COMPARATIVE STUDY ON NUTRITIONAL STATUS OF PRIVATE AND PUBLIC SCHOOL ADOLESCENTS OF DHARAN SUB-METROPOLITAN CITY.

by

Roshan Timsina

Department of Nutrition and Dietetics

Central Campus of Technology

Institute of Science and Technology

Tribhuvan University, Nepal

2024

Comparative Study on Nutritional Status of Private and Public School Adolescents of Dharan Sub-Metropolitan City.

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

by

Roshan Timsina

Department of Nutrition and Dietetics

Central Campus of Technology

Institute of Science and Technology

Tribhuvan University, Nepal

October, 2024

Tribhuvan University

Institute of Science and Technology

Department of Nutrition & Dietetics

Central Campus of Technology, Dharan

Approval Letter

This *dissertation* entitled ***Comparative Study on Nutritional Status of Private and Public School Adolescents of Dharan Sub-Metropolitan City*** by **Roshan Timsina** has been accepted as the partial fulfilment of the requirements for the degree of **Bachelor of Science in Nutrition and Dietetics.**

Dissertation Committee

1. **Head of the Department** — HEAD OF DEPARTMENT NUTRITION & DIETETICS
   (Asst. Prof. Mr. Kabindra Bhattarai)
2. **External Examiner**
   (Mr. Brij Kumar Das, Public Health Administrator, Health Training center, Dhankuta)
3. **Supervisor**
   (Assoc. Prof. Mrs. Babita Adhikari)
4. **Co-supervisor**
   (Teaching assistant Mr. Bipin Karki)
5. **Internal Examiner**
   (Asst. Prof. Mr. Kabindra Bhattarai)

October, 2024

Acknowledgements

First of all, I would like to acknowledge my supervisor, Assoc. Prof. Mrs. Babita Adhikari and Teaching assistant Mr. Bipin Karki for their continuous support, excellent guidance and encouragement during my dissertation work. Also, I am indeed grateful to Mr. Kabindra Bhattarai, Head of Department (Nutrition and Dietetics), Assoc. Prof. Dr. Dil Kumar Limbu (Campus Chief, CCT) for their kind co-operation to pursue my Bachelor degree. I am indebted to Central Campus of Technology and all the teaching and non-teaching staffs of this campus for their support.

Also, I take this opportunity to express my deepest gratitude towards the principals of all schools I have consulted and the students who were sampled, for their openheartedness and cooperation during the course of data collection.

I am thankful to my friends Abiral Ghimire, Bishal Bhattarai, Bishal Chaudhary, Kiran Gadtaula, Prastut Acharya and Sudip Parajuli for their huge support and encouragement during different stages of the dissertation work. Similarly, I am also grateful to my senior Rishi Raj Adhikari and my juniors Prekshya Karki, Apsana Joshi, Siwani Niroula and Yojana Bhattarai for their help and encouragement during proposal writing and thesis writing.

I wish to express my gratitude to my beloved parents for their love and support. Thanks, to all those helping hands who directly or indirectly contributed to the success of this study. And lastly, I am thankful to all my batchmates for making my time wonderful during the course of study of BSc. (Nutrition and Dietetics) in the prestigious Central Campus of Technology.

Date of submission: October, 2024

Roshan Timsina

Abstract

Adolescence refers to the transition period from childhood to adulthood and the good nutritional status at that point would build the foundation for a healthy existence thereafter. Their dietary intake and dietary behaviors directly affect their nutritional status. Thus, a cross-sectional survey was conducted to assess the nutritional status and dietary intake of adolescents studying in private and public schools of Dharan sub-metropolitan city, Sunsari district. A structured questionnaire was used to collect data of 280 subjects. Weight and height were measured by using digital weighing balance and stadiometer respectively. Dietary intake was assessed using 24-hour dietary recall and food frequency questionnaire. Data collected was analyzed using WHO Anthro plus, SPSS and Microsoft Excel. Chi-square test was used for necessary analysis of the factors associated with the nutritional status.

The analysis of the study revealed, the prevalence of stunting, thinness and overweight/obesity in private schools' adolescents was 4.3%, 4.3% and 32.9% respectively and 16.5%, 10% and 15.7% respectively among public schools' adolescents. The mean dietary intake of energy in both private and public school's adolescents was found to be low as compared to RDA. In private school's adolescents, consumption of green leafy vegetable and attempted weight loss were found to be associated with the stunting and age category, Perception about weight and attempted weight loss were found to be associated with the thinness and overweight/obesity. Similarly, in public school adolescent's factors like caste, water purification, source of food and involvement in physical activity were found to associated with the stunting and family size, Perception about weight, attempted weight loss, attempted weight gain and consumption of fast food were associated with the thinness and overweight/obesity. Proper intervention programs should be implemented in order to correct the nutritional status, nutrient intake and dietary habits of adolescent of the target population.

Contents

List of Tables

List of Figures

List of Abbreviations

Abbreviations	Full form
BAZ	Body mass index for age
BMI	Body Mass Index
CBS	Central Bureau of Statistics
CCT	Central Campus of Technology
CHDP	Child Health Disability Prevention
CHO	Carbohydrates
EAR	Estimated Average Requirements
FAO	Food and Agriculture Organization of United Nations
FFQ	Food Frequency Questionnaire
FSAU	Food Security Analysis Unit
GLV	Green Leafy Vegetables
HAZ	Height For Age
HDDS	Household Dietary Diversity Score
ICMR	Indian Council of Medical Research
IDA	Iron Deficiency Anemia
IDDS	Individual Dietary Diversity Score
IQ	Intelligence Quotient
Kcal	Kilocalorie
MoHP	Ministry of Health and Population
NAFLD	Non-Alcoholic Fatty Liver Disease
NDHS	Nepal Demographic and Health Survey
NIN	National Institute of Nutrition
NRB	Nepal Rastra Bank
NRC	National Research Council
RDA	Recommended dietary allowance
SPSS	Statistical Package for the Social Sciences
SD	Standard Deviation
T2D	Type 2 Diabetes

UNICEF	United Nations Children's Emergency Fund
UK	United Kingdom
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

PART I

Introduction

1.1 Background of the study

Adolescence is the period of life between childhood and adulthood, ranging in age from 10 to 19 years. Adolescence includes components of biological growth and substantial social role shifts (Sawyer *et al.,* 2018). The onset of adolescence is a vital stage of biological and psychological development for the individual. Several individuals will also experience a significant change in their social environment. These years have a significant impact on health-related behavior patterns and activities (WHO, 1977). Thus, adolescence is a pivotal point in the life course. It offers unique opportunities to adopt changes in diet and physical activity that can persist into later life (Hargreaves *et al.*, 2022).

Nutrition is the science that encompasses all aspects of food, how food nourishes our body and influences our health. It also involves studying the factors that influence our eating patterns, making recommendations about the amount we should eat of each type of food, attempting to maintain food safety, and addressing issues related to the global food supply (Thompson and Manore, 2009). Nutritional status is defined as the nutritional state of an individual, or a population or a community, and assessing the nutritional status is an essential part of monitoring the health of a community (WHO, 2024). Poor nutrition hinders an estimated 200 million children from reaching their full developmental potential. Additionally, severe undernutrition leads to stunted, wasted, and underweight adolescents. This disorder negatively impacts cognitive and physical development and increases the risk of illness and mortality. Additionally, approximately 45% of child deaths worldwide are linked to malnutrition (Katoch, 2023). Adolescent growth and nutrition has been largely overlooked in intervention and policy research (Hargreaves *et al.*, 2022).

According to MOHP (2022), among adolescent women age 15-19, 26% are thin according to body mass index for age (BMI-for-age) and 6% are overweight or obese. Overall, 34% of women age 15-49 are anemic, 18% are mildly anemic, 15% are moderately anemic, and 1% are severely anemic. the proportion of young women (age 15–19) who are thin is highest in the terai

zone (33%) and lowest in the mountain zone (11%). Similarly, among adolescent men age 15–19, 41% of young men are thin, 4% are overweight, and 3% are obese. A study on adolescents done by Aryal *et al.* (2016) reveals that 71% of adolescent boys and 59 % of adolescent girls were malnourished in Nepal. More than 43% married adolescent and 65% of unmarried adolescents were undernourished. The likelihood of under nutrition was high among adolescent residing in the Terai 72% followed by Hill 59% and Mountain 54%. The prevalence was almost similar among adolescents living in urban areas 63% and rural areas 65%. Overall, 35% of adolescents were anemic at the time of study. A study in adolescents of Kathmandu highlighted that overweight/obesity among Nepalese adolescents is at an alarming level and on par with many developing and developed countries. Sleep problem, consumption of carbonated /soft drinks, consumptions of fast foods and junk foods, physical education/training, sedentary behaviors were major predictors for overweight/obesity among adolescents (Singh *et al.*, 2021). 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 Dharan sub-metropolitan city has been conducted till date, this study was done to assess the nutritional status and dietary intake of the adolescents studying in the schools of Dharan sub metropolitan city. It can be beneficial for policy makers at both local and national level.

1.2 Statement of the problem

Kapur (2015), defines adolescence as "the transitional period between puberty and adulthood in human development, extending mainly over the teen years. It also refers to the period or stage of development, as of a society, proceeding maturity. Nutrition plays a crucial role in the biological, behavioral, and social changes that occur during adolescence, emphasizing the importance of addressing nutritional concerns in this developmental stage. Food habits and nutrition are not only vital for physical health but also impact interpersonal relationships among peers, family, and ethnocultural groups, underscoring the broader social implications of nutrition during adolescence (Achterberg and Shannon, 2020).

Various individual and environmental factors affect food choices and eating behaviors during adolescence. Amongst the individual characteristics, adolescents' level of knowledge about nutrition holds an important place. The food choices of adolescents are also influenced by

gender. In adolescence, physical activity is known to be related to both physical and mental aspects of health. Research has shown that obesity is associated with unhealthy behaviors, such as inadequate physical activity and increased sedentary behavior. The intake of certain foods and beverages is known to affect sleep. Excessive and heavy eating, consumption of chocolate, cola, tea and coffee and insufficient protein intake can impact the nutritional status of adolescents (Koca and Arkan, 2021).

The main nutrition problems affecting adolescents include undernutrition in terms of stunting, thinness, catch-up growth, and intrauterine growth restriction (WHO, 2002). Adolescent undernutrition promotes the cycle of poverty and intergenerational undernutrition (Bhargava *et al.*, 2020). A study in Solukhumbu, Nepal found that a significant proportion of adolescent school children were underweight (27.6%), overweight (5.7%), and obese (1.6%) (Sherpa *et al.*, 2019).Similarly, research done in Malangwa Municipality, Sarlahi, Nepal showed high rates of malnutrition among adolescents, with many being underweight, overweight, or obese. The prevalence of malnourished is 40.1% among them 37.6% were underweight and 2.5% were overweight (Dhobi and Giri, 2022). Studies suggest that malnutrition in Nepalese adolescents is associated with socioeconomic factors like parental occupation and education level (Sherpa *et al.*, 2019). Also, the double burden of malnutrition is a major public health challenge affecting children and adolescents globally, with significant regional and gender variations. Globally, the prevalence of overweight and obesity in children and adolescents under 18 years old was 22.2% (Caleyachetty *et al.*, 2018). There are very few studies on adolescents' nutrition in Nepal.

Adolescence being important period of life, it is necessary to address the aspects affecting the nutritional status at this period. Yet, the comparative study on adolescents' nutritional status of private and public schools hasn't been the topic of concern among the research communities in Nepal. As a result, this study was conducted among adolescents aged 10 to 19 years in private and public schools in the Dharan sub-metropolitan city to identify substantial disparities in nutritional status and associated factors affecting them.

1.3 Objectives of the study

1.3.1 General objective

The general objective of this study was to assess and compare the nutritional status of adolescents studying in private and public schools of Dharan sub-metropolitan city, Sunsari

1.3.2 Specific objectives

a) To compare the nutritional status between the adolescents of private and public schools of Dharan sub-metropolitan.
b) To assess the nutritional status of the adolescents of private and public schools Dharan sub-metropolitan by anthropometric measurement.
c) To identify the factors associated with nutritional status among adolescents of private and public schools Dharan sub-metropolitan.

1.4 Research questions

i. What is the existing nutritional status of adolescent studying in private and public schools of Dharan sub-metropolitan?
ii. Is there any difference in the nutritional status of adolescent studying in private and public schools of Dharan sub-metropolitan?
iii. What are the different associated factors which influence the nutritional status of the adolescents?

1.5 Significance of the study

The outcomes of the study will be supportive to:

a) Figure out the distribution of the malnutrition among adolescent studying in private and public schools.
b) Address malnutrition and promote responsible personalities to enhance adolescent nutritional status by improving dietary pattern.
c) Reflect sanitary condition, socio-economic variables, degree of malnutrition and condition of adolescent.

d) Assists in developing appropriate nutritional and health initiatives for this population.

e) Encourage concerned authorities for the proper nutrition planning and implementation of nutrition program effectively.

