. Mean protein intake of 14 years age girls increased slightly to reach 43.6 ± 10.16 g but the requirement was 52.8 g. For 15 years age girls, intake reduced slightly to 42.1 ± 12.81 g while requirement was 53.8 g. As shown in figure 4.3, intake of 16 years age girls increased drastically to reach 53.51 ± 13.02 g which could not meet requirement 54.9 g. The daily protein consumption of 17 years girls was 55.6 ± 13.6 g which was closer to the requirement of 56 g. The mean

protein intake of rural Indian girls of age 16 to 17 years was 45.3 ± 20.3 g (NNMB, 2012). The protein requirement of 18 years age girls was slightly lesser than that of 17 years girls, but the intake reduced to reach 49.8 ± 16.87 g.

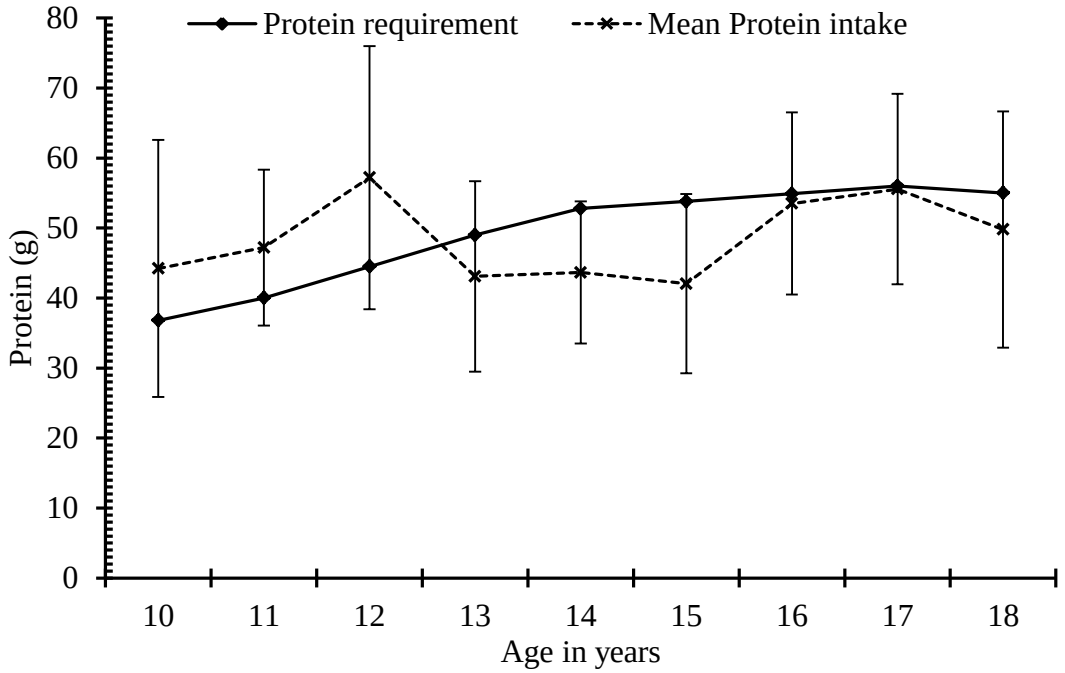

Figure 4.3 Mean protein intake of surveyed girls

Note: Vertical error bars represent standard deviation of values from mean.

The Australian data provided by CSIRO *et al.* (2008) showed the higher mean protein intake protein by adolescent girls i.e. 79.5 g by 9 to 13 years girls and 81.6 g by 14 to 17 years girls. The UK data of 2009 showed protein intake by British adolescent girls was 59.6 g with first and third quartile being 49.8 g and 66.1 g.

The protein intake was found higher for boys of all age groups which are revealed by figure 4.4. Since there were no 10 year boys in study, their protein intake was not possible to calculate. The intake of 11 year boys was 64.8 ± 9.44 g. It was about 25 g higher than the requirement. Intake decreased slightly to 62.2 ± 18.22 g while requirement reached 43.7 g. for the age groups of 12 years. Mean protein intake of 10 to 13 years Indian boys was closer to requirement and it was 40.3 ± 18.6 g (NNMB, 2012).The intake slightly increased to 63.6 ± 13.44 for 13 years age boys and it was higher than the requirement by

about 14 g. Intake of 14 years boys had been increased to reach 66.1 ± 20.18 while the requirement was 54.7 g. For 15 years age boys, intake was 70.2 ± 16.53 g while requirement was 58.2 g. The NNMB data showed mean protein intake of the 13 to 15 years boys was 46.0 ± 20.6 g. Intake of 16 years age boys was 70.3 g which was about 10 g higher than their requirement. The average daily protein consumption of 17 years boys was 73.7 ± 12.04 g but requirement was 62.2 g.

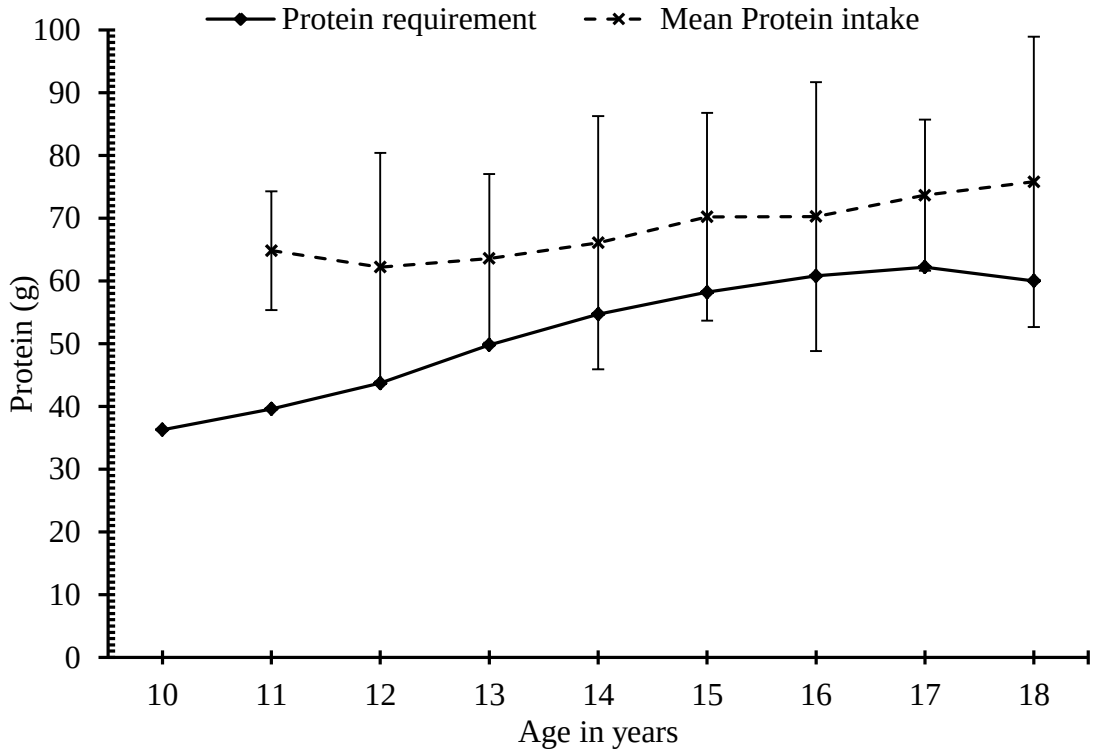

Figure 4.4 Mean protein intake of surveyed boys

Note: Vertical error bars represent standard deviation of values from mean.

The mean protein intake of 16 to 17 years' Indian adolescents was 50.0 ± 23.4g. The protein requirement of 18 years age boys was reduced than that of 17 years boys, but the intake was increased slightly to reach 75.8 ± 23.13 g. Mean intake of Australian boys was 95.2 g for 9 to 13 years age and 121.1 g for 14 to 16 years age (CSIRO *et al.*, 2008). But the median intake of British boys was 88.8 g with first and third quartiles being 72.3 g and 104.6 g respectively (Whitton *et al.*, 2011). The mean intake for Chinese adolescents was 58.0 g and 64.9 g for 11 to 13 years and 14 to 17 years age respectively in 2009 (Cui and

Dibley, 2012).Lean body mass rapidly increases during adolescent growth spurt but when protein intakes are consistently inadequate, reductions in linear growth, delays in sexual maturation, and reduced accumulation of lean body mass may be seen (Story and Stang, 2005a) so average daily intake is important.

4.9.3 Mean fat intake

Average visible intake of 10, 11 and 12 year age girls was 12.0 ± 4.77 g, 10.2 ± 4.32 g, 16.2 ± 10.87 g respectively but their requirement was 35 g as shown in figure 4.5. Visible fat requirement of 13 to 15 years girls was 40 g per day but their intake were 15.2 ± 8.87 g, 15.0 ± 10.69 g, 17.2 ± 10.43 g for 13, 14 and 15 years respectively. Average visible fat intake of 16 and 17 years girls was 19.4 g per day for both age groups but their requirement was 35 g. For 18 years girls, visible fat requirement was 25 g but their intake was 18.5 ± 11.25 g.

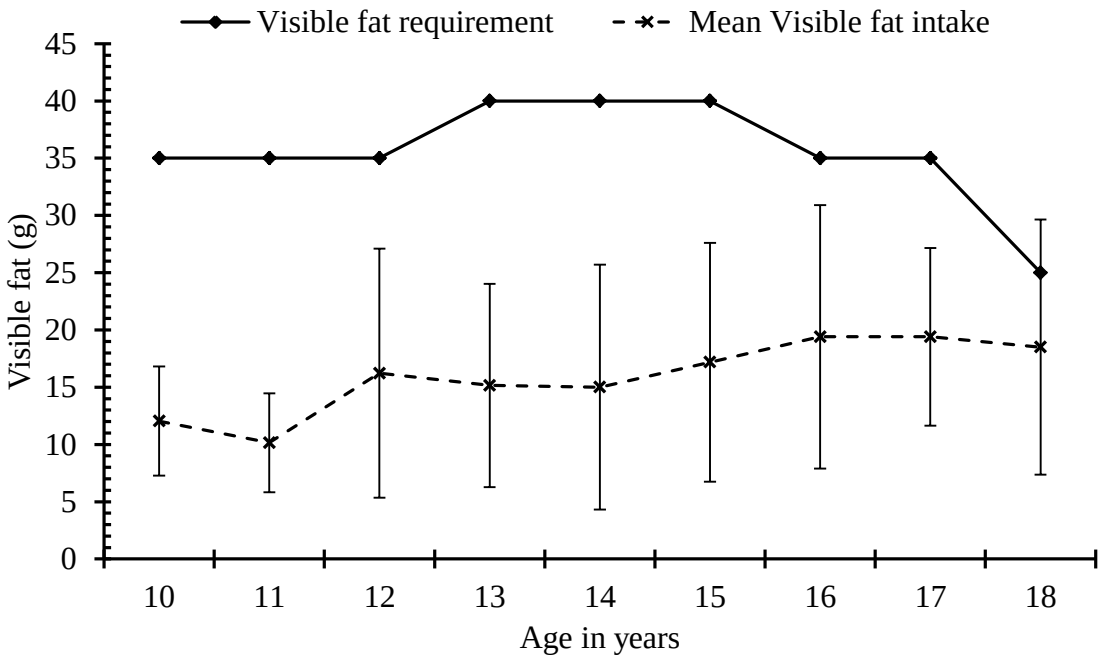

Figure 4.5 Mean visible fat intake of surveyed girls

Note: Vertical error bars represent standard deviation of values from mean.

The study showed that total fat intake of 10 years girls was 23.48 ± 13.35 g that of 11 and 12 years girls were 23.13 ± 9.60 g and 32.23 ± 13.48 g respectively. NNMB data

showed mean total fat intake of 10 to 12 years girls was 20.7 ± 14.4 g. Table 4.14 showed the intake of total fat among 13, 14 and 15 years girls were 22.85 ± 9.88 g, 28.93 ± 13.64 g and 26.37 ± 13.12 g respectively. Total fat intake of 13 to 15 years girls in India was 22.5 ± 15.2 g and that of 16 to 17 years girls was 24.4 ± 15.0 g (NNMB, 2012). The study showed the mean total fat intake of 16, 17 and 18 years girls was 31.93 ± 12.38 g, 37.05 ± 12.52 g, and 25.50 ± 16.69 g respectively.

Table 4.14 Mean total fat intake of surveyed girls

Age in Years	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Mean total fat intake (g)	23.48	23.13	32.23	22.85	28.93	26.37	31.93	37.05	25.50
Std. deviation (g)	13.35	9.60	13.48	9.88	13.64	13.12	12.38	12.52	16.69

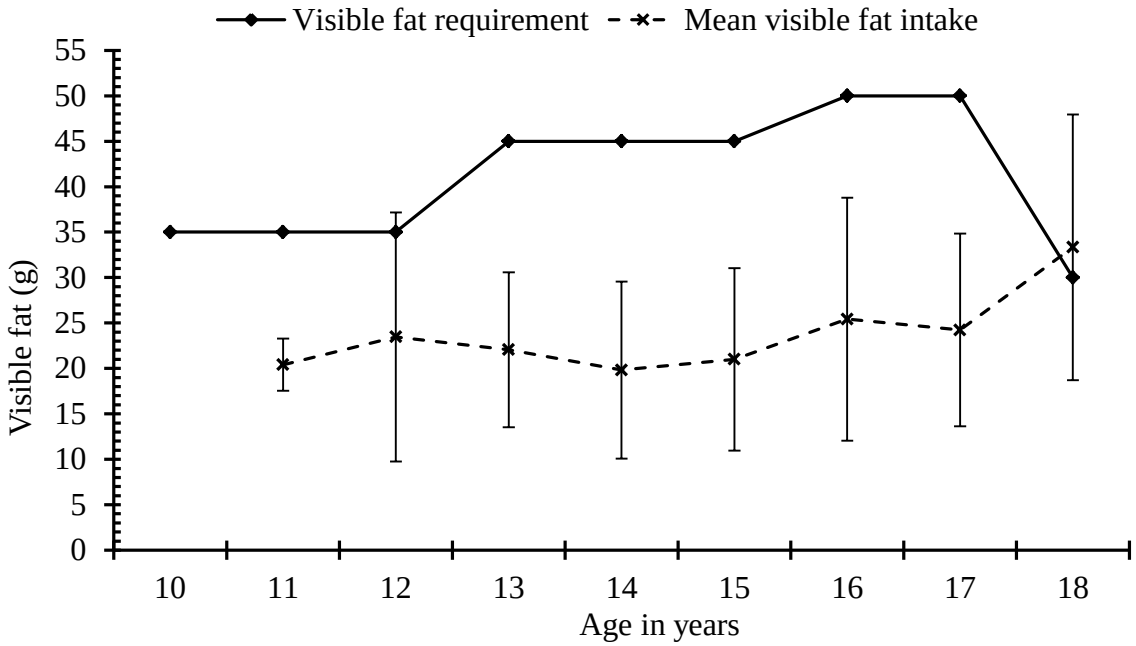

Figure 4.6 Mean visible fat intake of surveyed boys

Note: Vertical error bars represent standard deviation of values from mean.

Intakes of visible fats among were much lower than their requirement except for that of 18 year group boys as shown in figure 4.6. Average visible fat intake of 11 and 12 year age boys was 20.4 ± 2.87 g, 23.5 ± 13.69 g respectively but their requirement was 35 g.

Additional fat requirement of 13 to 15 years boys was 45 g per day but their intake were 22.1 ± 8.51 g, 19.8 ± 9.74 g and 21.0 ± 10.03 g for 13, 14 and 15 years respectively. Average visible fat intake of 16 and 17 years boys was 25.4 ± 13.36 g and 24.2 ± 10.61 g per day for both age groups but their requirement was 50 g. For 18 years boys, the requirement was 30 g but their intake was 33.3 ± 14.6 g. Mean total fat intake of the Australian girls was 70.4 g and 73.1 g for 9 to 13 years age group and 14 to 16 years age group respectively (CSIRO *et al.*, 2008) and that of British adolescent girls was 67.3 g with first and third quartiles being 52.0 g and 79.7 g respectively (Whitton *et al.*, 2011).

The study showed that total fat intake of 11 years boys was 35.7 ± 6.79 g that of 12 years girls were 40.56 ± 19.87 g. NNMB data showed mean total fat intake of 10 to 12 years boys was 21.9 ± 15.4. Table 4.15 showed the intake of total fat among 13, 14 and 15 years boys were 36.48 ± 14.53 g, 38.58 ± 16.83 g, and 37.24 ± 18.40 g respectively.

Table 4.15 Mean total fat intake of surveyed boys

Age in Years	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Mean total fat intake (g)		35.7	40.56	36.48	38.58	37.24	45.67	45.95	50.28
St. deviation (g)		6.79	19.87	14.53	16.83	18.40	24.43	17.49	24.02

Total fat intake of 13 to 15 years boys in India was 24.0 ± 15.2 g and that of 16 to 17 years boys was 27.8 ± 19.8 g (NNMB, 2012). The study showed the mean total fat intake of 16, 17 and 18 years boys was 45.67 ± 24.43 g, 45.95 ± 17.49 g, and 50.28 ± 24.02 g respectively. Mean total fat intake of the Australian boys was 81.0 g and 99.7 g for 9 to 13 years age group and 14 to 16 years age group respectively (CSIRO *et al.*, 2008) and that of British adolescent boys was 77.8 g with first and third quartiles being 62.6 g and 99.2 g respectively (Whitton *et al.*, 2011). Mean total fat intake among 10 to 13 years Chinese adolescents in 2009 was 62.9 ± 3.0 g and that of 14 to 17 years group was 68.0 ± 3.6 g (Cui and Dibley, 2012).

Additional fat sources are mainly plant based sources used for cooking vegetables and other food products in Nepali families. Since, plant sources are major sources of essential

fatty acids and inadequate intake of it may lead to growth retardation, reproductive failure, skin lesions, kidney and liver disorders, and subtle neurological and visual problems, and may also lead to depression (Rolfes *et al.*, 2009b), intake of must be taken care. Also, insufficient fat intake can cause malabsorption of fat soluble vitamins.

4.9.4 Mean calcium intake

The calcium requirement of 10 to 17 years girls was 800 mg per day and that of 18 years girls was 600 mg per day. From figure 4.7 it can be known that intake of all age groups except 18 years age were lower than the requirement and with high deviation. Intake was lowest for 15 years age group and it was 291.1 ± 409.9 mg.

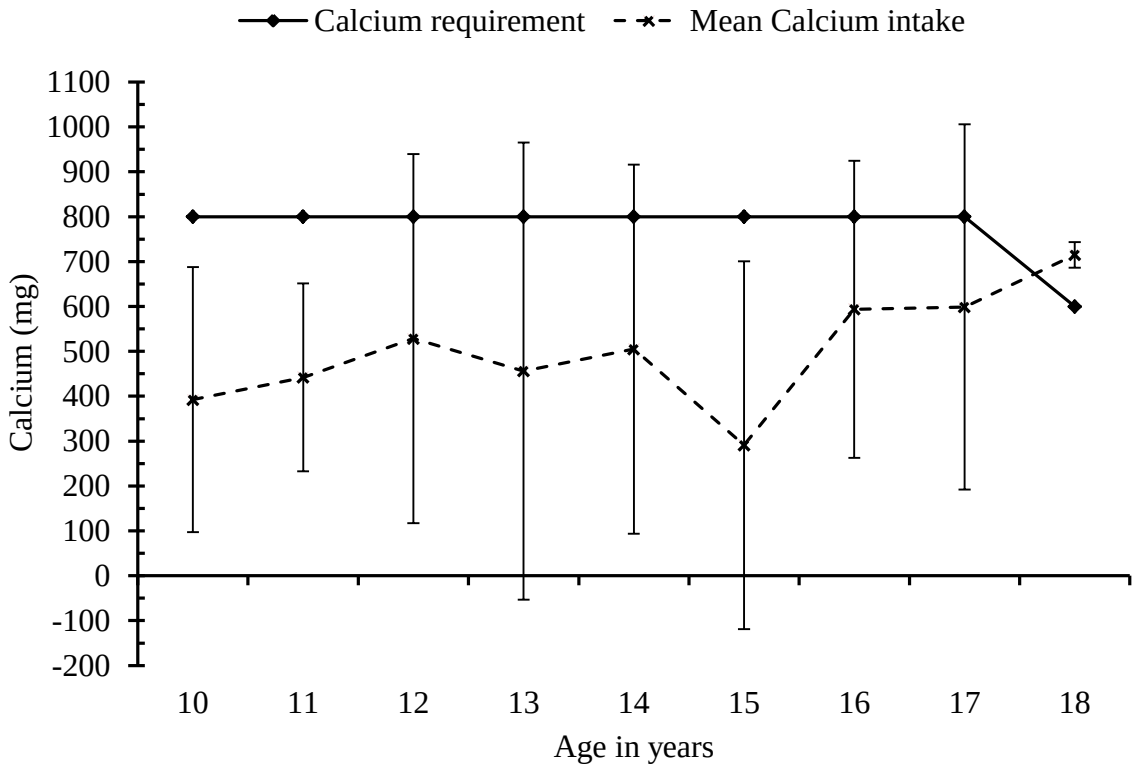

Figure 4.7 Mean calcium intakes of surveyed girls

Note: Vertical error bars represent standard deviation of values from mean.

Intake of 10, 11, 12, 13, 14 years age groups were 392.3 ± 295.27 mg, 442.0 ± 209.49 mg, 528.4 ± 441.27 mg, 456.1 ± 509.27 mg, and 505.1 ± 411.29 mg respectively. The

mean calcium intake by 10 to 12 years Indian girl was found to be 293 ± 256 mg and that for 13 to 15 years girl was 319 ± 271 mg (NNMB, 2012). The intake of 16 and 17 years age group were 593.9 ± 331.03 mg and 598.8 ± 407.05 mg respectively. The mean intake of 16 to 17 years Indian girl was 337 ± 246 mg. The intake of 18 years age group was highest and it was 715.02 ± 28.42 mg which was above the RDA. In 2009, median calcium intake by British adolescent girls was 682 mg with first and third quartiles being 520 mg and 583 mg respectively (Whitton *et al.*, 2011). But the intake of Australian girls was 791.6 mg and 821 mg for 9 to 13 years girls and 14 to 17 years girls respectively (CSIRO *et al.*, 2008). The mean intakes of Chinese girls were 345 mg and 460 mg respectively for 11 to 13 and 14 to 17 years girls respectively (Wang *et al.*, 2017).

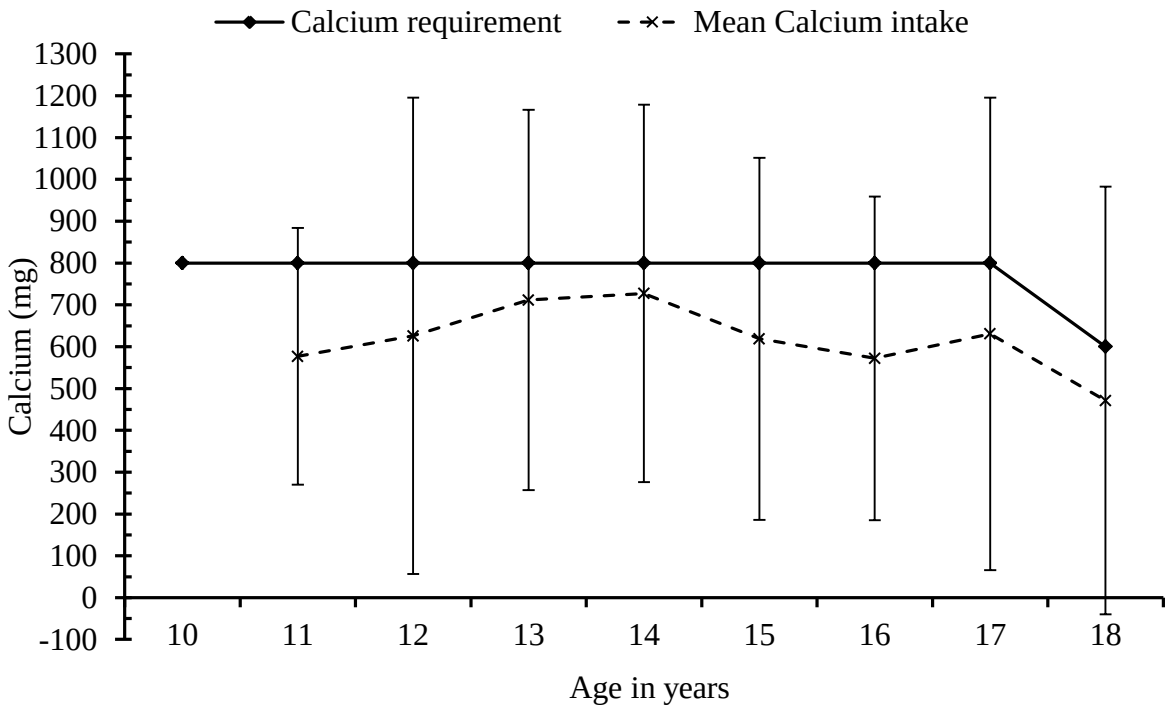

Figure 4.8 Mean calcium intake of surveyed boys

Note: Vertical error bars represent standard deviation of values from mean.