1.6 Conceptual framework of the study

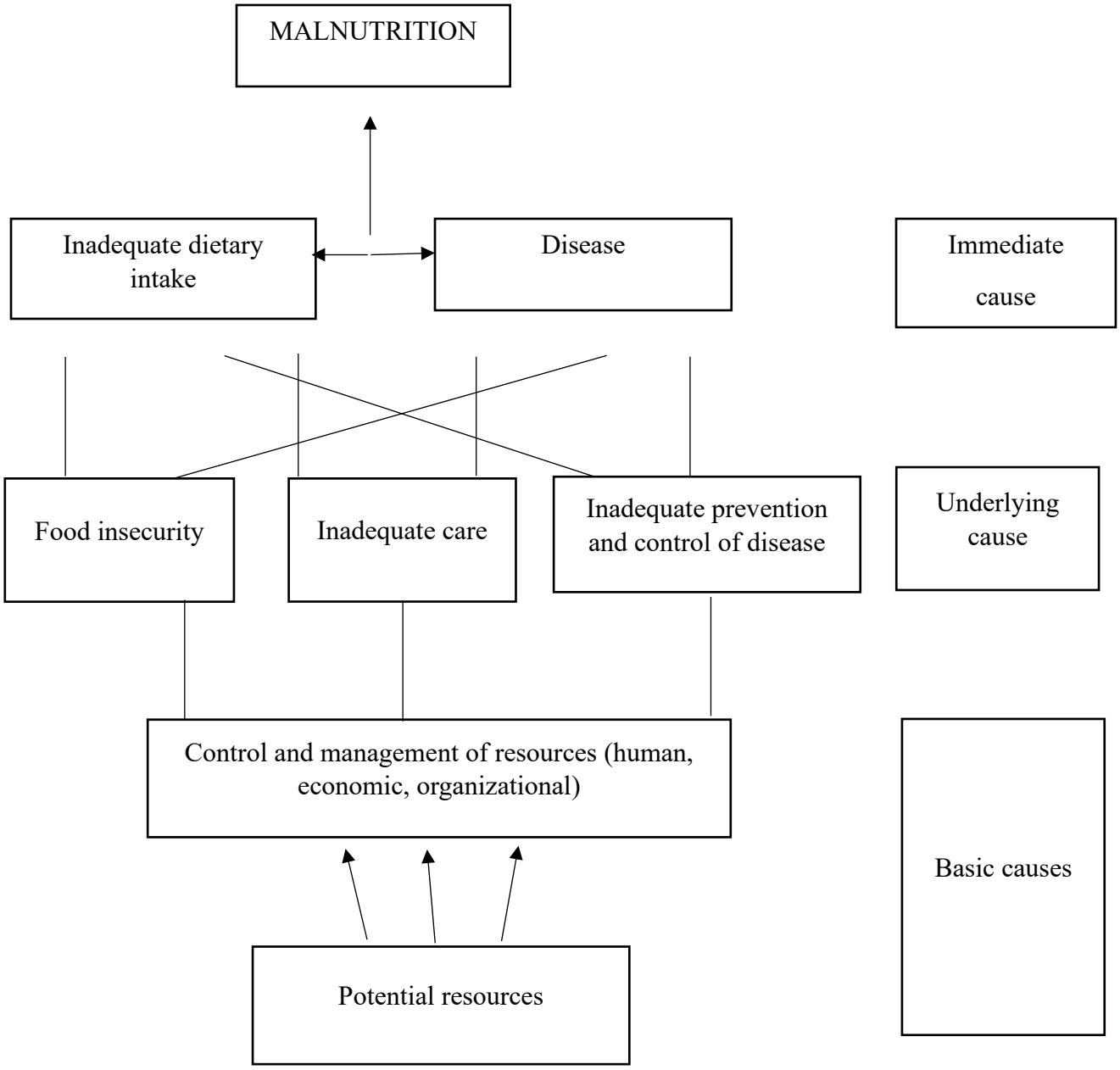


Fig 1.1: Framework of the study

Source: (UNICEF, 1990)

1.7 Limitations of the study

a) The biochemical and clinical assessment methods were not included in this study.

PART II

Literature review

2.1 Nutrition

Nutrition is the discipline related to food and its interaction with an organism for the maintenance and promotion of health and well-being. It is the combination of all bodily processes that enable each portion to obtain and make use of the resources or nutrients required for both proper operation and the growth and regeneration of all body parts (Joshi, 2015). A broad range of disciplines is covered by nutritional science. Consequently, nutritional scientists have the option to focus on certain areas of nutrition, including education, psychology, immunology, biology, physiology, biochemistry, sustainability, and sociology. The science of nutrition help us improve our food choice by identifying the amounts of nutrients we need, the best food source of those nutrients, and the other components in food that are harmful or helpful (Insel *et al.*, 2014).

2.2 Malnutrition

Malnutrition is a condition when a prolonged deficiency in one or more nutrients impairs physical growth or results in particular clinical problems (Joshi, 2015). For a healthy existence and to achieve normal physical growth (in youngsters), humans require a sufficient diet. Sufficient nourishment is an essential entitlement for every individual. People will experience hunger or malnutrition if they do not eat enough nutrients in both quantity and quality. Malnutrition manifests itself in many ways (MOHP, 2004)

Malnutrition can raise the risk of morbidity and mortality, and it is therefore a health result as well as a risk factor for disease and aggravated malnutrition. Even yet, unless there are extremely uncommon circumstances, like extreme starvation, it is rarely the direct cause of mortality. The term "protein-energy malnutrition" refers to malnutrition that is the direct cause of death (Blossner *et al.*, 2005).

Every country is facing a serious public health challenge from malnutrition. One in three people is malnourished in one form or another. Malnutrition, encompassing both undernutrition

and overweight, is a problem facing virtually every country in the world. The consequences of malnutrition have fundamental implications throughout the life cycle: reduced chances of survival, increased risk of acute and chronic disease, impaired learning in school, and lower economic productivity (Haddad *et al.*, 2014)

2.3 Forms of malnutrition

Jelliffe (1996) has categorized malnutrition into different forms as below:

a) **Undernutrition:** The pathological state resulting from consumption of inadequate quantity of food over an extended period of time. It includes being underweight for one's age, too short for one's age (stunted), dangerously thin for one's height (wasted) and deficient in vitamins and minerals.
b) **Overnutrition:** This is the pathological state resulting from the consumption of excessive quantity of food over an extended period of time.
c) **Specific deficiency:** It is the pathological state resulting from a relative or absolute lack of an individual nutrient. Some common specific nutrient deficiency diseases are iodine deficiency disorder, iron deficiency anemia, vitamin A deficiency, calcium deficiency.
d) **Imbalance:** It is the pathological state resulting from a disproportion among essential nutrient with or without the absolute deficiency of any nutrient.

2.4 Nutritional status

Nutritional status is defined as the health status of individuals or population groups as influenced by their intake and utilization of nutrients. The range of nutritional status included severe malnutrition and obesity. The three most commonly used indicator to evaluate children's nutritional status are underweight, wasting, and stunting (R. Gibson, 1998).

The assessment of nutritional status aims at checking growth and body ratios of an individual or community, thus allowing the implementation of intervention actions. This way, it is of paramount importance that there be a standardization of assessment methods to be used for each age group, bringing the criteria employed by health professionals into uniformity (Sigulem *et al.*, 2000)

2.5 Adolescence

The terms adolescence means ‘growing mature by developing’ and refers to the transition period from childhood to adulthood (WHO, 1993). This period is dynamic process in which a rapid physical, biochemical, psychological, and social growth, development, and maturation take place. The individual becomes an adult with sexual, physical and psychological development and cognitive and social change (Büyükgebiz, 2013).

The process of adolescence involves developments in the areas of self-esteem, identity, self-improvement, mental health, and social, cultural, moral, and professional domains. It concludes in increased social output. Although adolescence is a period of great promise and progress, it is also a risky time when social surroundings have a significant impact (Yılmazer, 2013).UNICEF (2011) divides the adolescence as below:

2.5.1 Early adolescence (10–14 years)

Early adolescence can be defined as the years between 10 and 14 years of age. Physical changes normally start at this point, usually starting with an acceleration of growth and progressing quickly to include the development of the sex organs and secondary sexual features. For the person whose body is changing, these outward changes might cause pride or excitement in addition to concern as they are frequently quite noticeable. Even though they are less obvious, the individual's internal changes are just as significant. Additionally, there is a remarkable spike in the electrical and physiological growth of the brain. Over the course of a year, brain cells can nearly double in number, and neural networks can undergo drastic reorganization. This can have an influence on their mental, physical, and emotional well-being (UNICEF, 2011).

2.5.2 Late adolescence (15–19 years)

The period between the ages of 15 and 19 is known as late adolescence. Even while the body is still maturing, the primary physical changes have typically already taken place by now. The ability to think critically and analytically is substantially improved as the brain continues to grow and restructure itself. Opinions from peer groups still often have impact early on, but as teenagers become more self-assured and clearer about who they are and what they think, that influence starts to diminish (UNICEF, 2011).

2.6 Changes during adolescence

2.6.1 Physical changes

Puberty begins during adolescence, which is marked by physical changes. It is marked by a rise in height, a change in voice, the appearance of secondary sexual traits, the onset of sex hormone development, the development of body hair, the emergence of male and female menarches, and the development of sexual urges. Quick changes in the body might be frightening, thrilling, or confusing. The worry of standing out as distinct can increase for some teenagers who grow early and others who mature later. Since adolescence is the prime developmental period for the desire to blend in with peers, this can be particularly stressful (Rathus, 2017).

2.6.2 Cognitive changes

Adolescents notice that they have more mental capacity, and this alters the way they view the world. Teenagers' perspectives about themselves, their families, and friends, as well as how they approach more general social and moral issues, are influenced by the cognitive changes that occur during adolescence (Rathus, 2017). Adolescents are known to express their independence from their families and start making decisions on their own. This is mostly because of changes in the brain that occur during growth and lead to notable improvements in cognitive capacities. During this period, there is a fast increase in the number of neurons forming and in the interconnectivity between neurons, enabling more complex and sophisticated thinking (Feldman, 2017).

2.6.3 Psycho-social changes

Adolescence is a time of identity development, shifting how much time is spent with parents and friends, growing social relationships, gaining more autonomy, discovering one's sexual orientation, etc. Juvenile criminality can involve an adolescent (Rathus, 2017). Adolescents can begin to recognize their differences from their family and from other people during this time, and they also have more complex cognitive skills. Self-esteem problems are frequent as kids start to set themselves apart from other people and go through bodily changes. Teenagers' experiences with self-esteem can be complicated; some may have strong self-esteem among

their families but low self-esteem among their peers or in their academic performance (Feldman, 2017).

2.7 Major nutritional problem in adolescence

2.7.1 Undernutrition

Undernutrition denotes insufficient intake of energy and nutrients to meet an individual's needs to maintain good health (Maleta, 2006). Martins *et al.* (2011)defined undernutrition as an insufficient provision of energy and nutrients, such as good quality protein with an adequate balance of essential amino acids, vitamins and minerals, and an inability to meet the requirements of the body to ensure growth, maintenance, and specific functions. 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, 1998).

NDHS took weight and height measurements of women age 15–49. Among adolescent women age 15-19, 26% are thin according to body mass index for age (BMI-for-age). The proportion of young women (age 15–19) who are thin is highest in the terai zone (33%) and lowest in the mountain zone (11%). Among adolescent men age 15–19, data on height, weight, and age were used to calculate BMI-for-age. Forty-one percent of young men are thin. (MOHP, 2022)

2.7.2 Iron deficiency anaemia (IDA)

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). Iron deficiency anemia (IDA) is the most common nutritional deficiency worldwide. It can cause reduced work capacity in adults and impact motor and mental development in children and adolescents. Iron deficiency results when iron demand by the body is not met by iron absorption from the diet (Killip *et al.*, 2007).However, 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). In a research done by MOHP (2022), overall, 34% of women age 15-49 are anemic, 18% are mildly anemic, 15% are moderately anemic, and 1% are found to be severely anemic.

2.7.3 Vitamin A deficiency disorder

Even though the risk of vitamin A insufficiency usually decreases with age, it is now known that it frequently increases in adolescence and the early stages of adulthood, particularly in women (WHO, 2005). A few indications of insufficiency include xerophthalmia, anorexia, growth retardation, increased susceptibility to infections, blockage and expansion of hair follicles, and keratinization of the skin's mucous epithelial cells, which is accompanied by a lack of normal differentiation. Reduced iron uptake by red blood cells and reduced iron mobilization from reserves are linked to vitamin A insufficiency (Gropper and Smith, 2013).

2.7.4 Iodine deficiency disorder

Iodine deficiency disorders were widely prevalent in most populations until corrective measures were taken. The most significant effects of iodine shortage are varying degrees of neuromotor and cognitive deficits. Deficit in iodine is acknowledged as the most frequent cause of avoidable mental retardation worldwide. Lower academic performance and a negative shift in IQs have been observed in iodine-deficient areas, even after correcting for confounding variables. 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 goiter primarily affects people aged 15-45 years, in particular women. Iodine deficiency is assessed by

goiter and urinary iodine levels among schoolchildren, as these are captive groups (WHO, 2005).

2.7.5 Other micronutrient deficiency

Micronutrient deficiency is defined as a lack of essential vitamins and minerals that are required in small amounts by the body for proper growth and development (Ritchie and Roser, 2017). Micronutrient deficiency conditions are widespread in developing and in developed countries. These are silent epidemics of vitamin and mineral deficiencies affecting people of all genders and ages, as well as certain risk groups. They not only cause specific diseases, but they act as exacerbating factors in infectious and chronic diseases, greatly impacting morbidity, mortality, and quality of life. Micronutrient deficiency conditions relate to many chronic diseases, such as osteoporosis, osteomalacia, thyroid deficiency colorectal cancer and cardiovascular diseases. The World Health Organization (WHO) considers that more than 2 billion people worldwide suffer from vitamin and mineral deficiencies, primarily iodine, iron, vitamin A and zinc, with important health consequences. Common micronutrient deficiency like iron, iodine, zinc, vitamin B12, vitamin D has significant on cognitive and physical development and well-being (Tulchinsky, 2010).

2.7.6 Overweight and obesity

Obesity and overweight are a complex condition that interweave biological, developmental, environmental, behavioral, and genetic factors; it is a significant public health problem. The most common cause of overweight and obesity throughout childhood and adolescence is an inequity in energy balance; that is, excess caloric intake without appropriate caloric expenditure (Kansra *et al.*, 2021) .

The majority of high-income nations, developing nations going through a nutrition transition, and even developing nations with ongoing issues with food insecurity and undernutrition are seeing an increase in obesity. Stunting, which is a sign of chronic malnutrition, and obesity frequently coexist. There could even be a connection between both, as those who are stunted are more likely to be obese, and persons who were exposed to starvation as children are more likely to develop chronic illnesses. During their adolescent growth spurt, adolescents who were

growth-retarded at birth also have a tendency to gain greater weight. Teenagers are particularly sensitive to discrimination from society when it comes to their bodies, and they have sensitive Perception about weight issues. Adolescent obesity is regularly linked to low self-esteem and negative Perception about weight. 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).

Overweight and obesity during adolescence represents a strong predictor of obesity in adulthood. Obesity during adolescence increases the risk of developing type 2 diabetes (T2D) and cardiovascular disease in adulthood. Obesity during childhood and adolescence also predicts higher adult mortality (Nicolucci and Maffeis, 2022) . In the Norwegian, very high adolescent BMI was associated with 30–40% higher adult mortality compared with medium BMI (Engeland *et al.*, 2004). Obesity increases the risk of developing early puberty in children, menstrual irregularities in adolescent girls, sleep disorders such as obstructive sleep apnea, cardiovascular risk factors that include Prediabetes, Type 2 Diabetes, High Cholesterol levels, Hypertension, NAFLD, and Metabolic syndrome. Additionally, obese children and adolescents can suffer from psychological issues such as depression, anxiety, poor self-esteem, Perception about weight and peer relationships, and eating disorders (Kansra *et al.*, 2021) .

2.8 Factor affecting nutritional status of an adolescence

The availability and distribution of food, food consumption, income and purchasing power, family size, illiteracy, sociocultural and religious beliefs, birth order, environmental hygiene, and access to healthcare facilities are some of the additional factors that impact nutritional status. In poor nations such as Nepal, the primary causes of nutritional inadequacy are poverty, inadequate access to food, and inadequate nutrition education (Devkota *et al.*, 2015). The factors that affect the nutritional status are discussed below:

2.8.1 Dietary adequacy

Diet has an impact on adolescent health and development, which carries over into adulthood. Inadequate consumption of calories, macronutrients, or micronutrients throughout adolescence may have negative long-term consequences. Adolescent malnutrition can also result in disordered eating habits, such as dieting or restriction, negative Perception about weight, or a

strained connection with food, all of which can contribute to an inadequate diet (Evans and Docter, 2020).

In a study conducted in south central Ethiopia Damot Gale district, a high prevalence of inadequate dietary intake of both macro- and micronutrients among adolescent girls was found (Yilma *et al.*, 2021). Although poverty is thought to be the main factor influencing food intake, other studies believe that cultural factors rather than socioeconomic conditions have a greater influence on how food is allocated and how adequate the nutrition is. Individual family members' mean calorie consumption may be less than what is needed, even in situations when there are sufficient food supplies. Adolescents and children under two are the most vulnerable (WHO, 2006) .

2.8.2 Psychosocial factor

Social, cultural, and environmental occurrences and influences that impact behavior and mental health are known as psycho-social factors. Eating habits often change during adolescence and early adulthood. This is due to social shifts that happen from school age to adolescence, such as the shift from eating mostly at home to eating with peers or on campus, but it's also a time for identity exploration. 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. Adolescents' changing identities, struggles with independence and acceptability, and self-consciousness about looks could all have a significant effect on their eating habits, lifestyle, and intake. An important factor influencing food habits and nutritional risk during adolescence is Perception about weight and associated disorders, especially in females (WHO, 2005) .

2.8.3 Food security

Although it is essential for proper nutrition, having access to food does not ensure it. Although food usage might also be included, there are three core components to food security: food availability, food stability, and food access. Adequate food supplies obtained from both domestic production and imports are referred to as national food security. Food insecurity can be brought on by a lack of food, a low level of purchasing power, improper distribution, or poor home food utilization (UNICEF, 1990). There seems to be a link between household food

insecurity and a higher risk of stunting and underweight in children and adolescents. Furthermore, the likelihood of stunting or underweightness in food-insecure homes may rise due to the severity of food insecurity and the growing ages of children (Moradi *et al.*, 2019).

Adolescents experiencing food insecurity were shown to be substantially more likely to skip breakfast, sleep fewer than 8 hours a day, smoke, or drink alcohol on a regular basis. Adolescent food hardship may be a significant risk factor for poor cardiometabolic health (Robson *et al.*, 2017). Food insecurity is an indicator of socio-economic distress and hardship. In a study done in New Zealand at 2012, young people with food security concerns were more likely to report poor indicators of health and wellbeing. Adolescents experiencing food security concerns were more likely to be overweight, experience poorer mental health, and were more likely to skip school (Utter *et al.*, 2018)

According to MOHP (2022), overall 13% of the household population experienced moderate or severe food insecurity in the 12 months. Moderate or severe food insecurity is higher in rural areas (16%) than urban areas (11%). By ecological zone, food insecurity is highest in the mountain zone (21%) compared to the hill and terai zones (12% each). By province, food insecurity ranges from 8% in Gandaki Province to 32% in Karnali Province.

2.8.4 Health, water and sanitation

Many factors, such as knowledge and environment, influence population-wide practices that support and sustain good health. These habits include obtaining medical attention from professionals when ill, having access to healthcare, and managing communicable illnesses. Individuals who are in bad health typically find it difficult to participate in worthwhile, productive activities and have to spend more money on medical care than on eating. Nutritional vulnerability can be increased by poor health, which also makes one more susceptible to food insecurity (FSAU and UNICEF, 2007).

Sanitation issues like disposal of human waste, disposal of garbage and cleanliness of the household environment affect the health of a population. Poor sanitation may be associated with a number of infectious and nutritional outcomes, and these outcomes also cause a heavy burden of disease globally. Diarrhea accounts for the largest share, causing an estimated 1.4 million deaths annually. Poor sanitation can adversely impact nutritional status in young children and

adolescent not only through the impaired absorption of nutrients associated but through sub-clinical infections with fecal pathogens(Freeman *et al.*, 2017).

Providing safe water quality at the point of use and ensuring proper hygiene practices remain issues, despite the fact that 62% of Nepal's population has access to basic sanitation facilities and 89% of the country's population has at least basic water supply services. Intestinal parasite infection was discovered in 31.5% of youngsters in Nepal's Eastern area according to a recent study. Thumb sucking, not wearing sandals, and not using soap after urinating have all been strongly linked to parasitic illnesses. But there hasn't been much research done on children's health and nutritional status in Nepal's remote hill country, nor on how it relates to WASH and nutrition (A. Shrestha *et al.*, 2020a) .

2.8.5 Socio-economic and political condition

The political and economic state of the nation has a direct impact on the availability of food, health care, and overall development. The distribution and use of natural resources, demographic characteristics, literacy rates, market circumstances, and the modernization of the agricultural sector are the socioeconomic factors that impact the country as a whole. The economy's resource and investment allocation are mostly determined by political conditions as much as political will. Food security is influenced at the subnational or regional level by cultural views about what to possess and consume, social institutions like family size, caste or ethnicity and relationships, livelihood systems (occupation), and household features like the percentage of working people (FSAU and UNICEF, 2007).

Large families, low literacy rates, food insecurity, food safety, and women's education seem to be the main contributing causes to the poor health of children from low socioeconomic classes. To increase nutritional status, improvements in the areas of politics, society, and the economy are needed, in addition to personal growth through educational possibilities (Babar *et al.*, 2010).

2.9 Dietary intake and behavior of an adolescence

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 (WHO, 2005). Total nutrients intake and energy needs during puberty exceed those at any other stage of life as a result of increasing skeletal mass, body fat and lean body mass. Unfortunately, there is a limited data about the optimal energy and nutrients intakes during adolescence (Hammoud *et al.*, 2008).

Current dietary practices seen in adolescents may have several consequences on their health. Strong evidence showed that many adolescents do not follow a diet that meets their dietary guidelines. Study from UK National Diet and Nutrition Survey showed that only 7% of females and 10% of males of adolescent age meet up their nutrient requirement(Kubik *et al.*, 2003) . Adolescent eating patterns are established through a complex process involving internal and external factors such as food preferences and availability, body weight perception, and parental and peer influences (Azeredo *et al.*, 2016).

2.10 Nutritional requirement of an adolescence

Recommended Dietary Allowances (RDAs) are the level of intake of essential nutrients that, on the basis of scientific knowledge , are prepared by the food and nutrition expert to be adequate to meet the known nutrients needs of practically all healthy person (NRC, 1989). Human nutritional requirement depends upon the age and sex of the individual. An adult man requires nutrients for maintenance while infants, children and adolescent need them for both maintenance and growth (Srilakshmi, 2006).

NIN (2020) has classified the period of adolescence into three groups of 10-12 years, 13-15 years and 16-18 years. Present guideline of ICMR-NIN does not suggest an RDA for energy requirements although EAR for energy is suggested. EAR for boys of age group 10-12 years, 13-15 years and 16-18 years are 2220 kcal, 2860 kcal and 3320 kcal respectively whereas EAR for same age groups of girls are 2060 kcal, 2400kcal and 2500 kcal respectively. There is no RDA for carbohydrates. But for visible fat it recommends the daily minimum intake levels and for total fats it recommends minimum amount of fat in term of total calories. The recommendation of minimum daily total fat intake in adolescent is 25% of total calories. Fat from invisible source is recommended to be at least 10% of total energy. If the proportion of invisible fat increases it is suggested to decrease the requirement of visible fat. The recommended levels of visible fat intake in boys of age 10-12 years, 13-15 years and 16-18

years are 35g/day, 45g/day and 50g/day respectively. While in girls of same age group the recommended levels are 35g/day, 40g/day and 35g/day respectively. Moderate level of activity among adolescents is considered for calculation of RDA. Table 2.1 and 2.2 shows the RDA for adolescent boys and girls respectively.

Table 2.1 RDA of nutrients for 10-18 years age boys.

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

Source: (NIN, 2020)

Table 2.2 RDA of nutrients for 10-18 years age girls

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

Source: (NIN, 2020)

2.11 Nutritional assessment

The information provided by a nutritional status assessment is essential for researching how nutrition affects health and disease, identifying essential nutrients in a given population and the groups most at risk of insufficiency, and creating public health programs that effectively prevent and treat diseases linked to poor nutrition (Elmadfa and Meyer, 2014). Nutrition assessment provides timely, high-quality, and evidence-based information for setting targets, design,

planning, monitoring, and evaluating programs aiming at eradicating hunger and reducing the burden of malnutrition in all its forms (FSAU and UNICEF, 2007).

According to Joshi (2015) the assessment of nutritional status can be done by direct or indirect method as below:

a. Direct method: Addresses the individual and measure's objective criteria. The direct approach of nutritional surveys can be stated as ABCD.

i. Anthropometric method
ii. Biochemical assessment
iii. Clinical examination
iv. Dietary intake assessment

b. Indirect method**:** Use community indices to assess nutritional condition and need. The indirect approach of nutritional surveys can be stated as follows:

i. Vital health statistics
ii. Ecological factors

2.11.1 Direct method

There are four different types of direct methods that can be used independently or cooperatively, depending on the goal.

a) Anthropometric Method

Anthropometric measurements are noninvasive quantitative measurements of the body. Anthropometry provides a valuable assessment of nutritional status in children and adults. Typically, they are used in the pediatric population to evaluate the general health status, nutritional adequacy, and the growth and developmental pattern of the child. Growth measurements and normal growth patterns are the gold standards by which clinicians assess the health and well-being of a child. In adults, body measurements can help to assess health and dietary status and future disease risk. These measurements can also be used to determine body composition in adults to help determine underlying nutritional status and diagnose obesity. The core elements of anthropometry are height, weight, head circumference, body mass index

(BMI), body circumferences to assess for adiposity (waist, hip, and limbs), and skinfold thickness.

According to the American Academy of Pediatrics and the Child Health and Disability Prevention (CHDP) Program Health Assessment Guidelines, accurate serial anthropometric measurements can help identify underlying medical, nutritional, or social problems in children and adolescent (Casadei and Kiel, 2019).

Advantages of anthropometry (Srivastava, 2008):

- Simple, non-invasive.
- Quickly identifies mild to moderate malnutrition.
- Relatively unskilled personnel can perform measurements.

Table 2.3 Anthropometric indicators of nutritional status for adolescents

	Cut off	**Indicators**	
		Height for age	**BMI for age**
Z score	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	May be abnormal	Severely Obese

b) Biochemical Assessment

The process of measuring bodily secretions, fluids, etc. against a standard parameter is known as biochemical evaluation. For example, testing for immunological function, albumin, creatinine, etc. (Shrivastava *et al.*, 2014). Blood and urine are the two easily available fluids, which are used in biochemical assessment of nutritional

status. A wide range of tests can be used and an appropriate one should be selected depending on the type of survey being carried out (Joshi, 2002).

c) Clinical examination

It is possible to perform an external evaluation for alterations in the superficial epithelial tissues, including the skin, eyes, hair, and buccal mucosa. In addition, organs near the skin's surface, like the thyroid and parotid glands, may be inspected. It is predicated on physical sign observation, and it doesn't need complex field equipment (Joshi, 2002).

d) Dietary intake assessment

Dietary intake assessment is done to assess the nutritional intake, questionnaire, recall or record method can be implied for performing intake assessment (Shrivastava *et al.*, 2014). A dietary assessment is a comprehensive evaluation of a person's food intake. It is the blanket term for any method used in diet surveys. Diet history, 24 hour dietary recall, food frequency questionnaire, record methods etc. are some of the common techniques used for dietary evaluation (Joshi, 2002).

2.11.2 Indirect method

a) Vital health statistics

Vital data, such as records of births and deaths of children, mother deaths, etc., are more important for public health since they can be used to determine the prevalence rate and identify risk groups (Shrivastava *et al.*, 2014).

b) Ecological factors

Malnutrition is a result of ecological factors such as socioeconomic conditions, access to healthcare, etc. An evaluation is required to determine the factors influencing society's nutritional status (Shrivastava *et al.*, 2014).

2.12 Dietary intake assessment

A dietary survey is a systematic evaluation of eating habits that can identify nutritional deficiencies. Dietary surveys can be conducted at the household, individual, region, state, or national levels using a variety of techniques (Shrivastava *et al.*, 2014).

While qualitative research focuses on the types of meals consumed, food preparation methods, food preferences, cultural influences, and attitudes toward foods, quantitative surveys collect data on the quantity of different foods consumed by individuals and/or populations. Because no single dietary assessment approach is perfect, it is best to employ a combination of the two depending on the kind and purpose of information needed (Vuckovic *et al.,* 2000). Dietary assessment can be done in different levels, from national to individual level (den Hartog *et al.*, 2006).

2.12.1 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 checklist method, Food inventory method, List-recall method, and Household record (weighing) method(den Hartog *et al.*, 2006). Household dietary diversity Score (HDDS) method can be used as qualitative method for the assessment (Kennedy *et al.*, 2011). A survey done at London, UK most participant prefer the food checklist method which yield higher estimates of energy and nutrient intakes (Holmes *et al.*, 2008).

2.12.2 Methods for individual dietary assessment

Main methods for assessing present or recent diet as individual survey include food records, 24-hours recall, and food frequency questionnaires. In order to quantify the intake of foods, some estimate of the weight of consumed food is required. To convert food intake into nutrient intake, the availability of a food composition database/food table is essential. By combining the information of dietary intake and food composition databases/tables one can determine whether the diet is nutritionally adequate or not (FAO, 2009). At the individual level, many qualitative and quantitative methodologies might be applied. Quantitative approaches are useful for assessing both current and past intakes. Some ways are listed below:

a) 24-hour dietary recalls

   In a 24-hour recall, the individual is asked to provide estimates of the amount of food and drink they have consumed during the previous 24-hour period. The greatest value of the 24–hour recall method is its ability to estimate nutrient intakes of population groups.