The calcium requirement of 10 to 17 years boys was 800 mg per day and that of 18 years boys was 600 mg per day. As shown in figure 4.8, intake of all age groups was lower than the requirement. Intake was lowest for 18 years age group and it was 471.2 ± 511.47 mg. Intake of 11, 12, and 13 years age groups were 576.9 ± 306.78 mg, 625.9 ± 569.48 mg,

and 711.7 ± 454.43 mg respectively. Calcium intake of 10 to 12 years Indian boys was 306 ± 220 mg and that of 13 to 15 years boys was 343 ± 259 mg (NNMB, 2012). Intake of 14 years age group was highest and it was 727.2 ± 451.37 mg. The intake of 15, 16, and 17 years age group were 618.7 ± 432.87 mg, 572.0 ± 386.80 mg, and 630.8 ± 564.82 mg respectively. Mean intake of 16 to 17 years Indian boys were 385 ± 326 mg (NNMB, 2012). Intakes of Australian boys were 988.5 mg and 1143.4 mg for 9 to 13 years and 14 to 16 years age groups respectively (CSIRO *et al.*, 2008). Median intake of British adolescent boys was 929 mg with quartiles being 651 mg and 1149 mg respectively. Above study by Wang *et al.* showed that mean intakes of Chinese boys were 378 mg and 428 mg respectively for 11 to 13 and 14 to 17 years boys respectively.

Maximum bone mass is acquired during adolescence, but the deficient intake among study subjects might apparently increase bone fracture, lead them to risk of osteoporosis during adulthood (WHO, 2005). Also it had been found that proper calcium intake helps in maintain healthy weight and prevention of hypertension (Rolfes *et al.*, 2009c) so mean intake of his nutrient among the studied subjects must be increased.

4.9.5 Mean iron intake

Figure 4.9 showed iron requirement of girls of age 10 to 15 years was 27 mg per day. The intakes were 8.4 ± 3.74 mg, 13.9 ± 9.23 mg, 26.7 ± 13.82 mg, and 14.7 ± 7.67 mg, 13.4 ± 6.03 mg, and 16.2 ± 8.63 mg for 10, 11, 12, 13, 14, and 15 years age groups. NNMB data showed the iron intake of 10 to 12 years girls was 11.4 ± 8.1 mg and that of 13 to 15 years girls was 12.8 ± 9.3mg. Requirement of 16 and 17 years group was 26 mg per day; their intakes were 18.5 ± 9.35 mg and 20.9 ± 10.06 mg respectively. Intake of 16 to 17 years Indian girls was 13.5 ± 8.5 mg. Requirement of 18 years girls was 21 mg but their intake was 28.4 ± 1.65 which was above requirement and highest among the mean intake of all age groups. Mean intake of Australian girls was 10.8 mg and 11.1 respectively for 9 to 13 years age groups and 14 to 16 years age groups respectively (CSIRO *et al.*, 2008). But intakes of Chinese girls were quite higher i.e. 16.2 mg and 17.7 mg respectively for 11 to 13 years age groups and 14 to 17 years age group (Wang *et al.*, 2017). Median intake of

British adolescent girls was 11.8 mg with first and third quartiles being 9.6 mg and 14.3 mg respectively (Whitton *et al.*, 2011).

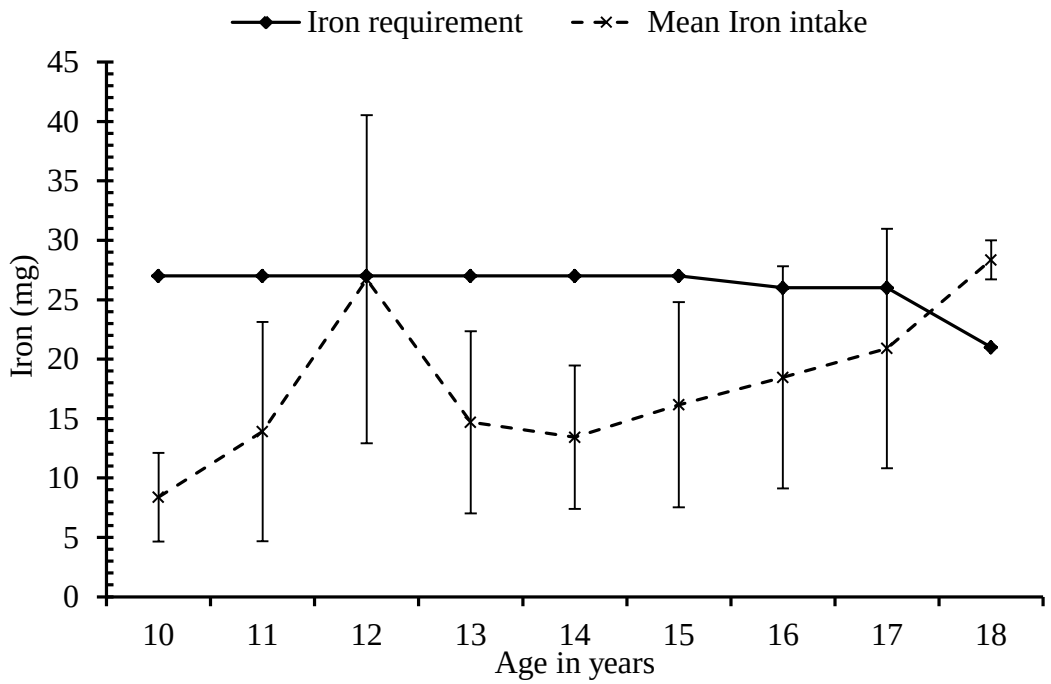

Figure 4.9 Mean iron intake of surveyed girls

Note: Vertical error bars represent standard deviation of values from mean.

The study found that the mean iron intakes of all groups of boys were below their respective requirements. Requirement of 10 to 12 years of boys was 21 mg per day but the intake was 16.1 ± 7.15 mg and 13.5 ± 7.45 mg for 11 and 12 years group respectively as shown in figure 4.10. The mean iron intake of 10 to 12 years Indian boys was 12.1 ± 8.3 mg. Requirement of 13 to 15 years group was 32 mg per day but the mean intakes were 20.8 ± 12.61 mg, 18.0 ± 11.66 mg, and 20.3 ± 11.16 mg for 13, 14 and 15 years age groups respectively. Mean iron intake of 13 to 15 years Indian boys was 13.4 ± 8.2 mg and that of 16 to 17 years boys was 14.8 ± 10.6 mg (NNMB, 2012). Respective mean intakes of 16 and 17 years age groups were 22.4 ± 18.73 mg, 19.0 ± 11.15 mg but their requirement was 28 mg per day. Requirement of 18 years group was 17 mg per day but their intake was 15.8 ± 8.09 mg. Mean iron intake of Australian boys were 13.6 mg and 16.3 mg respectively for 9 to 13 years age group and 14 to 16 years age groups (CSIRO *et al.*, 2008). But the mean

intakes of Chinese boys were 17.8 mg and 20.3 mg respectively for 11 to 13 years age group and 14 to 17 years age groups (Wang *et al.*, 2017). The median intake of British adolescent boys was 11.1 mg with first and third quartiles being 9.1 and 13.0 mg respectively (Whitton *et al.*, 2011).

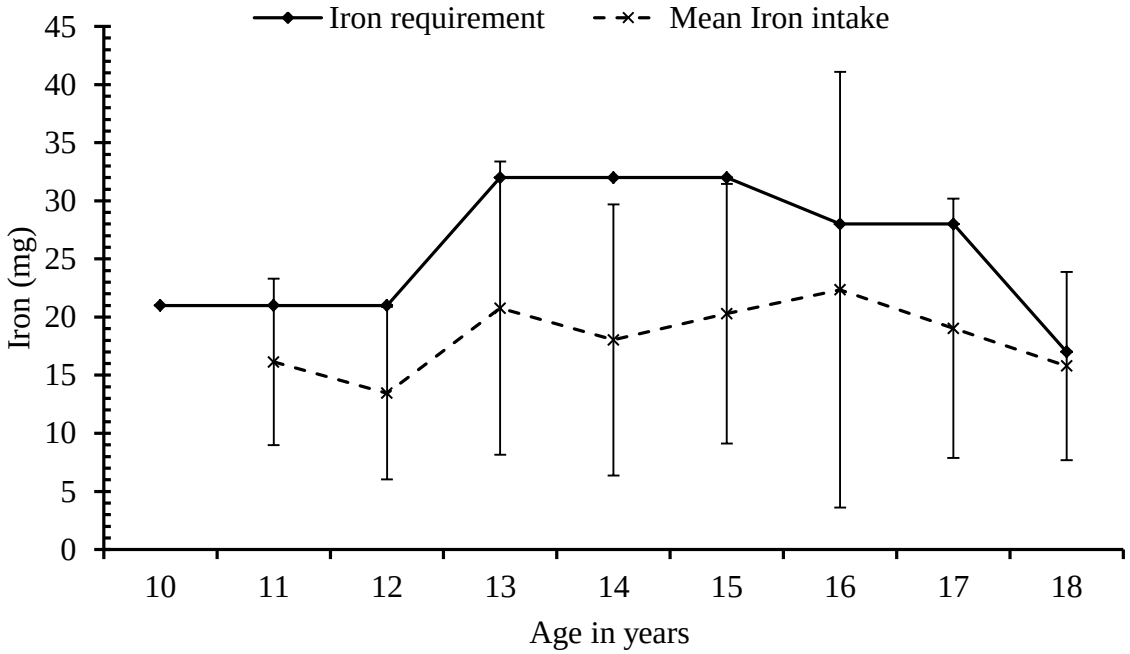

Figure 4.10 Mean iron intake of surveyed boys

Note: Vertical error bars represent standard deviation of values from mean.

The study showed there was lower mean intake of iron with high fluctuation among the subjects except for 18 years girls, it might lead them to anaemia because increased requirement of iron due to rapid growth and increment in blood volume along with menstruation among girls must be fulfilled by the intake (Story and Stang, 2005a). Thus the intake of iron rich food should be encouraged.

4.10 Prevalence and distribution of malnutrition

From the study it was seen that stunting, thinness and obesity prevalence among adolescents were 21%, 5.9% and 7.8% respectively as shown in figure 4.11. Demographic Health surveys of Nepal had shown that prevalence of stunting among under five children was 57%, 49% and 41% respectively in 2001, 2006 and 2011 (MoHP *et al.*, 2012) but

stunting was found to be 21% from this study, it can be said that the growth potential may be attained by the children in their second decade of life.

Figure 4.11 Prevalence of malnutrition according to gender

A study performed in Darjeeling district, India by Mondal and Sen (2010) showed the prevalence of stunting and thinness among adolescents to be 46.6% and 42.4% respectively. The prevalence of obesity was found to be almost negligible (0.3%). Comparing to this study, stunting and thinness prevalence is found to be lower in our study but obesity prevalence was considerably higher. Study done among school going adolescents of Mekelle City, Northern Ethiopia has shown prevalence of thinness and obesity were 37.8%, and 2.4% respectively (Gebremariam *et al.*, 2015). Another study done in Northern Ethiopia also showed that prevalence of stunting and wasting were 28.5% and 26.1% respectively (Melaku *et al.*, 2015).

While taking the gender in consideration, stunting was more prevalent among boys i.e. 22.4% of boys and 19.4% of girls were stunted. This lights a less researched question about boys suffering growth related issues and possibly nutritional deficiency as the focus of such research has been mostly on girls. In Northern Ethiopia stunting was found to be prevalent among 37.7% and 21.2% of the boys and girls respectively and that for thinness

among boys and girls was 32.4% and 21.6% respectively (Melaku *et al.*, 2015). Thinness prevalence was found to be more than four times higher in boys as compared to girls i.e. 9.3% of boys were thin but only 2.00% girls were thin. But at the same time, obesity prevalence was 9.3% in boys and that of girls was 6.1%. This makes results of BMI z – scores to be inconclusive. The study done by Mansur *et al.* (2015) has shown that prevalence of stunting and thinness were 21.08% and 14.94% respectively among the girls. The prevalence of stunting and thinness in adolescent girls of Dibrugarh town of Assam, India was found to be 31.33% and 25.70% respectively (Bhattacharyya and Barua, 2013). The difference may be due to the study was done in slums of Dibrugarh town. A study on Saudi adolescent girls by AL-Jaaly (2012) had shown that 14.4% of adolescent girls had lower BMI for age and 24.1% of them had obesity (overweight and obese).

Table 4.16 Prevalence malnutrition according to age group and gender

Gender	Age group	Stunting	Thinness	Obesity
Both sex	10 to 14 years	19.4%	6.1%	9.2%
	15 to 19 years	22.4%	5.6%	6.5%
Female	10 to 14 years	10.42%	2.08%	6.25%
	15 to 19 years	28.00%	2.00%	6.00%
Male	10 to 14 years	28.00%	10.00%	12.00%
	15 to 19 years	17.54%	8.77%	7.01%

While considering the age groups, table 4.16 shows stunting to be higher in late adolescents' i.e. 22.4% as compared to that of early adolescents' (19.4%). But if the genders are also studied along with age groups, early adolescent boys are more stunted (28.00%) than late adolescent boys (19.38%). But in case of girls, 10.42% of early girls were stunted while 28.00% of late adolescent girls were stunted. This might be related to the difference in ages of growth spurt of boys and girls i.e. boys grow faster during early adolescence but growth rate is higher in girls during late adolescence. Stunting was found to be 66.9% for 10 to 13 years girls and 54.5% for 14 to 19 years girls in Tanzania (Chen, 2012). And in Dibrugarh, Assam 34.19% of early adolescent girls and 27.90% of late adolescent girls were found to be stunted (Bhattacharyya and Barua, 2013).

Table 4.16 showed thinness was more prevalent in early adolescents (6.1%) but 5.6% of late adolescents are also affected by it. It also showed that age had not large effect on thinness of girls because 2.08% of 10 to 14 years and 2.00% of 15 to 19 years girls were thin. But the study by Chen (2012) in Tanzania revealed that thinness was more prevalent (19.4%) among 10 to 13 years girls versus 10.7% for 14 to 19 years girls. The study of Bhattacharyya and Barua (2013) also showed that 27.09% of early adolescent girls and 24.03% of late adolescent girls were thin. In case of boys, 10.00% of early teens and 8.77% of late teens are thin. Obesity was more prevalent in early teens of both sexes. In context of early teens, total obesity prevalence was 9.2% but it was 6.5% for late teens as shown in table 4.16.

4.10.1 Stunting

While categorizing stunting into moderate and severe form, 17.1 % of the adolescents were moderately stunted and 3.9% of total were severely stunted. Among males, 4.7% of them were severely stunted and 17.7% of them were moderately stunted. Prevalence of moderate and severe stunting in girls was 16.3% and 3.1% respectively as shown in figure 4.13.

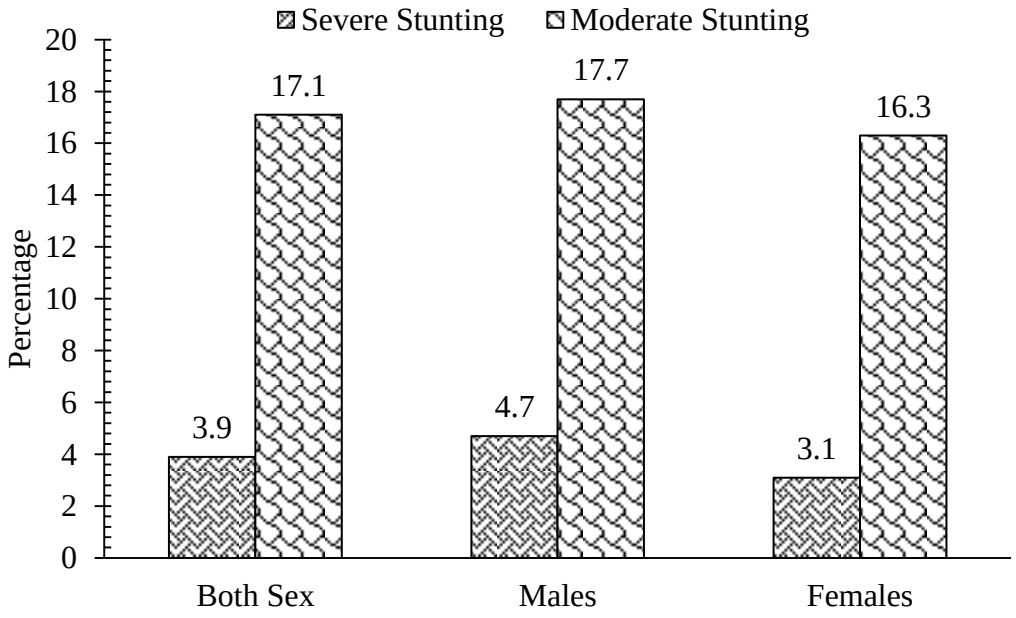

Figure 4.13 Prevalence of stunting according to it severity

The figure 4.14 shows that the curve for distribution of HAZ is sifted towards left as compared to WHO reference curve. It is because mean, median and mode Z-scores of the curve are -1.25, -1.26 and -1.25 respectively which are lesser than the average of WHO reference curve i.e. zero. And the curve is more peaked than normal curve. Thus it can be said more values are concentrated around the sample mean and most of Z-scores are lesser than the WHO mean. Thus, higher number of subjects have their height for age z – score less than zero but still very few subjects have z-score more than zero. This indicates majority of the subjects had shorter stature it might be associated with prior stunting or by infection and inadequate dietary intake. This might cause reduced lean body mass and deficiency in muscular strength and working capacity (WHO, 1995).

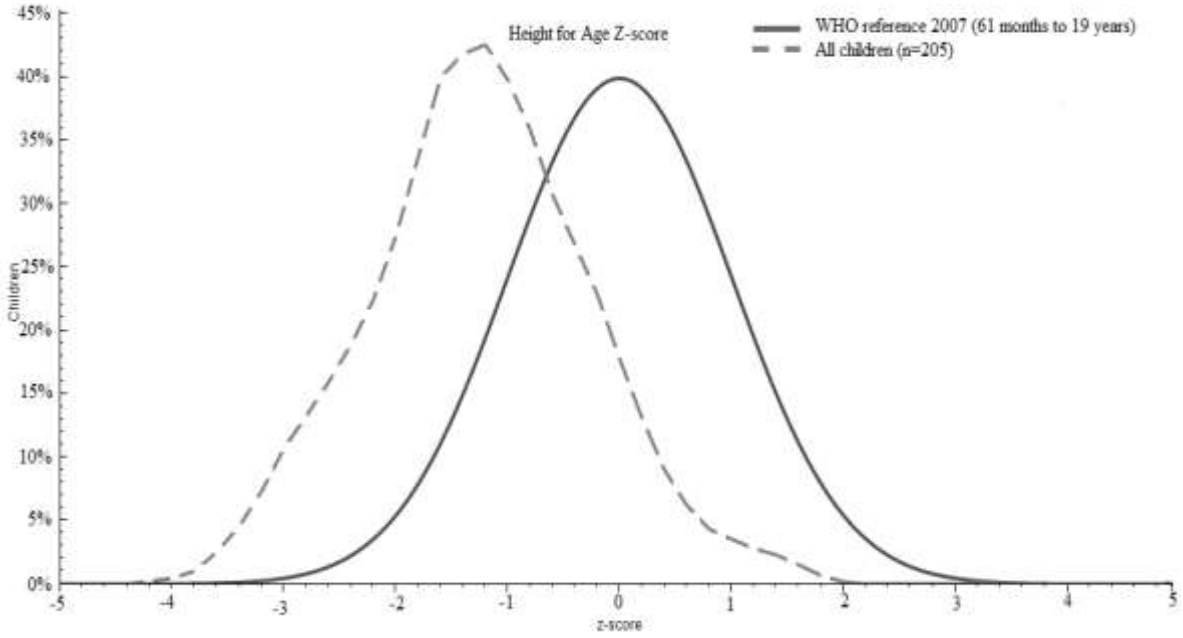

Figure 4.14 Distribution of HAZ

Figure 4.15 shows the mean height for age of male subjects as compared to the WHO reference chart. Mean heights of none of the age groups were found to be above the reference median. Average heights of 11, 12 and 13 years boys were 145.5 cm, 144.0 cm, and 146.3 cm respectively but reference median for these age groups were 147.0 cm, 151.9 cm and 165.3 cm respectively. And the figure also shows the rate of increment of height among these ages is not much satisfactory. The heights of 14 and 15 years boys increased

more rapidly to become 155.6 cm and 162.4 cm respectively. The reference median for 14 and 15 years age groups were 155.6 cm and 162.4 cm respectively. Mean height of 16 years boys was found to be 161.9 cm while reference median was 174.2 cm. mean heights of 17 and 18 years boys were 165.6 cm and 169.4 cm but their reference medians were 175.7 and 176.3 cm.

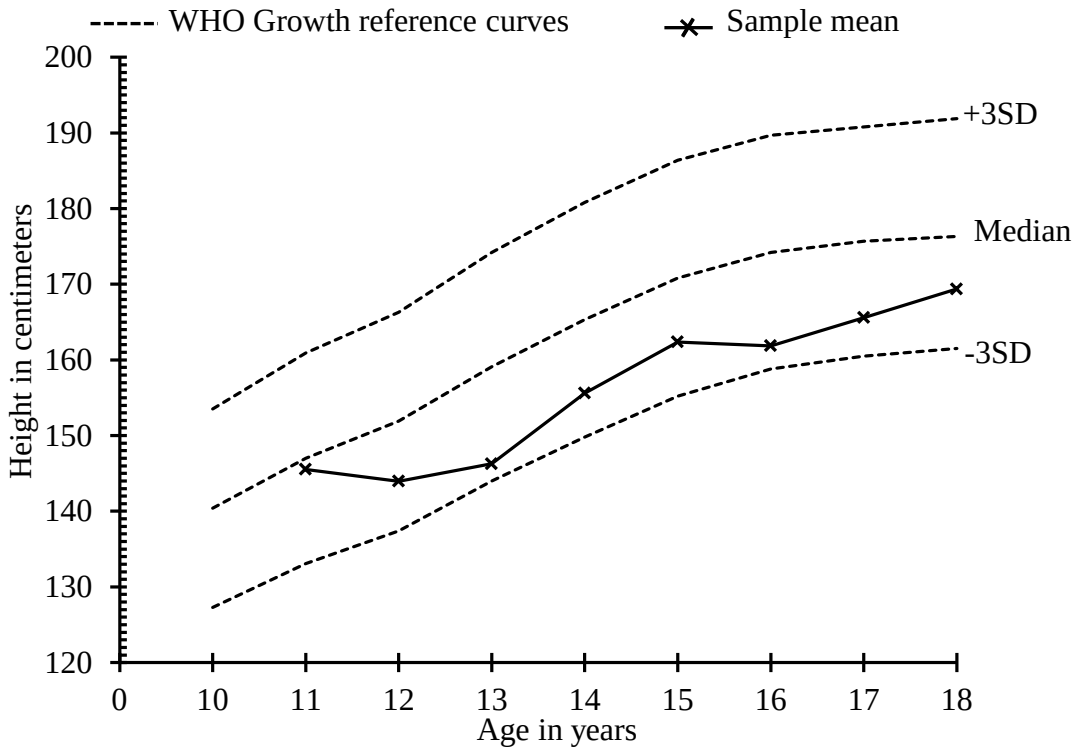

Figure 4.15 Mean height for age of boys

Figure 4.16 shows the mean height for age of female subjects as compared to the WHO reference chart. It shows that growth rate of the studied girls was slower than that of reference population and mean heights of all age groups were found to be below the reference median. It increased constantly up to 15 years. Average heights of 11, 12, 13, 14 and 15 years girls were 139.0 cm, 143.1cm, 146.5cm, 149.1cm, 152.0cm, and 153.2cm respectively but reference median for these age groups were 142.3cm, 147.7cm, 154.4cm, 157.7cm, 160.7cm and 162.0cm respectively. Mean height of 16 years girls was found to be 152.1cm while reference median was 162.7 cm. Mean heights of 17 and 18 years girls

were 154.0cm and 154.1cm but their reference medians were 162.9cm and 163.1cm respectively.