This method is used widely to compare nutrient intakes with specific dietary recommendations. Repeated 24-hour recalls are often used as a comparison method to represent usual intake in food frequency questionnaires (FFQ) validity studies. The major limitation of recalls is that they are seldom representative of usual intake (FAO, 2004).

b) Estimated food records

An estimated food record is similar to a 24-hour recall: it consists of a detailed description of food and drink consumed over a period (usually three to five days). 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 (FAO, 2004).

c) Weighed food record

The weighed food record or duplicate-food collection method is often regarded as the most precise method for estimating food and/or nutrient intakes of individuals. Here, the amounts of food consumed are actually weighed and recorded so more accurate measurements of actual intake than calculations based on food composition tables can be obtained. 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 (FAO, 2004).

d) Dietary history

The dietary history method estimates usual food intakes of individuals over a relatively long period lasting several weeks or months. The advantage of this method is its ability to detect seasonal changes, obtain data on all nutrients and to correlate well with biochemical measures. However, 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 (FAO, 2004).

e) Food frequency questionnaire

The FFQ is the best available method for conducting studies on diet and disease relationships: it 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 exposure period than short-term intakes. The benefit of this method is that it can provide more representative information on usual intake than a few days of diet records or recalls. However, the method is limited in that it may not provide details of accurate quantities or portion sizes (FAO, 2004)

2.12.3 Dietary diversity score

Dietary diversity is a qualitative indicator of food intake that represents household access to a range of foods and serves as an indicator for an individual's diet's adequacy in terms of nutrients. The dietary diversity questionnaire is a quick, simple, and affordable diagnostic tool that can be easily used. It is simple to score and analyze the data gathered through the questionnaire. A simple tally of the food types that a family or an individual consumed over the last 24 hours makes up the dietary variety scores. Additionally, the data gathered can be analyzed to yield details on particular food groups of interest (Kennedy *et al.*, 2011).

Dietary diversity has been linked to the pillars of food security: accessibility, availability and utilization. Nutrition status is seen as an outcome of biological processes that involve adequate nutrient intakes among groups while dietary diversity ensures adequate nutrient intakes in population. Dietary diversity is a better predictor of diet quality than that based on individual food items. Consuming a diet that consists of a wide range of food items has been shown to increase intake of energy and micronutrients in developing countries (Sealey-Potts and Potts, 2014).

The household dietary diversity score (HDDS) offers a quick overview of a household's financial capacity to purchase a range of foods. Research indicates a relationship between home food security (household energy availability) and socioeconomic position and an increase in dietary diversity. The goal of individual dietary diversity scores (IDDS) is to represent adequate nutritional intake. Research across a range of age groups has demonstrated a correlation between higher individual dietary variety scores and increased nutrient adequacy of diets (Kennedy *et al.*, 2011).The seven food groups are provided by WHO (2010) includes

a) Grain, root 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, 2010).

Minimum dietary diversity score (MDDS)

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

PART III

Materials and methods

3.1 Research design

A school based cross-sectional study was conducted to assess the nutritional status and associated factors among adolescent aged 10-19 years which includes:

a) Anthropometric measurement of adolescent in the schools of Dharan sub-metropolitan city.
b) General survey of the situation of household belonging to the adolescent under study with the help of questionnaire.

3.2 Study area

Study was done in private and public schools of Dharan sub-metropolitan city. Dharan lies in Sunsari district of Koshi province. According to the municipality data, it has twenty wards and has a population of 1,66,531. The total population of adolescents in Dharan is 29,586 according to the national census of Nepal 2078, in which the male adolescent population was 14,991 and female adolescent population was 14,595.

3.3 Study variable

Dependent variables

a) Height for Age
b) BMI for Age

Independent Variables

a) Demographic and socioeconomic characteristics
b) Adolescent's characteristics
c) Household characteristics
d) Food preferences and physical activities

3.4 Target population

The target population of the study was 10-19 years adolescent of selected private and public schools in Dharan sub-metropolitan city.

a) **Inclusion criteria**

   Students within age group of 10-19 years.

b) **Exclusion criteria**

   Students who were ill and who were not willing to participate.

3.5 Sampling technique

Cross-sectional descriptive study was conducted in Dharan sub-metropolitan city. By using the simple random sampling method, 10 schools (5 private and 5 Public) were selected from the list of schools. Then, students were selected from each class by using lottery method by drawing out the roll numbers of students presented in the class.

3.6 Sample size

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

Sample size (n0) = z^2pq / e^2

Where, n0= required sample size

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

p = estimated prevalence of malnutrition in project area

m = margin of error at 6% (standard value of 0.05)

Here , P=34.7 ≈ 35 % was estimated on the basis of research conducted in private and public schools of kohalpur municipality (Pandey, 2018).

Now, n0= $(1.96)^2 \times 0.35 \times 0.65 \ / \ (0.06)^2$

$= 242.77 \approx 243$

According to the National census 0f Nepal-2078, the total population of adolescent age 10-19 years of Dharan sub metropolitan city is 29,586. So, we have formula for finite population

$$n = \frac{no}{1+(\frac{no-1}{N})}$$

where, n = sample size for finite population and

N= Population size

$$n = \frac{243}{1+(\frac{243-1}{29586})}$$

$$= 241.07 \approx 241$$

With addition of non-response rate of 10 %, sample size becomes, 241+ 10% × 241 = 265.1≈ 265

Source: Kothari (2004)

3.7 Research instrument

Following equipment's were used during the survey:

a) Digital weighing machine
b) Stadiometer
c) Questionnaire

3.8 Pre-testing

The prepared sets of questionnaire and anthropometric instruments were pre-tested among 25 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 were omitted and questionnaire was revised in accordance with the findings of pre-testing and suggestions.

3.9 Validity and reliability

To ascertain the degree to which the data collection instruments measured what they purposed to measure, the instruments were validated at Central Campus of Technology, Central department of Nutrition and Dietetics. The expected test in the questionnaire was also drawn according to the available literature in nutrition education for adolescent. The questionnaire was also pre-tested prior to data collection to ascertain content and face validity.

Reliability refers to quality control measure of data collected. Before data collection, detailed study was based on the objectives of the study and on data collection techniques. Questionnaire was checked daily for completeness, consistency and clarity as mentioned earlier. In addition, the thesis supervisors also visited the research site periodically to monitor the process of data collection.

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 to obtain socio-demographic and economic information. Height and weight were measured by using stadiometer and digital weighing balance.

Secondary data was obtained from Sub-metropolitan office, Nepal Demographic Health Survey (NDHS), Central Bureau of Statistics (CBS).

3.10.1 Date of birth

The date of birth was asked to the participant, if the answer was suspected to be unreliable queries about schooling, school identity cards, etc. were made to extract correct data.

3.10.2 Height

In order to measure height subject was first asked to stand straight without shoes on horizontal platform with heels together and hanging the arms loose. Head was made at Frankfurt plane, buttocks and shoulder blades in contact with vertical surface of stadiometer. He was asked to take deep breath and stand tall to aid the straightening of the spine and shoulders relaxed.

Movable headboard was lowered until it touches crown of head. Height measurement was taken at maximum inspiration, with examiner's eyes in level with headboard to avoid parallax error. Reading was taken to nearest millimeter. For reading falling between two values, lower reading was recorded (R. S. Gibson, 1993).

3.10.3 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 center of the platform and look straight ahead standing relaxed but still. Body weight was recorded to nearest 0.1 kg (R. S. Gibson, 1993).

3.10.4 Food frequency and dietary recall

A well-designed food frequency table along with 24-hour dietary recall sheet was used to study the food consumption pattern and nutrient intake of the adolescents. 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 respondents were asked to recall in detail all the food and drink consumed in 24 hours (previous day). Adequate time and assistance were given to respondent to recall properly and estimate the portion sizes. Necessary comparisons were made between the household utensils and measuring cups used in data collection for assistance of respondents to recall with accuracy. From the data collected from dietary recall, gram equivalents of those foods consumed were first calculated which were converted into nutrient intake namely, carbohydrate, protein, fat and total calories by using 'Nepalese food composition table 2017'. The amount of ingredients required to prepare fast foods were estimated by asking with the local shopkeeper and restaurants in Dharan. The nutrient contents of packaged foods consumed were estimated by using nutritional information provided by manufacturers.

3.11 Data analysis

First the data was checked for completeness and consistency. Data was analyzed by using SPSS version 25 and MS excel. Likewise qualitative data was transcribed and coded by assigning

labels to various categories. The data was analyzed both by descriptive and inferential statistics. Frequency and percentage distribution was used to describe adolescent characteristics, demographic characteristics, socio-economic characteristics, dietary habit and behaviors, dietary diversity, consumption of food groups, nutrition related knowledge and prevalence and distribution of malnutrition. Mean was used to describe the dietary intakes. Chi-square test was used to test the association between dependent and independent variables and also for the factors associated with dependent variable.

3.12 Logistic and ethical considerations

Ethical clearance was obtained from Central Campus of Technology, Department of Nutrition and Dietetics and the school authority. Verbal consent was obtained from the respondents after explaining the purpose of the study. Privacy and confidentiality of collected information was ensured at all level.

PART IV

Results and discussion

The study investigates the food habits and nutritional status of adolescents enrolled in private and public schools of Dharan sub-metropolitan city. In addition, socioeconomic and demographic variables were examined, along with aspects related to eating behavior, environmental conditions, and adolescent's characteristics and their associations with nutritional status. The results and findings of the study are:

4.1 Demographic and socio-economic characteristics

Table 4.1 shows the caste and religion of the surveyed adolescents of private and public schools of Dharan sub-metropolitan city. Out of 140 adolescents of private schools 27.86% were Rai followed by 21.43% Tamang. Similarly in Public school, among 140 adolescents' highest percentage which is 32.86% of students were Tamang followed by 27.14% Rai.

Table 4.1 Frequency distribution of caste and religion of the surveyed adolescents.

Variables	**Private school (n=140)**		**Public school (n=140)**	
	Frequency	**Percent**	**Frequency**	**Percent**
Caste				
Brahmin	13	9.29	10	7.14
Chhetri	16	11.43	23	16.43
Rai	39	27.86	38	27.14
Magar	6	4.29	3	2.14
Limbu	25	17.86	20	14.29
Tamang	30	21.43	46	32.86
Others	11	7.86	0	0.00
Religion				
Hindu	73	52.14	81	57.86
Christian	4	2.86	7	5.00
Kirat	46	32.86	40	28.57
Buddhist	16	11.43	10	7.14
Others	1	0.71	2	1.43

The surveyed adolescents from both private and public schools were predominantly from Hindu religion. In private school 52.14% students belonged to Hindu religion whereas in public school

57.86% students were Hindu. From the table 4.1, 32.86% Kirat, 11.43% Buddhist, 2.86% Christian and 0.71% students following other religion were found in private school. Similarly, 28.57% kirat, 7.14% Buddhist, 5.00% Christian and 1.43% students were from other religion in public school.

Table 4.2 Frequency distribution of economic characteristics of the surveyed adolescent's families.

Variables	**Private school (n=140)**		**Public school (n=140)**		**p-value**
	Frequency	**Percent**	**Frequency**	**Percent**	
Father's occupation					
Agriculture	9	6.43	6	4.29	<0.001*
Service	24	17.14	15	10.71	
Labor	7	5.00	37	26.43	
Business	16	11.43	21	15.00	
Foreign	34	24.29	16	11.43	
Others	50	35.71	45	32.14	
Mother's occupation					
Agriculture	3	2.14	3	2.14	<0.001*
Service	9	6.43	8	5.71	
Labor	0	0.00	16	11.43	
Business	13	9.29	9	6.43	
foreign	15	10.71	12	8.57	
Housewife	80	57.14	91	65.00	
Others	20	14.29	1	0.71	
Monthly income					
< 30 thousand	48	34.29	83	59.29	<0.001*
> 30 thousand	92	65.71	57	40.71	

The frequency distribution and economic features of the adolescent households surveyed are displayed in Table 4.2. The majority of private school students' fathers were employed abroad (24.29%). In the same way, 26.43% of the fathers of adolescents attending public schools were labor. The majority of mothers of adolescents in both private and public schools were housewives.

According to the NRB (2016) average household earnings in Nepal was Rs, 30,121 which was used as the reference for comparison of earnings. The majority of the families of adolescents attending private schools earn more than Rs 30,000 per month. Merely 34.29% of adolescents from private school families do not earn more than Rs 30,000 per month. Similarly, 40.71% of the families of adolescents enrolled in public schools make more than Rs 30,000 a month, compared to 59.29% of the families who do not. There was significant difference among fathers' occupation, mothers' occupation and monthly income between the private and public school adolescent's families.

Table 4.3 Frequency distribution of socio-demographic characteristics of the surveyed adolescent's families.

Variables	**Private school (n=140)**		**Public school (n=140)**		**p-value**
	Frequency	**Percent**	**Frequency**	**Percent**	
Family type					
Nuclear	75	53.57	104	74.29	<0.001*
Joint	65	46.43	36	25.71	
Family size					
< 5 members	55	39.28	43	30.71	0.133
> 5 members	85	60.72	97	69.29	
Father's Education					
Higher Secondary	39	27.86	23	16.43	0.019*
Secondary	57	40.71	57	40.71	
Primary	26	18.57	42	30.00	
Informal	16	11.43	11	7.86	
Illiterate	2	1.43	7	5.00	
Mother's Education					
Higher Secondary	45	32.14	20	14.29	0.002*
Secondary	49	35.00	52	37.14	
Primary	21	15.00	37	26.43	
Informal	20	14.29	19	13.57	
Illiterate	5	3.57	12	8.57	

Table 4.3 shows the socio-demographic characteristics of the surveyed adolescents. Adolescents attending private schools make up 53.57% of nuclear families and the remaining 46.43% of joint families. In the same way, among adolescents attending public schools, 74.29% came from

nuclear families and 25.71% from joint families. According to MOHP (2022), the national average family size is 4.37. From the table, it is indicated that 39.28% and 60.72% private school adolescents' families have less than 5 and more than 5 family members respectively. Meanwhile, among public schools' adolescents 30.71% have family's member less than 5 and 69.29% have family's member more than 5.