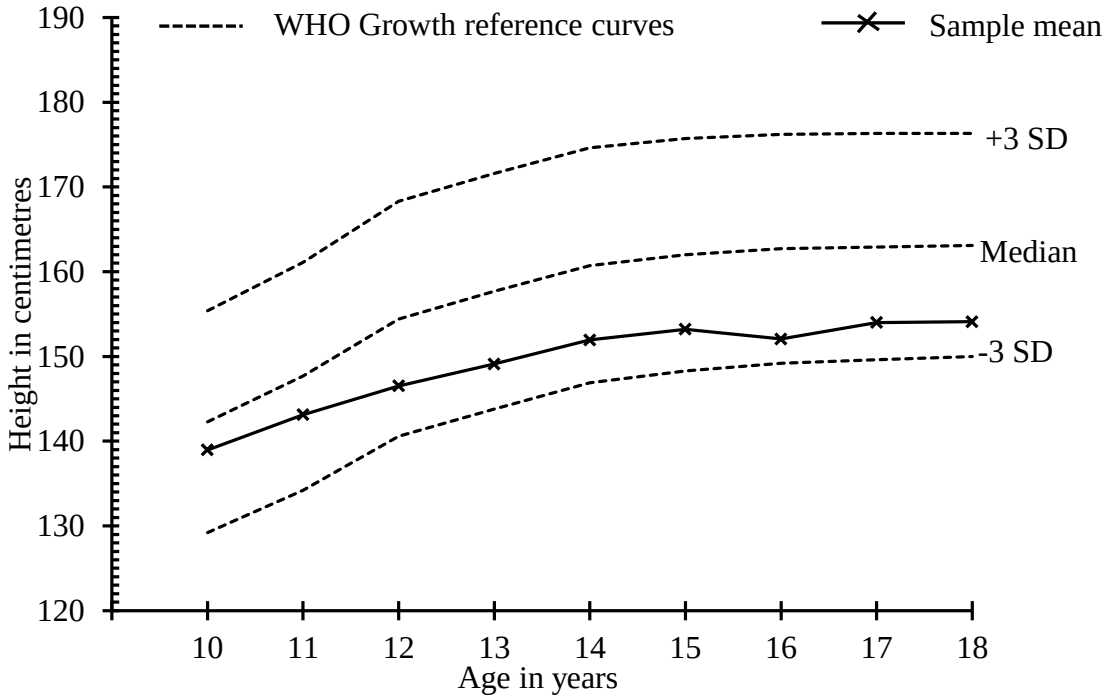

Figure 4.16 Mean height for age of girls

4.10.2 Thinness/Obesity

From table 4.17, it can be seen that none of the adolescents were severely thin or severely obese. But it shows that moderate thinness and overweight are major problems. Of total, 5.86% of adolescents were moderately thin. Prevalence of moderate thinness is higher in boys i.e. 9.34% as compared to that of girls. Prevalence of overweight was 6.34% in total, while that for boys was 7.48% and for girls was 5.10%. Out of all, 1.46% of the adolescents were obese, and that for boys and girls were 1.87% and 1.02% respectively as shown in table 4.17. From an Iranian study, 10.1% , 12.9%, and 1.4% of the girls were found to be suffered from thinness (severe and moderate), overweight and obesity (obese and severely obese) respectively (Talaie-Zanjani *et al.*, 2014).

Table 4.17 Distribution severity of thinness/obesity among study population

Gender	Severely thin	Moderately thin	Overweight	Obese	Severely obese
Female	0.00%	2.04%	5.10%	1.02%	0.00%
Male	0.00%	9.34%	7.48%	1.87%	0.00%
Both	0.00%	5.86%	6.34%	1.46%	0.00%

The figure 4.17 shows that the curve for distribution of BMIZ is sifted slightly towards left as compared to WHO reference curve. It is because mean, median and mode Z-scores are -0.44, -0.45 and -0.88 respectively which are lesser than the average of WHO reference curve i.e. zero. And the curve is less peaked than normal curve. It can be said less values are concentrated around the sample mean and most of Z-scores are the lower than zero. Thus, majority of the subjects have their BMI for age z-score less than zero.

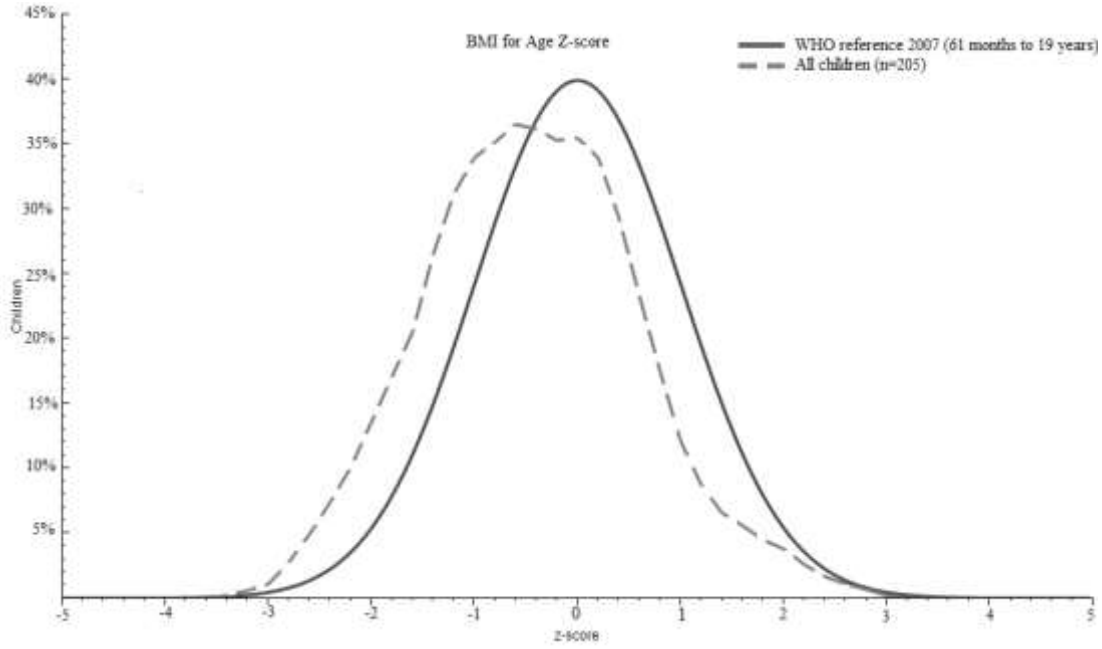

Figure 4.17 Distribution of BMIZ

Figure 4.18 shows mean BMI for age of the boys as compared to WHO reference chart. BMI was found to be increasing with age. Mean BMI of 11 years boys was 16.5 while reference median BMI was 17.3. Mean BMI of 12 years boys was same as median BMI of reference population i.e. 17.8. Mean BMI of 13 and 14 years boys were 18.06 and 18.24

respectively but respective reference values were 18.6 and 19.3. Mean BMI of 15, 16, 17 and 18 years boys were found to be 19.4, 19.8, 20.2 and 21.1 respectively. And their respective reference medians were 20.1, 20.8, 21.3 and 21.9. As shown in figure 4.18, mean BMI of the boys are closer to the reference median. It may be due to BMI for age is related to the inverse square of height of the subject but mean heights of participants lied farther from the reference median heights.

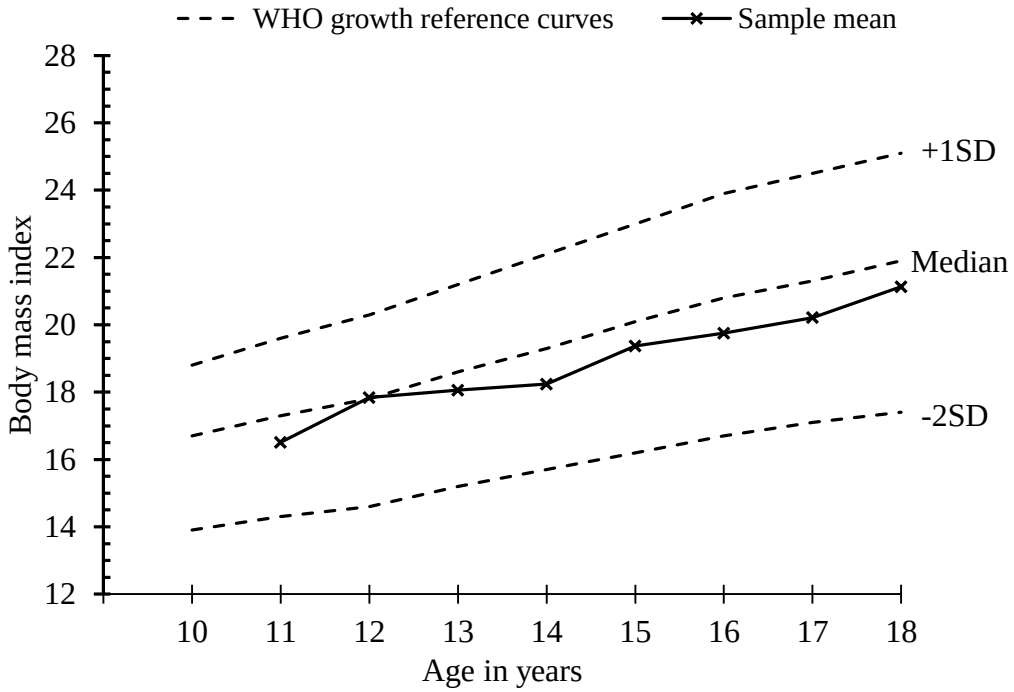

Figure 4.18 Mean BMI for age of boys

Figure 4.19 shows mean BMI for age of the girls compared to WHO reference chart. BMI was not steadily increasing with age. There was steady increase until 14 years age. This may be due to rate of increment of height of the girls reduced after 15 years of age as shown in figure 4.16. Mean BMI of 10, 11, 12, 13, 14, and 15 years girls were 16.1, 16.8, 17.4, 18.4, 19.1, and 20.8 respectively. The reference medians for these age groups were 17.0, 17.5, 18.5, 19.1, 19.9, and 20.8. Mean BMI of 16 and 17 years girls decreased continuously to become 20.7 and 19.7 respectively. And their respective reference medians were 20.8, 21.1. The WHO reference median for 18 years girls was 21.3 but mean BMI of

18 years sample girls was 20.3. The lower BMI of higher age groups of girls may be due to concerns about figure and dieting.

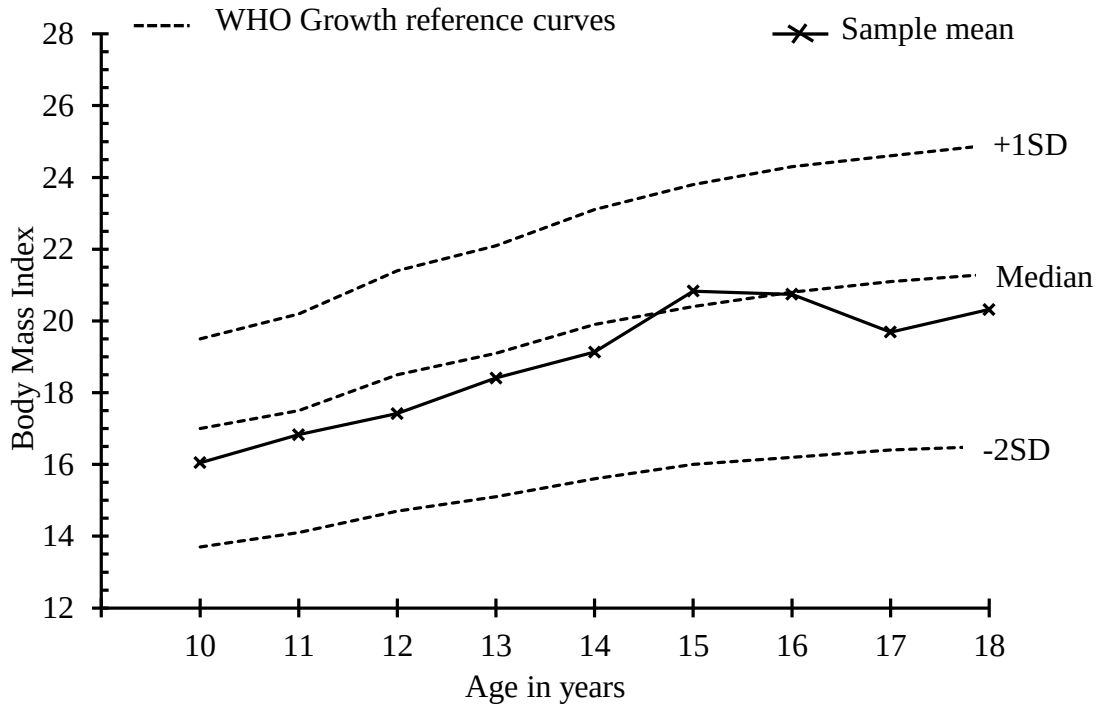

Figure 4.19 Mean BMI for age of girls

4.11 Factors associated with malnutrition

4.11.1 Factors associated with stunting

Among the demographic factors, ethnicity was found to be significantly associated (p=0.016) with stunting. It was seen that there is higher probability of stunting among the adolescents belonging to *Brahman/Kshetri/Thakuri* group than to them belonging to *janajati* or *dalit*. None of the social factors were found associated with stunting. Environmental factor found to be related with stunting was purification of drinking water (p=0.004) i.e. whether drinking water was purified or not was related with stunting. Physical activities were not found to be related with stunting. Among dietary behaviours, factor associated with stunting was trying to gain weight (p=0.031). Food frequency and nutrient intake were not found to be related with stunting. A study done by Melaku *et al.* (2015) in Northern Ethiopia showed that stunting was associated with sex, education of

father, education of mother, occupation of father and family size but source of water was found to be unrelated.

Table 4.18 Factors associated with stunting

Factors	Stunted	Normal	χ^2 – value	P – value
Ethnic group				
Brahman/Kshetri/Thakuri	36 (26.09%)	102 (73.91%)	8.276	0.016
Janajati	7 (14.28%)	42 (85.72%)		
Dalit & others	0 (0.00%)	18(100.00%)		
Purification of water				
Yes	6 (9.10%)	60 (90.90%)	8.294	0.004
No	37 (26.62%)	102 (73.38%)		
Ever tried gaining weight				
Yes	9 (39.1%)	14 (60.9%)		0.031_f
No	34 (18.7%)	148 (81.3%)		

$(p\text{-value})_f$ denotes fisher exact test was used

4.11.2 Factors associated with thinness and obesity

Within demographic factors, gender (p=0.050), family size (p=0.002) and number of adolescents in the family (0.028) were found to be related to thinness/obesity. Girls were found to be more likely to be normal. But this result contradicts with the result of the study by Rode (2015) in Mumbai, India since the study had found females are more likely to be malnourished. Adolescents having family members' more than average members in Nepali family (4.88) were found to be more probable of being normal. But the study of Gebregyorgis *et al.* (2016) shows girls whose family size was above 5 were found to be probable of being thin. Similarly, the probability of participants to be normal was higher for those whose family consisted more than one adolescent. Social and environmental factors were not found to be related with thinness/obesity. But among physical activities, hours of sleeping were found to be related (p=0.027). It was seen that probability of obesity is higher among who sleep more than 6 hours. A study by among Norwegian adolescents

found the association of sleeping hours with thinness or obesity status and it also revealed the relationship between BMI and sleep duration was curvilinear for girls, whereas it was linear for boys (Sivertsen *et al.*, 2014).

Table 4.19 Factors associated with thinness/obesity

Factors	Thinness	Normal	Obesity	Chi-square value	P-value
Gender					
Female	2 (2.00%)	90 (91.80%)	6 (6.10%)	6.001	0.050
Male	10 (9.30%)	87 (81.30%)	10 (9.30%)		
Family size					
Below average	4 (6.60%)	46 (75.40%)	11 (18.00%)	12.915	0.002
Above average	8 (5.60%)	131 (91.00%)	5 (3.50%)		
No. of adolescents					
1	6 (10.2%)	45 (76.3%)	8 (13.6%)	7.124	0.028
Above 1	6 (4.1%)	132 (90.4%)	8 (5.5%)		
Average sleeping hours					
6 hours or less	5 (10.20%)	44 (89.80%)	0 (0.00%)	7.197	0.027
More than 6 hours	7 (4.49%)	133 (85.26%)	16 (10.25%)		
Feeling about figure					
Overweight	0 (0.00%)	33 (73.33%)	12 (26.67%)	33.749	0.000
Normal	8 (6.06%)	121 (91.67%)	3 (2.27%)		
Thin	4(14.29%)	23 (82.14%)	1 (3.57%)		
Ever tried losing weight					
Yes	0 (0.00%)	28 (77.78%)	8 (22.22%)	14.557	0.001
No	12 (7.10%)	149 (88.17%)	8 (4.73%)		
Consumption of fast foods					
Daily	10 (5.20%)	169 (88.02%)	13 (6.77%)	7.291	0.026
Two to five times a week	2 (1.94%)	8(61.53%)	3 (23.07%)		

Similarly, those who have never tried losing weight have chance of being normal (p=0.001). The study by AL-Jaaly (2012) also found that trying to gain weight was associated with thinness/obesity status. A study done in West Bengal, India revealed that overweight or obesity status was associated with trying to change weight (Sarkar *et al.*, 2015). Consumption of fast food was related to thinness/obesity status (p= 0.026). Similar result was found in the study among adolescent girls Isfahan, Iran (Rouhani *et al.*, 2012). Consumption of pulses & legumes, or meat/fish/poultry was also found to be unrelated to nutritional status which is similar the study performed in Nasik, India by Khopkar *et al.* (2014).

Part V

Conclusions and recommendations

5.1 Conclusions

Through this study, nutritional status and dietary behaviours of adolescents studying in schools of Kohalpur were assessed. The conclusions that can be drawn from this study are:

a) Shorter stature is common undernutrition problem of adolescents of Kohalpur while over-nutrition is emerging problem.

b) Majority of the adolescents has insufficient intake dietary energy and nutrients. Mean intake of nutrients by girls and boys of different age groups are insufficient except protein for boys and also there were high dispersion among individual intakes of the subjects.

c) Undiversified food consumption, skipping of meal; irregular consumption of fruits, green leafy vegetables, pulses and legumes; meat, fish, poultry, milk and their products is common among adolescents of Kohalpur.

d) Ethnicity, purification of drinking water, and trying to gain weight were found to be related to stunting.

e) Gender, family size, number of adolescents in family, sleeping hours, and perception about own body size, trying to lose weight and frequency of consumption of fast foods were also associated with 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) The adolescents should be suggested not to skip meal and to increase frequency of meal in order to meet their energy and nutrient requirement for healthier weight gain.

b) They should be encouraged to consume the diversified foods, fruits, green leafy vegetables, pulses and legumes; meat, fish, poultry, milk and their products nutrient rich energy dense foods.

c) Municipality should plan and implement proper programme in coordination with schools and family in order to work out on above recommendations.

d) Federal and state governments can perform similar studies in other localities in order to determine overall national and state wise nutritional status and dietary behaviour of adolescents.

Recommendations for future researches:

a) Similar research can be conducted in other geographical area of the country.

b) Detailed study of adolescent obesity, dietary factors, physical activity level, nutrient intake and nutritional status and their association each other can be done.

c) Researches on nutritional status during adolescent pregnancy, nutritional status of married and non-school going adolescents can be performed.

d) Fibre and other micronutrient intake can also be studied.

PART VI

Summary

Adolescence is the stage of life of an individual when there is tremendous pace in growth and change that is second only to that of infancy. And it demands for higher intake of energy and nutrients. Their dietary intakes and habits are greatly influenced by various social and psychological factors while the influence of the family tends to decline. This ultimately affects the nutritional status. The foundations of health in adulthood and old age are laid during childhood and adolescence so, the health and nutritional status during adolescence becomes more important.

A cross sectional survey was conducted to assess the nutritional status and dietary intake of adolescents studying in schools of Kohalpur municipality, Banke district. From randomly selected eight schools, 205 adolescents were chose by random selection according to proportion. A well designed and pretested set of questionnaire to collect information regarding socio-economic condition, dietary practices, and hygiene and sanitation conditions of the target population was prepared. Weight and height were measured by using digital weighing balance (measuring up to 180 kg and least count 0.1 kg) and stadiometer respectively. Dietary intake was assessed by 24 hour dietary recall and food frequency questionnaire. Data collected was analysed using WHO Anthroplus version 1.0.4, SPSS version 20 and Microsoft excel. Chi- square test was used to analyse the factors associated with nutritional status.

Out of total 205 adolescents, 49.8 % of them were from private schools and 50.2% were from government schools. Of them, 47.80% (98) were females, 52.20% (107) were males. The prevalence of stunting, thinness and obesity were 21%, 5.9% and 7.8% respectively. The prevalence of insufficient intake of the nutrients as energy, protein, added fat, calcium, and iron was 85.37%, 41.95%, 92.20%, 77.56%, 76.58% respectively. Ethnicity (p=0.016) and purification of drinking water (p=0.004), trying to gain weight (p=0.031) were found to be statically associated with stunting. Gender (p=0.050), family size (p=0.002), number of adolescents in family (0.028), sleeping hours (p=0.027), and perception about own body

size (p=0.000) are associated with thinness or obesity. Similarly, trying to lose weight (p=0.001) and frequency of consumption of fast foods (0.026) were also associated with thinness or obesity. Proper intervention programmes should be implemented in order to correct the nutritional status nutrient intake and dietary habits of adolescent residing in Kohalpur.

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Appendices

Appendix – A Approval letter from NHRC

Government of Nepal
Nepal Health Research Council (NHRC)

Ref. No.: 1719

28 March 2017

Mr. Madan Pandey
Principal Investigator
Central Campus of Technology
Dharan

Ref: **Approval of Research Proposal** entitled **Assessment of Nutritional Status and Dietary Behaviour of Adolescents Studying in Schools of Kohalpur Municipality, Banke District**

Dear Mr. Pandey

It is my pleasure to inform you that the above-mentioned proposal submitted on 14 February 2017 (**Reg. no. 36/2017**) has been approved by Nepal Health Research Council (NHRC) National Ethical Guidelines for Health Research in Nepal, Standard Operating Procedures Section 'C' point no. 6.3 through Expedited Review Procedures.

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

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

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

As per your research proposal, the total research amount is **NRs. 44,000** and accordingly the processing fee amounts to **NRs-1000.00**. It is acknowledged that the above-mentioned processing fee has been received at NHRC.

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

Thanking you,

Prof. Dr. Anjani Kumar Jha
Executive Chairman

Tel: +977 1 4254220, Fax: +977 1 4262469, Ramshah Path, PO Box: 7626, Kathmandu, Nepal
Website: http://www.nhrc.org.np, E-mail: nhrc@nhrc.org.np

Appendix – B Consent form

Namaste!

I, Mr. Madan Pandey, a graduate student of Nutrition and Dietetics in Central Campus of Technology, Dharan; am going to conduct dissertation work in Kohalpur municipality area for the degree of Bachelor of Science in in Nutrition and Dietetics.

The topic for the study is **"**ASSESSMENT OF NUTRITIONAL STATUS AND DIETARY INTAKE OF ADOLESCENTS STUDYING IN SCHOOLS OF KOHALPUR MUNICIPALITY, BANKE DISTRICT**".**

Under this study, nutritional status and dietary pattern of adolescents studying in high school level will be surveyed.

You have been selected for the study. You will be asked some general questions, questions about your dirtary habits and your height and weight will be measured. This study will make you known about your nutritional status. Some questions may be personal, all information you provide will be important and the privacy of information will be maintained and they will not be misused. Your participation in this study will be voluntary. You may not answer some or all questions if you feel them personal or sensitive. But I hope you will be participated in this study.

Do you want to get participated in this study? *(Ask questions if only interested in the study, otherwise stop the interview)*

Yes, I want to be participated in the study and permit to take all measurements and ask the questions required for the study.

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

Date: Date:

Place: Place:

Appendix – C Survey Questionnaire

A. General information

School's Code: ☐☐ Date of interview (B.S.):

Yr.	Mth.	Day

Student's Code No.: ☐☐☐ Class: ☐☐

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

Yr.	Mth.	Day

3. Address -Municipality: Kohalpur Ward no: _____

   Tole:_____

4. Gender

   1) Male 2) Female

5. Caste/Ethnicity:

   1) Brahmin 3) Tharu 5) Thakuri
   2) Chhettri 4) Magar 6) Others:_____

6. Religion:

   1) Hindu 3) Christian 5) Others:
   2) Muslim 4) Buddhist _____

B. Anthropometric information

	Reading 1	Reading 2	Reading 3	Mean reading
Height (cm)				
Weight (kg)				

C. Family information

7. Type of family:

   1) Nuclear 2) extended 3) Joint

8. Number of family members: _____

9. Number of male members:_____

10. Number of female members:_____

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

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

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

    Total: _____ Brothers: _____ Sisters:_____

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

15. Occupation (of father):
    1) Agriculture
    2) Service
    3) Labour
    4) Business
    5) Foreign employment
    6) Others:_____

16. Occupation (of mother):
    1) Housewife
    2) Agriculture
    3) Service
    4) Labour
    5) Business
    6) Foreign employment
    7) Others_____

17. Family income:
    1) Less than Rs. 30000 monthly
    2) Equal to or more than Rs. 30000 monthly

18. Father's Education level:
    1) University level
    2) Secondary
    3) Basic
    4) Informal
    5) Illiterate
    6) Not aware

19. Mother's education level :

1) University level
2) Secondary
3) Basic
4) Informal
5) Illiterate
6) Not aware

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

1) Tube well
2) Well
3) River
4) Drinking water tap
5) Other: _____

21. Is the water purified?

1) Yes
2) No

22. Do you have toilet facility in your house?

1) Yes
2) No

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

1) Own production
2) Purchased from market
3) Both
4) Others_____

D. Physical activities

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

1) 5 or less hours
2) 6 hours
3) 7 hours
4) 8 or more hours

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

1) Private vehicle
2) Cycle
3) Public/school transport
4) Walk

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

1) None
2) Less than an hour a day
3) 1 to 2 hours a day
4) More than 2 hours a day

27. What do usually do at school breaks?

1) Sitting down (talking, reading or eating)
2) Standing or walking around
3) Running or playing game

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

1) Yes
2) No

If yes, what type?