The table indicates that most fathers of adolescents enrolled in both private and public schools had completed their secondary education. Of the fathers of adolescents in private schools, 27.86% had completed higher secondary education, 40.71% had completed secondary education, 18.57% had completed primary education, and 11.43% had completed informal education. Mean, fathers of adolescents attending private schools were found to have an illiteracy rate of 1.43%. Comparatively, 16.43% of the fathers of adolescents enrolled in public schools had completed higher secondary education, 40.71% had completed secondary education, 30% had completed primary education, 7.86% had completed informal education, and 5% were illiterate. Additionally, of the adolescents attending private schools, 32.14% of their mothers had completed their higher secondary education, 35% had completed their secondary education, 15% had only completed their primary education, 14.29% had received informal education, and 3.57% were illiterate. Comparably, of the mothers of adolescents attending public schools, 14.29% had completed their higher secondary education, 37.14% had completed their secondary education, 26.43% had completed their primary education, 13.57% had achieved informal education, and the other 8.57% were illiterate. There was significant difference among family type, father education and mother education between the private and public school adolescent's families. Meanwhile, no any significant difference was found among the family size between the two group.

4.2 Adolescent characteristics

Table 4.4 show the adolescent characteristics of surveyed population. Out of 280 adolescents, 140 were from private school and 140 were from public school. Among the adolescents attending the private school, 50.71% were female and 49.29% were male. At the same level, among the adolescents surveyed at public schools, 51.43% were male and 48.57% were female. Similarly, of the adolescents attending private schools, 48.57% belonged to the 10–14 age group

and 51.43% to the 15–19 age group. Comparably, among adolescents attending public schools, 45% belonged to the 10–14 age group and 55% to the 15–19 age group. No any significant difference was found among sex and age classification between the private and public school adolescents.

Table 4.4 Frequency distribution of age group and gender of the surveyed adolescents.

Variables	**Private school (n=140)**		**Public school (n=140)**		**p-value**
	Frequency	**Percent**	**Frequency**	**Percent**	
Sex					
Male	69	49.29	72	51.43	0.720
Female	71	50.71	68	48.57	
Age classification					
10-14 years	68	48.57	63	45.00	0.549
15-19years	72	51.43	77	55.00	

While analyzing the table 4.5, it was seen that most of the surveyed adolescents from the both private and public schools are elder most child of their family. Among adolescents attending private schools, 56.43% are first-born, 32.14% are second-born, 9.29% are third-born, and 2.14% are fourth-born. Similarly, among adolescents attending public schools, 46.43% are first-born children, 35% are second-born children, 15.71% are third-born children, 0.71% are fourth-born children, and 2.14% are fifth-born children. Likewise, the table shows that the majority of adolescent families in Public and private schools had one adolescent, with 50% and 51.43% of the cases, respectively. As shown in the table, 45% of the adolescents from private schools had one sibling, 20% had two siblings, 9.29% had three siblings and 0.71% had five siblings. Also, among public schools' adolescents 30% had one sibling, 40% had two siblings, 14.30% had three siblings, 5% had four siblings and 1.43% had five siblings. No any significant difference was found among birth order and number of adolescents in a family between the private and public school adolescents. However, there was significant difference among the number of siblings between the two groups.

Table 4.5 Frequency distribution of the adolescent's characteristics.

Variables	Private school (n=140)		Public school (n=140)		p-value
	Frequency	Percent	Frequency	Percent	
Birth order					
1	79	56.43	65	46.43	0.059
2	45	32.14	49	35.00	
3	13	9.29	22	15.71	
4	3	2.14	1	0.71	
5 or more	0	0.00	3	2.14	
Number of adolescents in a family					
0	3	2.14	3	2.14	0.160
1	72	51.43	70	50.00	
2	52	37.14	55	39.33	
3	7	5.00	11	7.91	
4	5	3.57	0	0.00	
5 or more	1	0.71	1	0.71	
Number of siblings					
0	35	25.00	13	9.29	<0.001*
1	63	45.00	42	30.00	
2	28	20.00	56	40.00	
3	13	9.29	20	14.30	
4	0	0.00	7	5.00	
5 or more	1	0.71	2	1.43	

4.3 Environmental conditions

Table 4.6 indicates the environmental characteristics of the surveyed adolescents of both private and public schools. Out of the adolescents attending private schools, 95.71% household got their drinking water from the tap, 0.71% from rivers, 1.43% from ponds, and 2.14% from other sources. In a similar way, 95.71% household use tap, 3.57% use river, 0.71% use pond as a source of drinking water among the adolescents of public school. Majority (91.43%) of household of private school adolescents adopted water purification method and 8.57% drink directly without purifying. Whereas 80% household of adolescents of public schools purify water before drinking and 20% household of public schools' adolescents consume water directly

without purifying. All the household of both private and public school adolescents have access to toilet facility.

Table 4.6 Frequency distribution of environmental characteristics of the surveyed adolescent's families.

Variables	Private school (n=140)		Public school (n=140)		p-value
	Frequency	Percent	Frequency	Percent	
Source of drinking water					
Tap	134	95.71	134	95.71	0.060
River	1	0.71	5	3.57	
Pond	2	1.43	1	0.71	
Other	3	2.14	0	0.00	
Purification of water					
Yes	128	91.43	112	80.00	0.006*
No	12	8.57	28	20.00	
Toilet Facility					
Yes	140	100.00	140	100.00	
Source of Food					
Own Production	3	2.14	4	2.86	0.035*
Market	40	28.57	62	44.29	
Both	97	69.29	74	52.85	

According to MOHP (2022) 98% of the household population in Nepal (98% of the urban population and 96% of the rural population) has access to at least basic drinking water service. Still, 1% of the household population have only limited service, 2% have access to unimproved sources, and less than 1% use surface water. In Nepal, only one-fourth (25%) of the population uses drinking water treated with appropriate methods (boiling, bleaching, filtering, and solar disinfection). Ceramic, sand, or other filters are the most common (15%) method of water treatment, followed by boiling (13%). More than one-fourth (28%) of the urban population treats drinking water with an appropriate method, as compared with about one-fifth (19%) of the rural

population. Also, In Nepal, 73% of the household population has at least basic sanitation service. There was significant difference among purification of water and source of food between the private and public school adolescent's families.

4.4 Physical activity

Table 4.7 Frequency distribution of physical activity of the surveyed adolescents.

Variables	Private school (n=140)		Public school (n=140)		p-value
	Frequency	Percent	Frequency	Percent	
Means of transportation					
Private vehicle	10	7.14	5	3.57	0.523
Cycle	3	2.14	5	3.57	
School bus	25	17.86	25	17.86	
Walk	102	72.86	105	75.00	
Homework time					
None	3	2.14	6	4.29	0.009*
Less than1hour	28	20.00	43	30.71	
1 to 2 hours	85	60.71	57	40.71	
more than 2 hours	24	17.14	34	24.29	
Activity in school break					
Sit, eat, talk, study	87	62.14	56	40.00	<0.001*
Walk	40	28.57	42	30.00	
Play games, run	13	9.29	42	30.00	
Involvement in physical activity at home					
Yes	114	81.43	90	64.29	<0.001*
No	26	18.57	50	35.71	
Involvement in Domestic activity					
Yes	132	94.29	130	92.86	0.626
No	8	5.71	10	7.14	
Sleep hour					
< 5 hours	3	2.14	6	4.29	0.650
6 hours	18	12.86	22	15.71	
7 hours	45	32.14	43	30.71	
>8hours	74	52.86	69	49.29	

Table 4.7 indicates the physical activity of the surveyed adolescents of both private and public schools. The majority of adolescents attending private schools (72.86%) and those going public schools (75%), walk to school. However, the percentage of adolescents who took the school bus, which is 25% in both cases, is similar. Additionally, 3.57% of adolescents in public schools and 7.14% of adolescents in private school's travel by private vehicle.

60.71% of adolescents in private schools spend one to two hours on their homework, compared to 40.71% of adolescents in public schools. 17.14% of adolescents in private schools spend more than two hours on their homework. Likewise, 24.29% of adolescents in public schools spend more than two hours on their homework. During break time 62.14% of adolescents attending private schools engage in activities such as eating, talking, studying, and sitting, while 40% of adolescents attending public schools fit the same description. During the break, 9.29% of adolescents from private schools and 30% from public schools engaged in game play.

It was discovered that 94.29% and 81.43%, respectively, of adolescents enrolled in private schools engaged in domestic duties and physical exercise. In similar fashion, it was discovered that 64.29% and 92.86% of adolescents studying at public schools engaged in physical and household activities. The percentage of adolescents in private and public schools who slept for longer than eight hours was 52.86% and 49.29%, respectively. No any significant difference was found among means of transportation, involvement in physical activity and sleep hour was found between the adolescents of private and public schools. While, there was significant difference in homework time, involvement in physical activity at home and activity in school break between the two groups.

4.5 Dietary habits and behavior

From the table 4.8, it is found that the presence of extra members and relatives will influence meal size for 33.57% of adolescent households in private schools, while the remaining 66.43% will have no such impact. Similarly, the presence of other members will affect the meal size of 55.71% of adolescents in public school households, while 44.29% will not be affected. It was discovered that 69.29% of adolescents studying private schools and 65% adolescents studying public schools skipped meals.

Table 4.8 Frequency distribution of diet related behaviors of the surveyed adolescents.

Behavioral Factors	Private school (n=140)		Public school (n=140)		p-value
	Frequency	Percent	Frequency	Percent	
Effect on size of meal in presence of others members and relatives					
Yes	47	33.57	78	55.71	<0.001*
No	93	66.43	62	44.29	
Skipping of meal					
Yes	97	69.29	91	65.00	0.445
No	43	30.71	49	35.00	
Types of skipped meal					
Breakfast	46	47.42	60	65.93	0.034*
Lunch	25	25.77	17	18.68	
Dinner	26	26.80	14	15.38	
Frequency of skipped meal weekly					
1 to 2 times	50	51.55%	55	60.44%	0.201
3 to 4 times	18	18.56%	19	20.88%	
5 or more	29	29.90%	17	18.68%	
Food eating place					
Kitchen	106	75.71%	87	62.14%	0.093
Bedroom	13	9.29%	17	12.14%	
In front of tv or mobile	19	13.57%	33	23.57%	
Others place	2	1.43%	3	2.14%	
Vegetarian or non-vegetarian					
Vegetarian	6	4.29%	6	4.29%	1.00
Nonvegetarian	134	95.71%	134	95.71%	
Consumption of water per day					
1glass(250ml)	11	7.86%	25	17.86%	0.049*
2 to 4 glasses	81	57.86%	81	57.86%	
5 to 7 glasses	32	22.86%	23	16.43%	
8 or more glass	16	11.43%	11	7.86%	
Have daily pocket money					
Yes	49	35.00%	81	57.86%	<0.001*

No	35	25.00%	26	18.57%	
Sometimes	56	40.00%	33	23.57%	
Buy food from canteen/shop/vendors					
Yes	97	69.29%	103	73.57%	0.427
No	43	30.71%	37	26.43%	
Perception about weight					
overweight	32	22.86%	25	17.86%	0.380
Normal	87	62.14%	98	70.00%	
Thin	21	15.00%	17	12.14%	
Tried losing weight					
Yes	69	49.29%	48	34.29%	0.011*
No	71	50.71%	92	65.71%	
Tried gaining weight					
Yes	29	20.71%	50	35.71%	0.005*
No	111	79.29%	90	64.29%	
Monitor weight regularly					
Yes	86	61.43%	68	48.57%	0.031*
No	54	38.57%	72	51.43%	
Habit of smoking					
Yes	0	0.00%	2	1.43%	0.498
No	140	100.00%	138	98.57%	
Habit of drinking alcohol					
Yes	15	10.71%	9	6.43%	0.200
No	125	89.29%	131	93.57%	
Knowledge about malnutrition					
Yes	94	67.14%	55	39.29%	<0.001*
No	46	32.86%	85	60.71%	

Table 4.8 showed that there were 47.42% of adolescents in private schools who skipped breakfast, 25.77% who skipped lunch, and 26.80% of adolescents who skipped dinner. In the same way, it was discovered that 65.93% of students at the public school skipped breakfast, 18.68% skipped lunch, and 15.38% skipped dinner. The majority of adolescents attending private schools (75.71%) eat in the kitchen. Adolescents eat in front of TVs or smartphones in 13.57% of cases and in bedrooms in 9.29% of cases, respectively. Similarly, adolescents

attending public schools eat in the kitchen, in front of TVs or smartphones, and in bedrooms, respectively, at a rate of 62.14%, 23.57%, and 12.14%.

Of the 140–140 adolescents studying the private and public school, 134 adolescents (95.71%) were found to be non-vegetarian, whereas the remaining 6 adolescents (4.29%) were found to be vegetarian. Majority (57.86%) adolescents of both private and public schools drank 2 to 4 glasses of water on a regular basis. Similarly, 35% adolescents from private school were found to have daily pocket money whereas 57.86% of adolescents from public schools had daily pocket money. Among the private school adolescents 22.86% feel themselves as overweight when asked about their Perception about weight, 62.14% feel right about their weight and 15% feel thin. In the same way, 17.86% adolescents feel overweight, 70% feel right weight and 12.14% feel thin among the public school adolescents. 61.43% and 48.57% adolescents from private and public school respectively monitor their weight regularly.

Similarly, 67.14% adolescents from private schools were found to have knowledge about malnutrition and 39.29% adolescents from public schools had knowledge about malnutrition. There was significant difference in effect on size of meal in presence of other member and relatives, types of skipped meal, consumption of water per day, have a daily pocket money, tried losing weight, tried gaining weight, monitor weight regularly and knowledge about malnutrition between the private and public schools' adolescents. No any significant difference was found among skipping of meal, frequency of skipped meal weekly, food eating place, vegetarian or non-vegetarian, buy food from canteen/shop/vendor, Perception about weight, habit of smoking and habit of drinking.

4.6 Consumption of food groups

Table 4.9 Frequency distribution of consumption of food group of the surveyed adolescents.