1) Play games
2) Aerobics/zumba
3) Swimming
4) Gymming
5) Running/jogging
6) Walking
7) Yoga

In a day, how much time do you do such activity? ____ Hrs/Minutes

How frequently in a week? _____

29. 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

D. Dietary intake and food habits

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

1) Yes
2) No

31. Do you skip any meal?

1) Yes
2) No

If yes, which meal does you skips.

1) Breakfast
2) Lunch
3) Dinner

How often do you skip this meal?

1) Once - twice a week
2) Three –four times a week
3) Five or more days

32. At home, where do you usually eat?

1) Dining room/Kitchen
2) Bedroom
3) In front of the TV
4) Other places _____

33. What are you?

1) Vegan
2) Lacto-vegetarian
3) Ovo-vegetarian
4) Lacto-ovo vegetarian
5) Non-vegetarian

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

1) 1
2) 2-4
3) 5-7
4) 8 or more

35. Do you have daily pocket money?

1) Yes
2) No
3) Sometimes (_____times a week)

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

1) Yes
2) No

If yes, what do you usually buy? _____

37. How do you feel about your figure?

1) Overweight
2) Right weight
3) Thin

38. Have you ever tried losing weight?

1) Yes
2) No

39. Have you ever tried gaining weight?

1) Yes
2) No

40. Do you watch your figure/weight?

1) Yes 2) No

41. Do you smoke?

1) Yes 2) No

42. Do you drink alcoholic beverages?

1) Yes 2) No

E. Food frequency table

Food	**Daily**	**4-5 times a week**	**2-3 times a week**	**Once in a week**	**Once in 15 days or less**	**Never**	**Remark**
Cereals							
Pulses and legumes							
Milk & milk products							
Green leafy vegetables							
Other vegetables							
Fruits							
Egg, Meat, Fishes							
Tea/Coffee							
Fast foods							

F. 24 hours dietary recall

Timing	Description of food or drink	Serving	Amount
Breakfast (6 to 9 A.M)			
Lunch (9 to 11 A.M)			
Snacks (1 to 5 P.M)			
Dinner (9 to 11 P.M)			

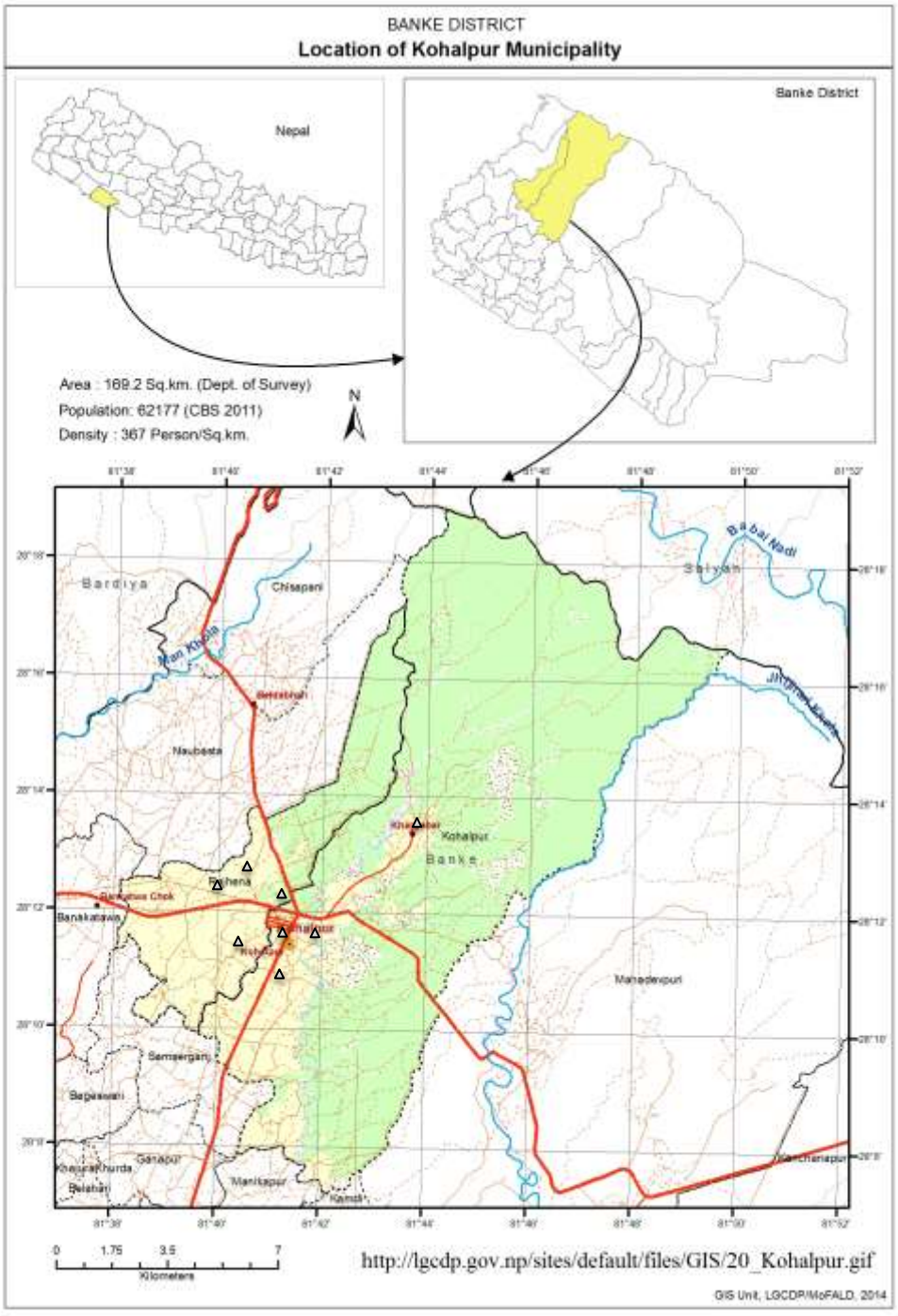
Appendix – D Photo gallery

a) Measuring Height

b)Measuring weight

c) Filling questionnaire

Appendix – E Survey site



△ Selected schools

Source:(LGCDP/MoAFLD, 2014)

Appendix – F Distribution of severity of malnutrition according to age groups and gender

		Stunting				Thinness/obesity							
Gender	**Age group**	***Stunting (total)***	Severely Stunted	Moderately Stunted	Normal	***Thinness (total)***	Severely thin	Moderately thin	Normal	***Obesity (total)***	Overweight	Obese	Severely obese
Female	**10 to 14 years**	***10.42%***	4.17%	6.25%	89.58%	***2.08%***	0.00%	2.08%	91.67%	***6.25%***	6.25%	0.00%	0.00%
	15 to 19 years	***28.00%***	2.00%	26.00%	72.00%	***2.00%***	0.00%	2.00%	92.00%	***6.00%***	4.00%	2.00%	0.00%
	Both (10 to 19 years)	***19.38%***	3.06%	16.32%	80.61%	***2.04%***	0.00%	2.04%	91.84%	***6.12%***	5.10%	1.02%	0.00%
Male	**10 to 14 years**	***28.00%***	6.00%	22.00%	72.00%	***10.00%***	0.00%	10.00%	78.00%	***12.00%***	8.00%	4.00%	0.00%
	15 to 19 years	***17.54%***	3.50%	14.04%	82.45%	***8.77%***	0.00%	8.77%	84.21%	***7.01%***	7.01%	0.00%	0.00%
	Both (10 to 19 years)	***22.43%***	4.67%	17.76%	77.57%	***9.34%***	0.00%	9.34%	81.31%	***9.35%***	7.48%	1.87%	0.00%
Both gender	**10 to 14 years**	***19.39%***	5.10%	14.29%	80.61%	***6.12%***	0.00%	6.12%	84.69%	***9.16%***	7.14%	2.04%	0.00%
	15 to 19 years	***22.42%***	2.80%	19.62%	77.57%	***5.61%***	0.00%	5.61%	87.85%	***6.54%***	5.60%	0.94%	0.00%
	Both (10 to 19 years)	***20.97%***	3.90%	17.07%	79.03%	***5.86%***	0.00%	5.86%	86.34%	***7.80%***	6.34%	1.46%	0.00%

Appendix – G Relationship of study variables with malnutrition

Relation of socio-economic and demographic factors with malnutrition

Types of malnutrition	**Stunting**				**Thinness/obesity**				
Factors	**Stunted**	**Normal**	**χ^2 – value**	**P – value**	**thinness**	**Normal**	**Obesity**	**χ^2 – value**	**P – value**
Gender									
Female	19 (19.38%)	79 (80.62%)	0.286	0.593	2 (2.00%)	90 (91.80%)	6 (6.10%)	6.001	0.050*
Male	24 (22.43%)	83 (77.57%)			10 (9.30%)	87 (81.30%)	10 (9.30%)		
Type of School									
Private	16 (15.69%)	86 (84.31%)	3.426	0.064	5 (4.90%)	86 (84.30%)	11 (10.80%)	2.720	0.257
Government	27 (26.21%)	76 (73.79%)			7 (6.80%)	91 (88.30%)	5 (4.90%)		
Ethnic group									
Khas/ Arya	36 (26.09%)	102 (73.91%)	8.276	0.016*	10 (7.25%)	118 (85.50%)	10 (7.25%)	4.912	0.296
Janajati	7 (14.28%)	42 (85.72%)			2 (4.09%)	41 (83.67%)	6 (12.24%)		
Dalit & others	0 (0.00%)	18(100.00%)			0 (0.00%)	18 (100.00%)	0 (0.00%)		
Religion									
Hindu	41 (20.91%)	155 (79.09%)		1.000_f	12 (6.10%)	168 (85.70%)	16 (8.20%)	1.489	0.475
Others	2 (22.22%)	7 (77.78%)			0 (0.00%)	9 (100.00%)	0 (0.00%)		
Type of Family									
Nuclear	34 (22.52%)	117 (77.48%)	0.821	0.365	8 (5.30%)	129 (85.40%)	14 (9.30%)	1.937	0.380
Joint	9 (16.67 %)	45 (83.33%)			4 (7.40%)	48 (88.90%)	2 (3.70%)		

Table cont….

Types of malnutrition	Stunting				Thinness/Obesity				
Factors	**Stunted**	**Normal**	**χ^2 – value**	**P – value**	**thinness**	**Normal**	**Obesity**	**χ^2 – value**	**P – value**
Size of family									
Below National Average	9 (14.75%)	52 (85.25%)	2.028	0.154	4 (6.60%)	46 (75.40%)	11 (18.00%)	12.915	0.002*
Above National Average	34 (23.61%)	110 (76.39%)			8 (5.60%)	131 (91.00%)	5 (3.50%)		
No. of adolescents in family									
1	10 (16.95%)	49 (83.05%)	0.450	0.241	6 (10.16%)	45 (76.3%)	(76.27%)	7.124	0.028
Above 1	33 (22.60%)	113 (77.40%)			6 (4.11%)	132 (90.41%)	8 (5.48%)		
No. of siblings									
0	1 (9.09%)	10 (90.91%)	2.882	0.237	1 (9.09%)	8 (72.73%)	2 (18.18%)	7.400	0.116
1	11 (16.17%)	57 (83.83%)			4 (7.28%)	55 (80.88%)	9 (13.24%)		
More than 1	31 (24.60%)	95 (75.40%)			7 (5.55%)	114 (70.48%)	5 (3.97%)		
Occupation of Father (n=198)									
Agriculture/Labour	12 (19.05%)	51 (80.95%)	0.259	0.611	3 (4.8%)	58 (92.1%)	2 (3.2%)	3.205	0.201
Service	30 (22.22%)	105 (77.77%)			8 (5.9%)	113 (83.7%)	14 (10.4%)		
Occupation of mother (n=202)									
Housewife	21 (21.90%)	75 (78.10%)	0.130	0.718	7 (7.3%)	79 (82.3%)	10 (10.4%)	2.982	0.225
Others	21 (19.80%)	85 (80.20%)			4 (3.8%)	96 (90.6%)	6 (5.7%)		
Education of father (n=181)									
Literate	39 (21.90%)	139 (78.10%)	0.838	0.360	9 (5.1%)	157 (88.2%)	12 (6.7%)	3.212	0.201
Illiterate	0 (0.00%)	3 (100.00%)			0 (0.0%)	2 (66.7%)	1 (33.3%)		

Types of malnutrition	Stunting				Thinness/obesity				
Factors	**Stunted**	**Normal**	**χ^2 – value**	**P – value**	**Thinness**	**Normal**	**Obesity**	**χ^2 – value**	**P – value**
Education of Mother (n=184)									
Literate	37 (23.87%)	118 (76.13%)	1.433	0.231	8 (5.16%)	135 (87.10%)	12 (7.74%)	0.791	0.673
Illiterate	4 (13.79%)	25 (86.21%)			2 (6.90%)	26 (89.65%)	1 (3.45%)		
Monthly family income									
Below Rs.30000	33 (21.85%)	118 (78.15%)	0.267	0.605	9 (6.0%)	132 (87.4%)	10 (6.6%)	1.115	0.573
Above Rs.30000	10 (18.52%)	44 (81.48%)			3 (5.6%)	45 (83.3%)	6 (11.1%)		
Source of Food									
Own Production	12 (26.67%)	33 (73.33%)	1.487	0.475	4 (8.16%)	39 (86.76%)	2 (4.08%)	2.748	0.601
Purchased from Market	9 (16.67%)	45 (83.33%)			4 (7.40%)	46 (85.20%)	4 (7.40%)		
Both	22 (20.75%)	84 (79.24%)			4 (3.78%)	92 (85.79%)	10 (9.43%)		

Relation of environmental factors with malnutrition

Types of malnutrition	Stunting				Thinness/Obesity				
Factors	**Stunted**	**Normal**	**χ^2 – value**	**P – value**	**Thinness**	**Normal**	**Obesity**	**χ^2 – value**	**P – value**
Source of drinking water									
Tube well	36 (22.09%)	127 (77.91%)	1.113	0.292	10 (6.14%)	141 (86.50%	12 (7.36%)	0.332	0.847
Drinking water tap	6 (14.63%)	35 (85.37%)			2 (4.88%)	35 (85.37%)	4 (9.75%)		
Purification of Water									
Yes	6 (9.10%)	60 (90.90%)	8.294	0.004*	4(6.06%)	54 (81.82%)	8 (12.12%)	2.561	0.278
No	37 (26.62%)	102 (73.38%)			8 (5.76%)	123 (88.49%)	8 (5.76%)		

Relation of physical activity with malnutrition

Types of malnutrition	Stunting				Thinness/Obesity				
Factors	**Stunted**	**Normal**	**χ^2 – value**	**P – value**	**Thinness**	**Normal**	**Obesity**	**χ^2 – value**	**P – value**
Average sleeping hours									
6 hours or less	12 (24.5%)	37(75.50%)	0.480	0.489	5 (10.20%)	44 (89.80%)	0 (0.00%)	7.197	0.027*
More than 6 hours	31 (19.90%)	125 (80.10%)			7 (4.49%)	133 (85.26%)	16 (10.25%)		
Activity level									
Below	27 (20.30%)	106 (79.70%)	0.104	0.747	5 (3.76%)	118 (88.72	10 (7.52%)	3.126	0.210
Above	16 (22.22%)	56 (77.77%)			7 (9.72%)	59 (81.95%)	6 (8.33%)		

Relation of dietary behaviour with malnutrition

Types of malnutrition	Stunting				Thinness/Obesity				
Factors	**Stunted**	**Normal**	**χ^2 – value**	**P – value**	**Thinness**	**Normal**	**Obesity**	**χ^2 – value**	**P – value**
Size of meal in presence of others									
Yes	6 (22.22%)	21 (77.88%)	0.29	0.864	3 (11.11%)	23 (85.19%)	1 (3.70%)	2.143	0.342
No	37 (20.79%)	141 (79.21%)			9 (5.06%)	154 (86.52%)	15 (8.42%)		
Skipping of Meal									
Yes	18 (16.36%)	92 (83.64%)	3.046	0.081	8 (7.27%)	96 (87.27%)	6 (5.46%)	2.520	0.284
No	25 (26.31%)	70 (73.69%)			4 (4.20%)	81 (85.30%)	10 (10.50%)		
Eating place									
Kitchen /dining	37 (22.29%)	129 (77.71%)	0.908	0.341	10 (6.02%)	143 (86.15%)	13 (7.83%)	0.048	0.976
Other room	6 (15.38%)	33 (84.62%)			2 (5.10%)	34 (87.20%)	3 (7.70%)		

Table cont….

Types of malnutrition	Stunting				Thinness/Obesity				
Factors	**Stunted**	**Normal**	**χ^2 – value**	**P – value**	**Thinness**	**Normal**	**Obesity**	**χ^2 – value**	**P – value**
Veg/Non-veg Eating Behaviour									
Lacto-Vegetarian	3 (33.33%)	6 (66.67%)	0.876	0.352	0 (0.00%)	9 (100.00%)	0 (0.00%)	1.489	0.475
Non-Vegetarian	40 (20.41%)	156 (79.59%)			12 (6.12%)	168 (85.72%)	16 (8.16%)		
Buy foods from sellers' at school									
Yes	35 (21.00%)	132 (79.00%)	0.000	0.990	9 (5.40%)	146 (87.40%)	12 (7.20%)	0.897	0.693
No	8 (21.10%)	30 (78.90%)			3 (7.89%	31 (81.58%)	4 (10.53%)		
Feeling about Figure									
Overweight	10 (22.22%)	35 (77.78%)	0.067	0.967	0 (0.00%)	33 (73.33%)	12 (26.67%)	33.749	0.000*
Normal	27 (20.45%)	105 (79.55%)			8 (6.06%)	121 (91.67%)	3 (2.27%)		
Thin	6 (21.43%)	22 (78.57%)			4 (14.29%)	23 (82.14%)	1 (3.57%)		
Ever tried losing Weight									
Yes	7 (19.44%)	29 (80.56%)	0.062	0.804	0 (0.00%)	28 (77.78%)	8 (22.22%)	14.557	0.001*
No	36 (21.30%)	133 (78.70%)			12 (7.10%)	149 (88.17%)	8 (4.73%)		
Ever tried gaining Weight									
Yes	9 (39.1%)	14 (60.9%)	5.151	0.023*	2 (8.70%)	19 (82.60%)	2 (8.70%)	0.426	0.808
No	34 (18.7%)	148 (81.3%)			10 (5.50%)	158 (86.81%)	14 (7.69%)		
Watch weight regularly									
Yes	35 (20.71%)	134 (79.29%)	0.041	0.840	11 (6.51%)	147 (86.98%)	11 (6.51%)	2.823	0.244
	8 (22.22%)	28(77.78%)			1 (2.78%)	30 (83.33%)	5 (3.89%)		
No									

Relation of food frequency with malnutrition

Types of malnutrition	Stunting				Thinness/Obesity				
Factors	**Stunted**	**Normal**	**χ^2 – value**	**P – value**	**Thinness**	**Normal**	**Obesity**	**χ^2 – value**	**P – value**
Consumption of pulses and legumes									
Daily	33 (22.91%)	111 (77.09%)	1.646	0.439	11 (7.64%)	123 (85.42%)	10 (6.94%)	5.563	0.234
Two to five times a week	9 (15.52%)	49 (84.48%)			1 (1.72%)	52 (89.66%)	5 (8.62%)		
Once a week or less	1 (33.33%)	2 (66.67%)			0 (0.00%)	2 (66.67%)	1 (33.33%)		
Consumption of milk & milk products (n=203)									
Daily	22 (22.45%)	76 (77.55%)	1.340	0.521	6 (6.12%)	81 (82.65%)	11 (11.22%)	3.302	0.509
Two to five times a week	14 (20.59%)	54 (79.41%)			3 (4.41%)	62 (91.18%)	3 (4.41%)		
Once a week or less	5 (13.51%)	32 (86.49%)			2 (5.41%)	33 (89.18%)	2 (5.41%)		
Consumption of green leafy vegetables (n=204)									
Daily	0 (0.00%)	0 (0.00%)	0.679	0.410	0 (0.00%)	0 (0.00%)	0 (0.00%)	1.169	0.557
Two to five times a week	38 (22.09%)	134 (77.91%)			10 (8.81%)	147 (85.47%)	15 (8.72%)		
Once a week or less	5 (15.62%)	27 (84.38%)			2 (6.25%)	29 (90.62%)	1 (3.13%)		
Consumption of other vegetables									
Daily	17 (21.79%)	61 (78.21%)	2.210	0.331	5 (6.41%)	66 (84.62%)	7 (8.97%)	1.094	0.895
Two to five times a week	26 (21.85%)	93 (78.15%)			7 (5.88%)	104 (87.40%)	8 (6.72%)		
Once a week or less	0 (0.00%)	8 (100.00%)			0 (0.00%)	7 (87.50%)	1 (12.50%)		

Table cont....

Types of malnutrition	Stunting				Thinness/Obesity				
Factors	**Stunted**	**Normal**	**χ^2 – value**	**P – value**	**Thinness**	**Normal**	**Obesity**	**χ^2 – value**	**P – value**
Consumption of fruits									
Daily	1 (16.67%)	5 (83.33%)	0.222	0.895	0 (0.0%)	5 (83.33%)	1 (16.67%)	1.684	0.794
Two to five times a week	32 (20.50%)	124 (79.50%)			9 (5.8%)	134 (85.9%)	13 (8.3%)		
Once a week or less	10 (23.26%)	33 (76.74%)			3 (6.98%)	38 (88.37%)	2 (4.65%)		
Consumption of meat, eggs & fish (n= 196)									
Daily	6 (33.33%)	12 (66.67%)	2.120	0.346	2 (11.11%)	14 (77.78%)	2 (11.11%)	1.496	0.827
Two to five times a week	27 (19.57%)	111 (80.43%)			8 (5.80%)	120 (86.95%)	10 (7.25%)		
Once a week or less	7 (17.50%)	33 (82.50%)			2 (5.00%)	34 (85.00%)	4 (10.00%)		
Consumption of tea or coffee (n=192)									
Daily	33 (26.40%)	92 (73.60%)	5.150	0.076	10 (8.00%)	108 (86.40%)	7 (5.60%)	7.177	0.127
Two to five times a week	3 (8.82%)	31 (91.18%)			0 (0.00%)	32 (94.12%)	2 (5.88%)		
Once a week or less	6 (18.18%)	27 (81.82%)			1 (3.03%)	27 (81.82%)	5 (15.15%)		
Consumption of fast foods									
Daily	41 (21.35%)	28 (78.65%)		1.000_f	10 (5.20%)	169 (88.02%)	13 (6.77%)	7.291	0.026*
Two to five times a week	2 (15.38%)	11 (84.62%)			2 (1.94%)	8(61.53%)	3 (23.07%)		

Relation of malnutrition with dietary intake

Types of malnutrition	Stunting				Thinness/Obesity				
Factors	**Stunted**	**Normal**	**χ^2 – value**	**P – value**	**Thinness**	**Normal**	**Obesity**	**χ^2 – value**	**P – value**
Adequacy of Energy intake									
Below RDA	39 (22.29%)	136 (77.69%)	1.238	0.266	12 (6.86%)	149 (85.14%)	14 (8.00%)	2.314	0.314
Above RDA	4 (13.33%)	26 (86.67%)			0 (0.00%)	28 (93.33%)	2 (6.67%)		
Adequacy of protein intake									
Below RDA	21 (24.42%)	65 (75.58%)	1.060	0.303	4 (4.65%)	76 (88.37%)	6 (6.98%)	0.567	0.753
Above RDA	22 (18.49%)	97 (81.51%)			8 (6.73%)	101 (84.87%)	10 (8.40%)		
Adequacy of added fat intake									
Below RDA	39 (20.64%)	150 (79.36%)	0.170	0.680	11 (5.82%)	162 (85.71%)	16 (8.47%)	1.469	0.480
Above RDA	4 (25.00%)	12 (75.00%)			1 (6.25%)	15 (93.75%)	0 (0.00%)		
Adequacy of calcium intake									
Below RDA	33 (20.75%)	126 (79.25%)	0.021	0.885	8 (5.03%)	137 (86.16%)	14 (8.81%)	1.729	0.421
Above RDA	10 (21.74%)	36 (78.26)%			4 (8.70%)	40 (86.95%)	2 (4.35%)		
Adequacy of iron intake									
Below RDA	35 (22.31%)	122 (77.71%)	0.702	0.402	8 (5.10%)	136 (86.62%)	13 (8.28%)	0.859	0.651
Above RDA	8 (16.67%)	40 (83.33%)			4 (8.33%)	41 (85.42%)	3 (6.25%)		