Variables	Private school (n=140)		Public school (n=140)		p-value
	Frequency	Percent	Frequency	Percent	
Cereals					
Daily	140	100.00	140	100.00	
Pulses					
Daily	102	72.86	96	68.57	0.267

4 to 5 times a week	21	15.00	17	12.14	
2 to 3 times a week	14	10.00	25	17.86	
Once a week	3	2.14	2	1.43	
Milk					
Daily	48	34.29	35	25.00	0.013*
4 to 5 times a week	21	15.00	27	19.29	
2 to 3 times a week	32	22.86	31	22.14	
Once a week	24	17.14	15	10.71	
Fortnightly	7	5.00	6	4.29	
Never	8	5.71	26	18.57	
GLV					
Daily	44	31.43	61	43.57	0.078
4 to 5 times a week	39	27.86	46	32.86	
2 to 3 times a week	36	25.71	21	15.00	
Once a week	13	9.29	7	5.00	
Fortnightly	1	0.71	1	0.71	
Other vegetables					
Daily	54	38.57	67	47.86	0.083
4 to 5 times a week	41	29.29	35	25.00	
2 to 3 times a week	37	26.43	25	17.86	
Once a week	5	3.57	10	7.14	
Fortnightly	1	0.71	3	2.14	
Never	2	1.43	0	0.00	
Meat, Egg, Fish					
Daily	12	8.60	5	3.60	<0.001*
4 to 5 times a week	35	25.00	19	13.60	
2 to 3 times a week	64	45.70	54	38.60	
Once a week	17	12.10	45	32.10	
Fortnightly	6	4.30	11	7.90	
Never	6	4.30	6	4.30	
Fruits					
Daily	31	22.14	21	15.00	0.234

4 to 5 times a week	35	25.00	34	24.29	
2 to 3 times a week	43	30.71	47	33.57	
Once a week	18	12.86	24	17.14	
Fortnightly	8	5.71	13	9.29	
Never	5	3.57	1	0.71	
Tea or Coffee					
Daily	62	44.29	70	50.00	0.088
4 to 5 times a week	14	10.00	20	14.29	
2 to 3 times a week	22	15.71	22	15.71	
once	17	12.14	12	8.57	
Fortnightly	12	8.57	2	1.43	
Never	13	9.29	14	10.00	
Fast food					
Daily	67	47.86	61	43.57	0.387
4 to 5 times a week	25	17.86	26	18.57	
2 to 3 times a week	27	19.29	32	22.86	
Once a week	11	7.86	15	10.71	
Fortnightly	9	6.43	3	2.14	
Never	1	0.71	3	2.14	

Table 4.9 illustrate the consumption of different food groups among adolescents of private and public schools. It shows that all the adolescents from both school type consume cereals on a daily basis. Since plant source are major source of protein in Nepal, 72.86% and 68.57% adolescents from private and Public respectively stated that they consume pulses on a daily basis. Similarly, 34.29% adolescents from private school and 25% adolescents from public school were found to be consuming milk on a regular basis. However, the case of consumption of green leafy vegetable on daily basis was found to be higher in public school's adolescents as compared to the private schools' adolescents which is 43.57% and 31.43% respectively.

Adolescents going private schools regularly consume one of the three food items—meat, fish, or eggs—at a rate of 8.60%, whereas their daily consumption at public schools is only

3.60%. Adolescents attending private schools consume fruits on a daily basis at a rate of 22.14%, four to five times a week at a rate of 25%, and never at all at a rate of 3.57%. Similarly, adolescents going public schools consume fruits on a daily basis at a rate of 15%, four to five times a week at a rate of 24.29% and 0.71% never consume fruits. Adolescents who attend private or public schools regularly drink tea or coffee at a rate of 44.29% and 50%, respectively.

Of adolescents going private schools, 47.86% eat fast food every day, 17.86% four to five times a week, 19.29% two to three times a week, 7.86% once a week, 6.43% in fewer than 15 days, and only 0.71% never do. Similarly, among adolescents attending public schools, 43.57% routinely eat fast food, 18.57% four to five times a week, 22.86% two to three times a week, 10.71% once a week, 2.14% in fewer than 15 days, and 2.14% never eat it.

Significant difference was found on the consumption of milk and meat, egg, fish between the private and public schools adolescents. Meanwhile, no significant difference was found on the consumption of pulses, green leafy vegetable, others vegetables, fruits, tea, coffee and fast food.

4.7 Dietary intake

4.7.1 Mean dietary intake

Table 4.10, 4.11, 4.12 and 4.13 showed the mean nutrient intake of adolescents of both private and public schools respectively. Calorie intake in all the age and gender groups were low as per the requirements however the protein requirement were met up. Mean calorie intake of private school's boys was found to be slightly higher than mean calorie intake of boys of public schools. However, there is not much difference between the mean calorie intake among the girls of private and public schools.

Table 4.10 Mean value of nutrient intake by adolescent boys of private school

Age group (Boys)	Calorie(kcal)	CHO (g)	Protein(g)	Total fat(g)
10-12	1580.83±280.91	242.83±34.43	54.50±11.67	44.49±14.80
13-15	1741.38±360.96	252.17±45.05	58.27±10.52	52.01±16.86
16-18	1801.95±358.34	270.37±56.94	55.21±7.99	55.15±12.80

Table 4.11 Mean value of nutrient intake by adolescent girls of private school

Age Group (Girls)	Calorie(kcal)	CHO (g)	Protein(g)	Total Fat(g)
10-12	1530.06±306.78	231.53±38.92	45.93±9.95	48.82±15.49
13-15	1702.27±252.18	252.66±40.38	50.90±9.73	53.54±15.29
16-18	1608.07±212.45	247.36±37.85	50.67±9.17	44.88±10.01

Table 4.12 Mean value of nutrient intake by adolescent boys of public school

Age group (Boys)	Calorie(kcal)	CHO (g)	Protein(g)	Total Fat (g)
10-12	1476.45±287.98	223.29±30.70	48.47±9.66	47.58±16.96
13-15	1614.88±268.35	228.29±64.60	58.26±35.78	48.28±14.21
16-18	1731.27±356.17	270.28±44.46	58.27±12.26	46.28±18.95

Table 4.13 Mean value of nutrient intake by adolescent girls of public school

Age Group (Girls)	Calorie (kcal)	CHO (g)	Protein (g)	Total Fat (g)
10-12	1428.00±300.67	215.14±50.31	45.10±16.94	46.53±16.89
13-15	1635.66±269.29	233.66±41.21	52.46±9.04	52.74±14.02
16-18	1686.91±339.72	244.73±69.70	55.38±9.53	50.22±12.92

In a study conducted in Delhi, India among the adolescents of private and public schools the average calorie intake among Public and private school students was 827.9±191.2 and 1491.3±541.0 respectively. Similarly, mean protein intake was 29.95± 6.7 gm and 57.49±20.9 gm respectively. The daily protein and calorie intake was found to be lower than the recommended dietary allowance. The deficit was more profound in respondents of Public school, and lower socio-economic group (Sharma *et al.*, 2005)

Study done in Malaysia showed that, male adolescents have higher energy and other macronutrient intakes compared to female adolescents (Abdul Majid *et al.*, 2016). Ochola and Masibo (2014)stated the protein intake was adequate in majority of children and adolescents, in it was at 1.5 to 2.5 times of RDA across all age groups and sex, in Libya it was 226% of RDA and in Ghana school children attained 100% of RDA for protein across all age groups and sex.

A study done on nutrient intake among school going adolescents girls in Lucknow district, India observed that the daily intake of energy was less than the RDA as per ICMR guidelines in all age groups both in urban and rural school girls (Sachan *et al.*, 2013).

In a study done at urban areas of Pokhara, it was found that majority (63.1%) of participant did not consume sufficient calorie. Mean ± SD of calorie intake of adolescent participant was 2009.97± 342.366 Kcal. It has been found that majority of the participants did not consume sufficient amount of foods from different groups like: body building and protective food as per required (Subedi and Yadav, 2018).

Table 4.14 Significant test between mean nutrient intake of private and public school's adolescents

Age Category	**Nutrient**	**p-value**
10 -12 years	Calorie(kcal)	0.229
	CHO(g)	0.170
	Protein(g)	0.495
	Total Fat(g)	1.000
13-15 years	Calorie(kcal)	0.071
	CHO(g)	0.041*
	Protein(g)	0.354
	Total Fat(g)	0.252
16-18 years	Calorie(kcal)	0.846
	CHO(g)	0.957
	Protein(g)	0.175
	Total Fat(g)	0.422

*p-values were derived from t-tests comparing mean nutrient intake of private and public school adolescents

From the table 4.14 it can be seen that in most of cases there is no any significant differences between the mean nutrient intake of private and public school's adolescents across all age group. However, there is significant difference in carbohydrate intake in 13-15 years age group between the private and public schools' adolescents.

4.8 Prevalence of malnutrition

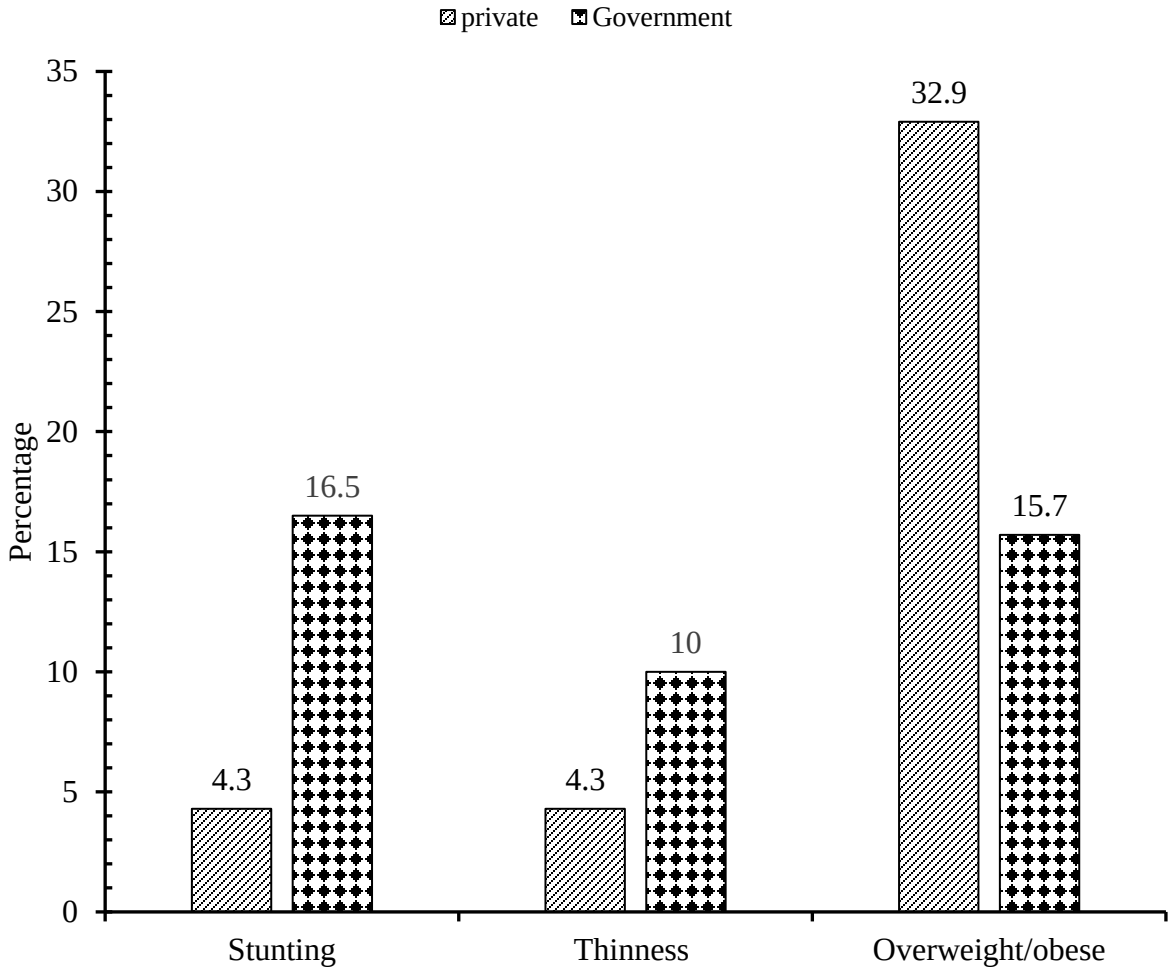


Fig: 4.1 Prevalence of malnutrition in adolescents

According to the figure 4.1, of the total participants, 4.3% were stunted in private schools, while 16.5% were stunted from which 2.9% were severely and 13.6 were moderately stunted in public schools. Thinness rates among private and public school adolescents had been found to be 4.3% and 10%, respectively. Among 10% thinned adolescent of public school, 1.4% were moderately thinned and 8.6% were severely thinned. Similarly, the overweight or obesity rate among private school adolescents was greater (32.9%) than in public school adolescents (15.7%). The overweight and obesity rate was found to be 23.6% and 9.3% respectively among private school adolescents. Likewise, 10.7% were overweight, 4.3% were obese and 0.7% were severely obese among public school adolescents.

According to MOHP (2022), overall, 25% of children under age 5 are stunted. Stunting is more common in rural areas (31%) than urban areas (22%). 8% of children under age 5 are wasted. Nineteen percent of children under age 5 are underweight. Only 1% of children under age 5 in Nepal are overweight. Among adolescent men age 15-19, 41% are thin and 7% are overweight or obese according to BMI-for-age. Among adolescent women age 15-19, 26% are thin according to body mass index for age (BMI-for-age) and 6% are overweight or obese.

The prevalence of underweight, overweight and obesity among school going adolescents between the age of 14–17 years in Dang district Nepal at the time of survey were 21.8%, 3.1% and 0.8% respectively. Prevalence of both under nutrition and over nutrition in school going adolescents demonstrated the existence of double burden of malnutrition (Bhattarai and Bhusal, 2019).

A study done by Maehara *et al.* (2019) among adolescents girls and boys in Indonesia showed that 25% of adolescent girls and 21% of boys were stunted. Approximately 5% of girls and 11% of boys were thin, whereas 11% girls and boys each were overweight.

4.9 Age wise distribution of stunting

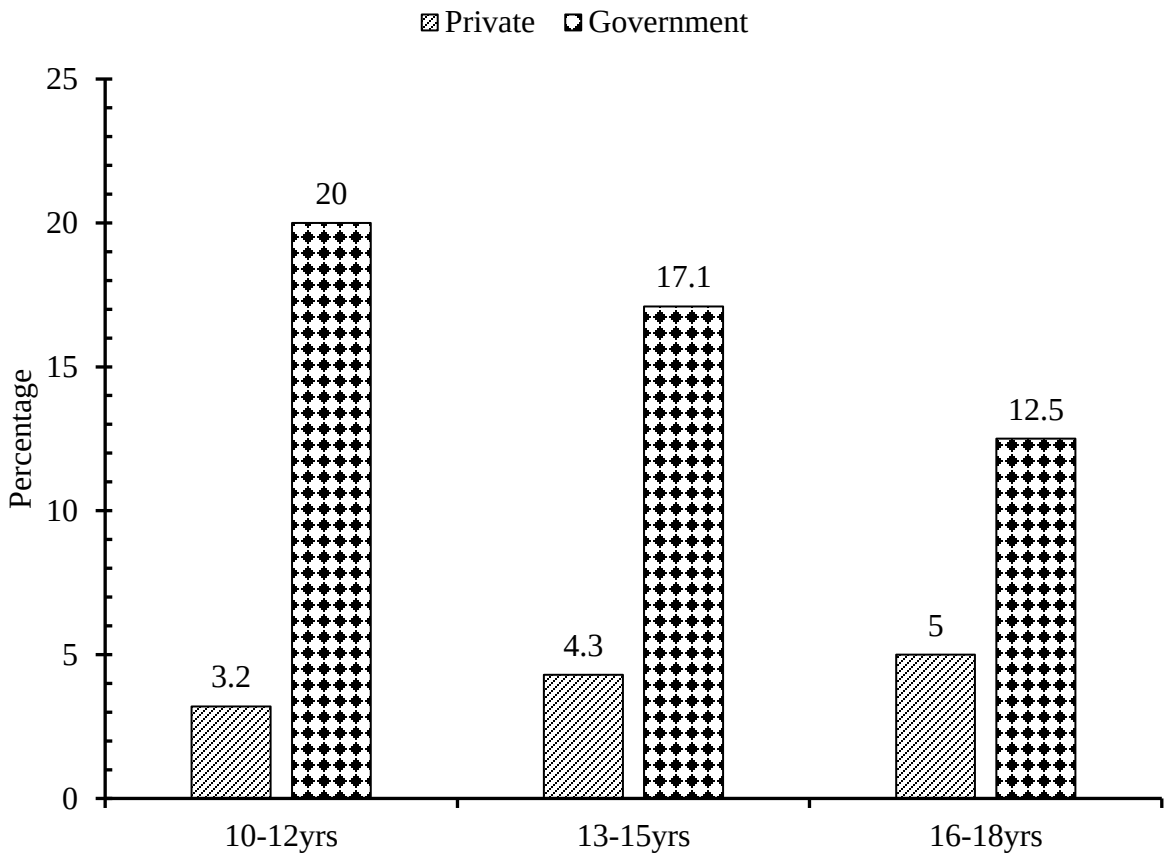


Fig 4.2 Distribution of stunting in adolescents across age groups.

Figure 4.2 shows that, among adolescents aged 10 to 12, 3.2% were stunted in private schools, while 20% were stunted in public schools. Similarly, among adolescents aged 13 to 15, 4.3% and 17.1% were stunted in private and public schools, respectively. Also, the percentage of stunting in the 16-18years age range was found to be 5% and 12.5% in private and public schools, respectively.

From the figure 4.2, it can be found that highest prevalence of stunting was in 16–18 years age group among private school adolescents. Meanwhile, the highest prevalence of stunting among public school's adolescents was found in 10-12 years age group.

4.10 Age wise distribution of thinness

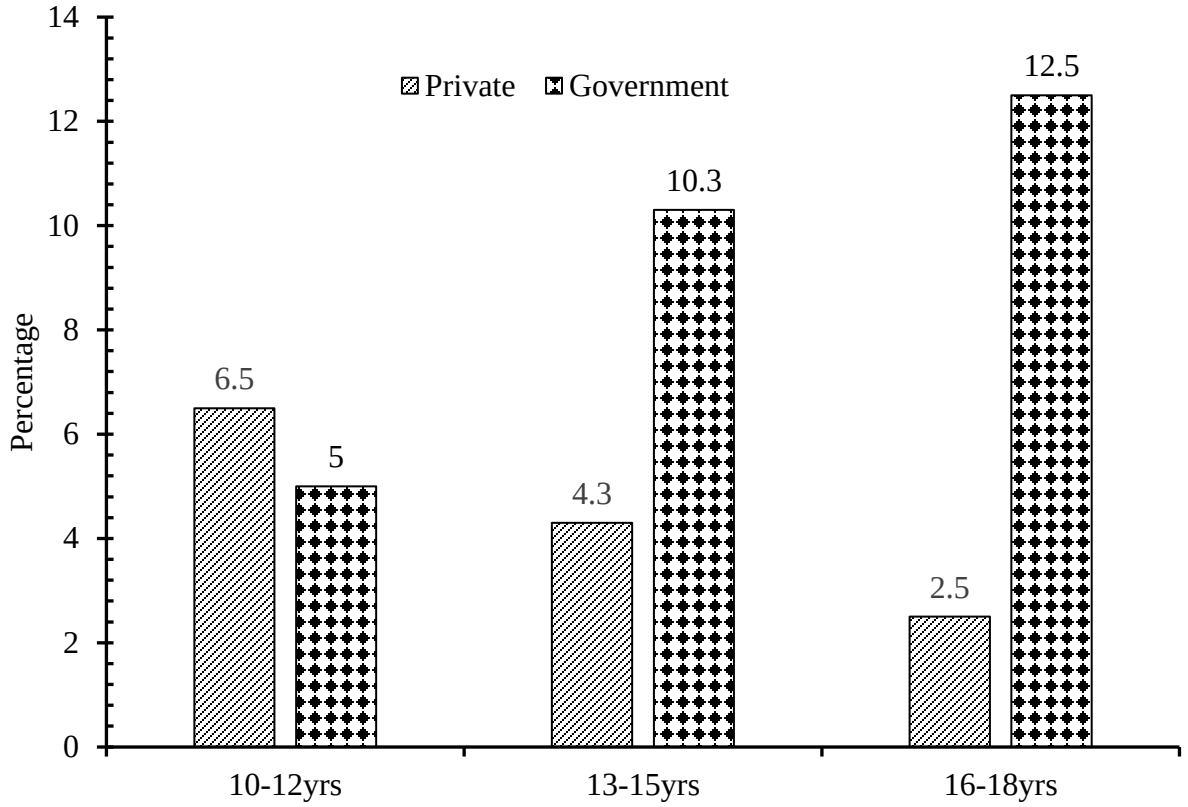


Fig 4.3 Distribution of thinness in adolescents across age groups.

Figure 4.3 indicates that, 6.5% of adolescents in private schools between the ages of 10 and 12 were found to be underweight, whereas 5% of adolescents at public schools in the same age group were thinned or underweight. In a similar vein, it was discovered that the percentage of thin adolescents attending Public and private schools was 10.3% and 4.3%, respectively. Similarly, 12.5% of adolescents from public schools and 2.5% of adolescents from private schools who were 16 to 18 years old were thinned.

From the figure 4.3, it can be found that highest prevalence of thinness among private school adolescents was among 10-12 years age group. Likewise, 16-18 years age group constituted highest prevalence of thinness among public school adolescents.

4.11 Age wise distribution of overweight/obesity

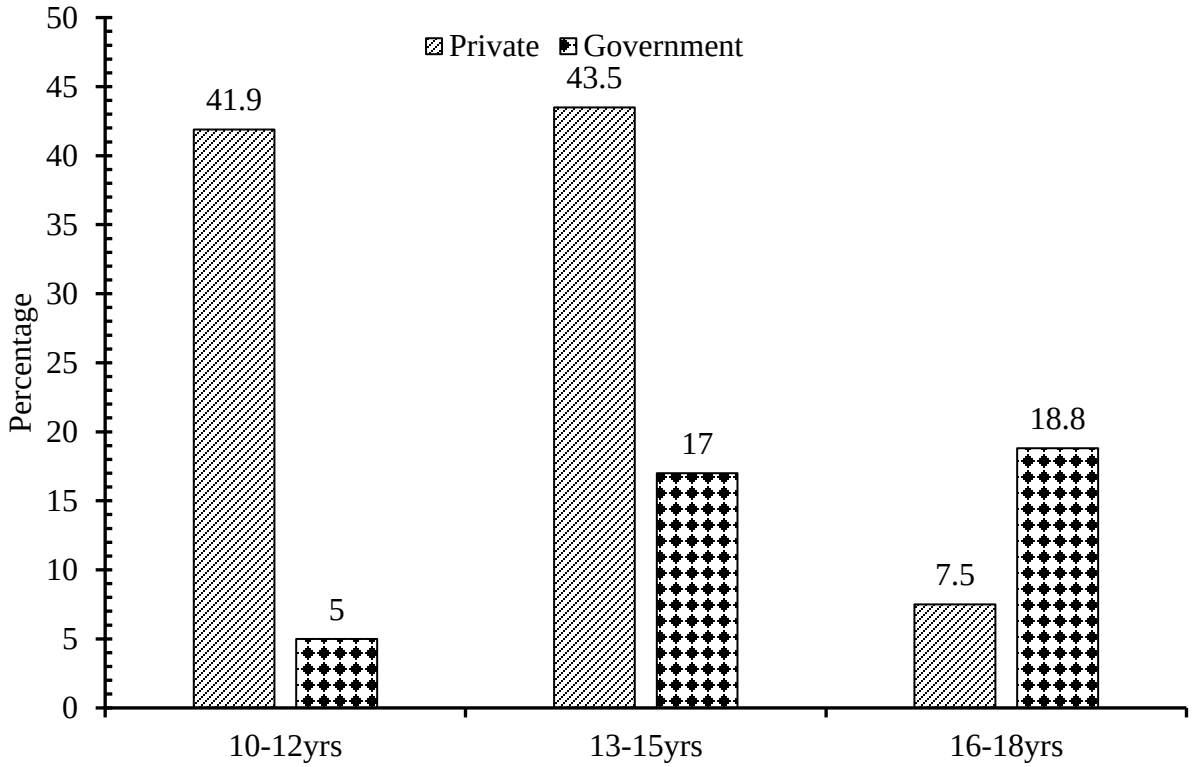


Fig 4.4 Distribution of overweight or obesity in adolescents across age groups.

According to figure 4.4, in private schools, 41.9% of adolescents in the 10–12 age range reported being overweight or obese; in public schools, the same age group's obesity or overweight percentage is only 5%. Comparably, among adolescents attending private and public schools, the rates of overweight or obesity in the 13–15 age range are 43.5% and 17%, respectively. Similarly, it was shown that 18.8% of adolescents in public schools and 7.5% of adolescents in private schools were overweight or obese.

According to figure 4.4, the 13-15 age group and 16-18 age group had the highest prevalence of overweight or obesity among adolescents in private and public schools, respectively.

4.12 Distribution of malnutrition according to height for age of private school

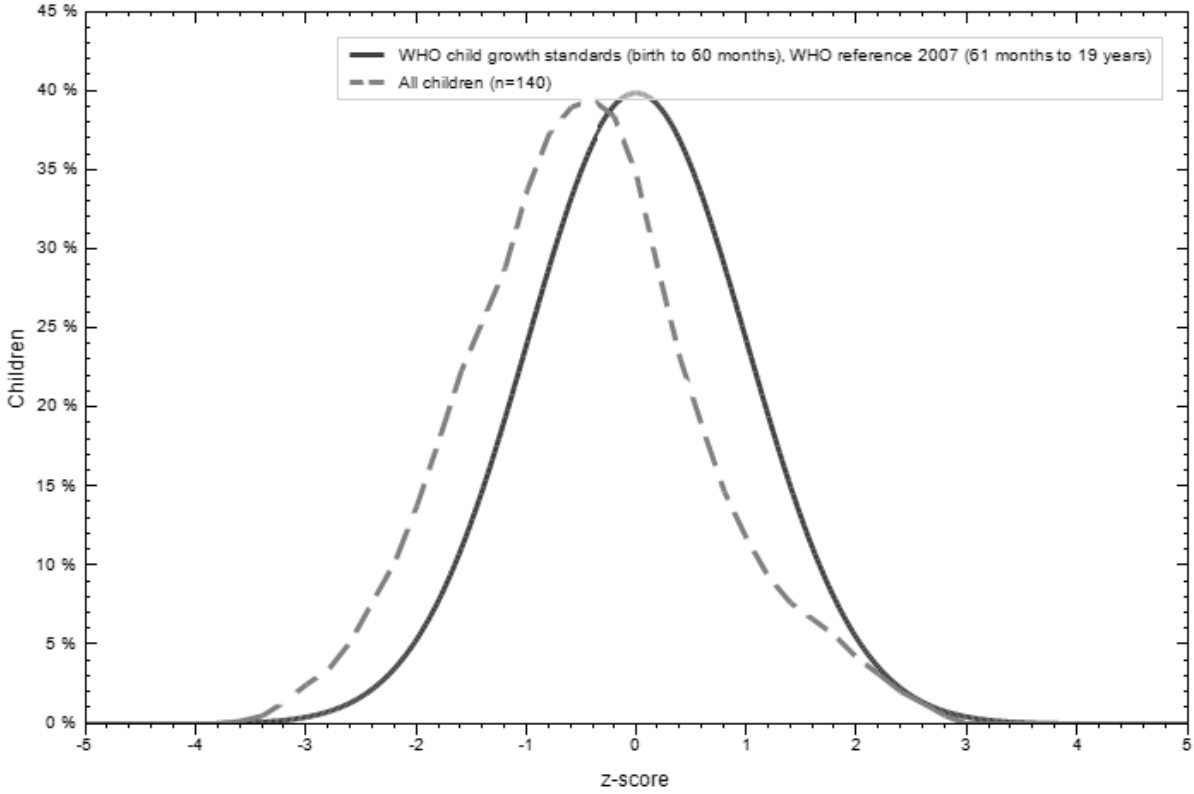


Fig: 4.5 Distribution of height for age Z-score (HAZ) curve of private school adolescents with reference to WHO standard.

The figure 4.5 shows that the curve for distribution of HAZ is shifted towards left as compared to WHO reference curve. It is because mean, median and mode Z-scores of the curve are -0.40, -0.60 and -1.07 respectively which are lesser than the average of WHO reference curve i.e. zero. The graph clearly states that the surveyed adolescents of private school had less mean height for age as compared to the WHO standard. Numerous factors can be associated with low height for age. Age, sex, family size, availability of latrine, and meal frequency were factors significantly associated with stunting (Berhanu *et al.*, 2022)

4.13 Distribution of malnutrition according to height for age of public school

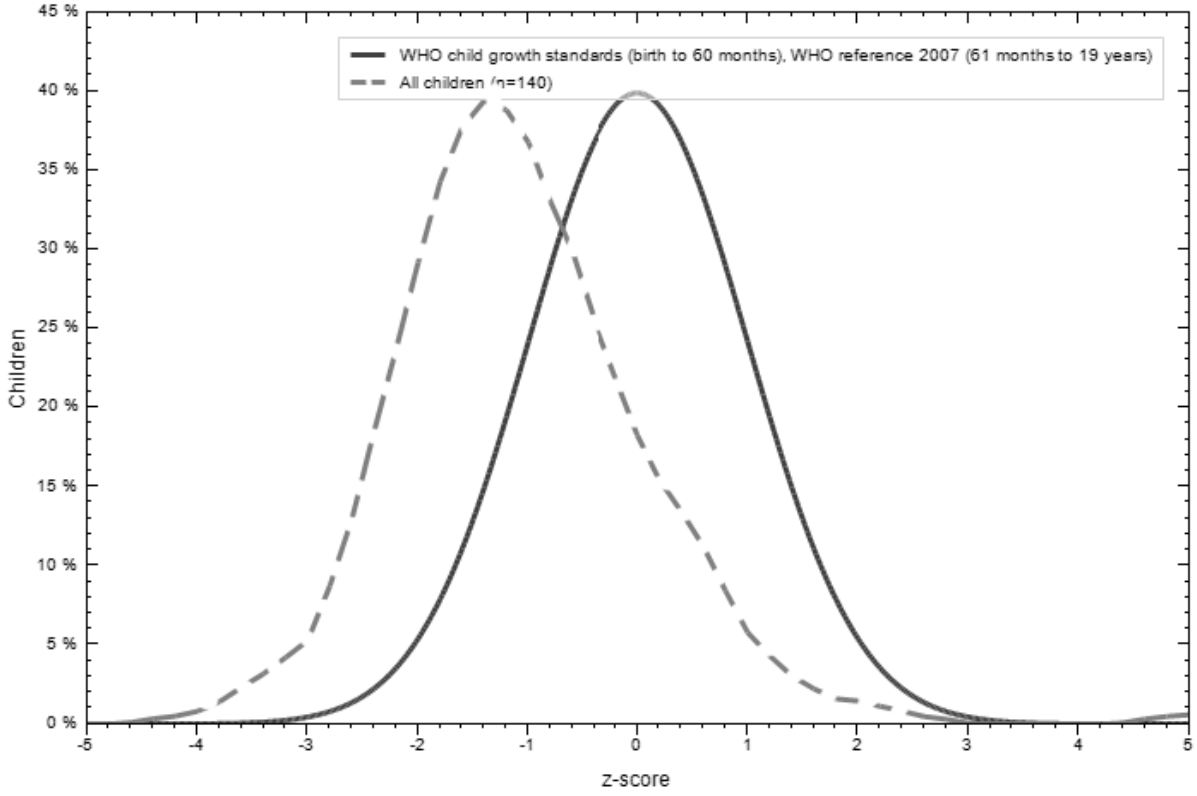


Fig 4.6 Distribution of height for age Z-score (HAZ) curve of public school adolescents with reference to WHO standard.

The figure 4.6 shows that the curve for distribution of HAZ is shifted towards left as compared to WHO reference curve. It is because mean, median and mode Z-scores of the curve are -1.06, -1.17 and -1.70 respectively which are lesser than the average of WHO reference curve i.e. zero. The graph clearly states that the surveyed adolescents of public school had less mean height for age as compared to the WHO standard. Multiples factors can be associated with the low height for age status.

4.14 Distribution of malnutrition according to weight for age of private school

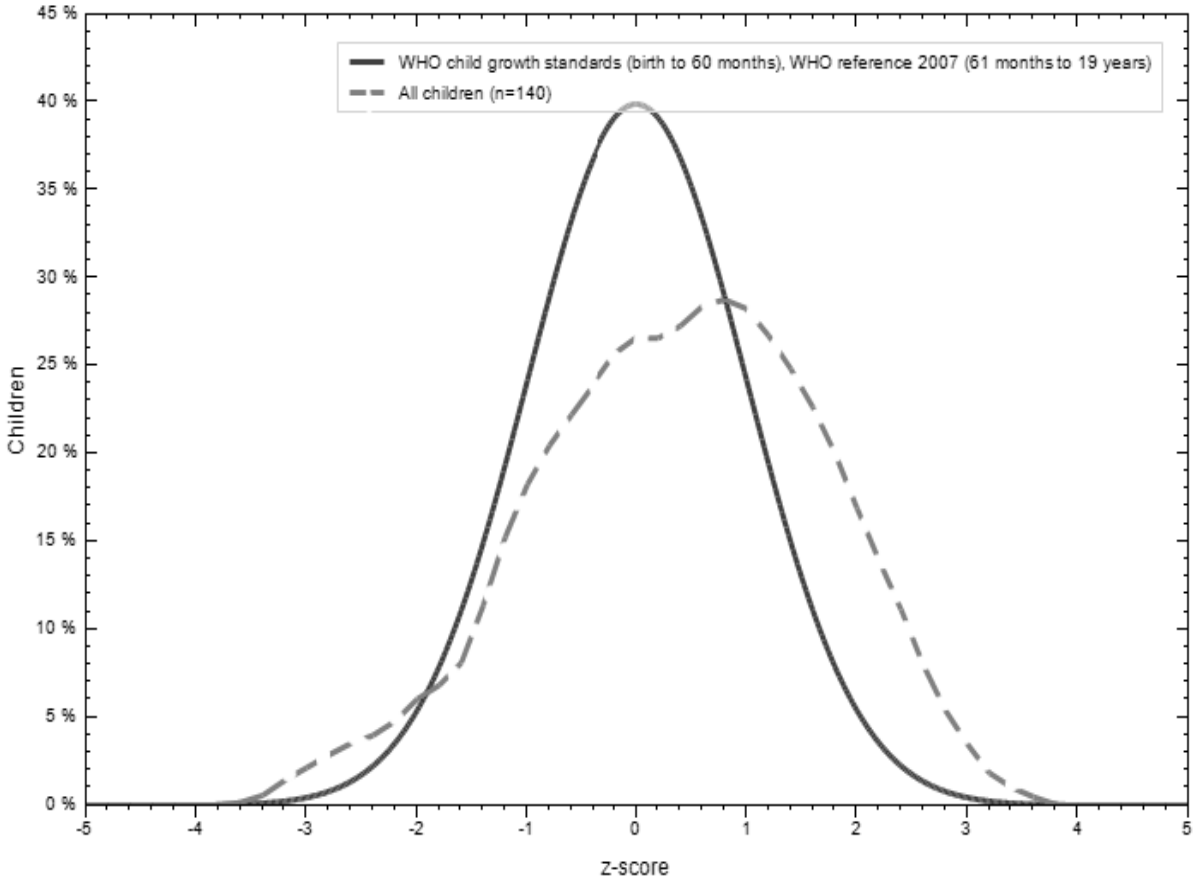


Fig: 4.7 Distribution of weight for age Z-score (BAZ) curve of private school adolescents with reference to WHO standard.

The figure 4.7 shows that the curve for distribution of BAZ is shifted towards right as compared to WHO reference curve. It is because mean, median and mode Z-scores of the curve are 0.33, 0.35 and -0.57 respectively which are lesser than the average of WHO reference curve i.e. zero. From the graph we can say that most of the surveyed adolescents of private schools have their weight for age status more than the WHO standard.

4.15 Distribution of malnutrition according to weight for age of public school

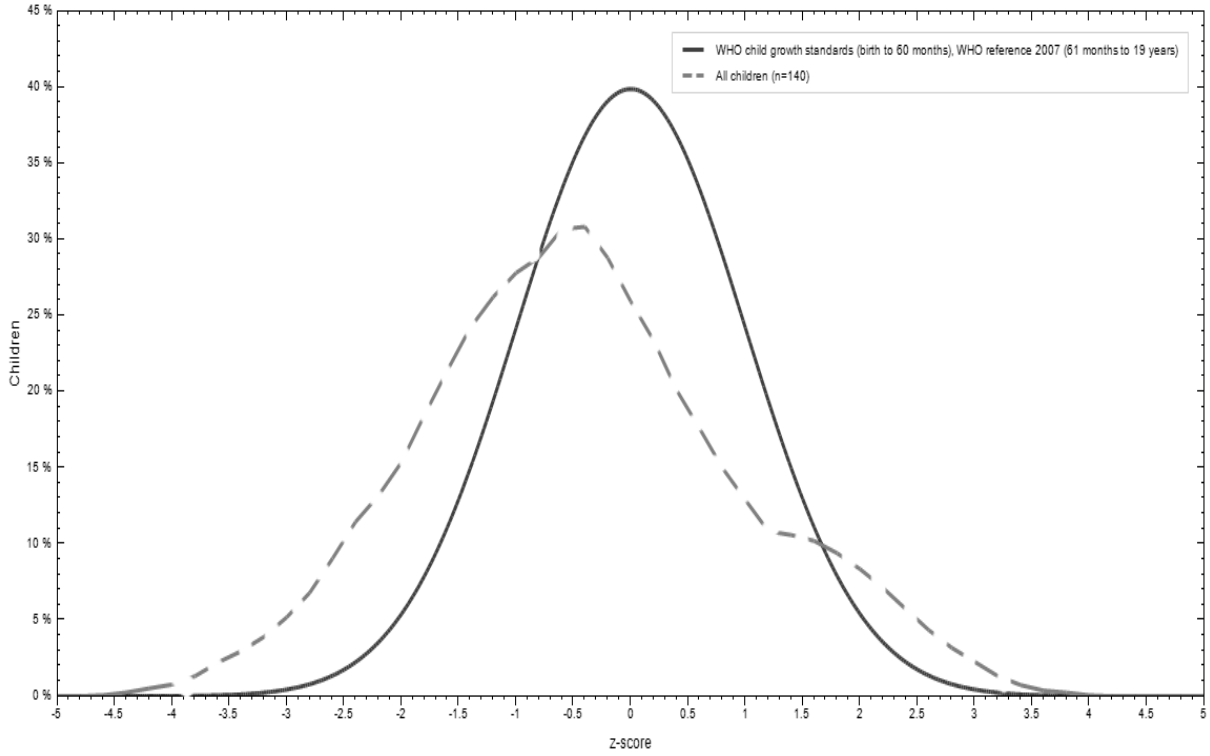


Fig:4.8 Distribution of weight for age Z-score curve (BAZ) of public school adolescents with reference to WHO standard.

The figure 4.8 shows that the curve for distribution of BAZ is shifted towards left as compared to WHO reference curve. It is because mean, median and mode Z-scores of the curve are -0.40, -0.60 and -1.07 respectively which are lesser than the average of WHO reference curve i.e. zero. From the graph it is clear that maximum adolescents of public schools have their weight for age status low as compared to the WHO standard.

4.16 Factors associated with malnutrition

Factors seen to be statistically related to stunting among the private schools' adolescents are shown in the table 4.14.

Table 4.15 Factor associated with stunting of private school adolescents

Factors	stunted	Normal	χ 2-value	p-value
Attempted weight loss				
Yes	0(0%)	69(100%)	8.409	0.004*
No	6(8.5%)	65(91.5%)		
Consumption of green leafy vegetable				
Regularly	1(1.2%)	82(98.8%)	7.765	0.034*
Frequently	3(6.1%)	46(93.9%)		
Rarely	0(0%)	1(100%)		
Never	2(4.3%)	5(95.7%)		
Skip Meal				
Yes	5(5.2%)	92(94.8%)	0.648	0.421
No	1(2.3%)	42(97.7%)		
Family income				
< 30 thousand	3(6.3%)	45(93.7%)	0.654	0.419
> 30 thousand	3(3.3%)	89(96.7%)		

Factors like consumption of green leafy vegetable (p=0.034) and attempted weight loss (p=0.004) were found to be related with stunting in adolescents of private schools. A study of Brazilian school children found that the prevalence of stunting was 2.6 times higher among children who did not consume fruits and vegetables regularly compared to those who did (Augusto *et al.*, 2015). Sreenivasa Rj (2018) had found that green leafy vegetables, as well as fruits and other vegetables, are important for preventing micronutrient deficiencies that can contribute to stunting and other forms of malnutrition.

From the table 4.15 we can see the factors associated with thinness and overweight/obesity of private school's adolescents. Factors like age category (p=0.003), Perception about weight (p=0.001) and attempted weight loss (p=0.001) were found to be associated with the thinness and overweight/obesity. A study had found that obesity rates are lowest among the youngest children (2-5 years) at 10%, and highest among adolescents (12-17 years) at 17.9% (Fryar *et al.*, 2014).

Table 4.16 Factor associated with thinness and overweight/obesity of private school adolescents

Factors	Thin	Normal	Overweight/obesity	χ 2-value	p-value
Age category					
10-12	2(6.5%)	16(51.6%)	13(41.9%)	21.054	0.003*
13-15	3(4.3%)	36(52.2%)	30(43.5%)		
16-18	1(2.5%)	36(90%)	3(7.5%)		
Perception about weight					
Overweight	1(3.1%)	7(21.9%)	24(75%)	33.741	0.001*
Normal	3(3.4%)	66(75.9%)	18(20.7%)		
Thin	2(9.5%)	15(71.5%)	4(19%)		
Attempted weight loss					
Yes	2(2.9%)	34(49.3%)	33(47.8%)	14.229	0.001*
No	4(5.6%)	54(76.1%)	13(18.3%)		
Fast food					
Regularly	5(5.5%)	64(70.3%)	22(24.2%)	11.133	0.084
frequently	1(2.6%)	20(51.3%)	18(46.1%)		
Rarely	0(0%)	4(44.4%)	5(55.6%)		
Never	0(0%)	0(0%)	1(100%)		
Transport form					
Private Vehicle	0(0%)	5(50%)	5(50%)	3.435	0.753
Cycle	0(0%)	2(66.7%)	1(33.3%)		
School bus	2(8%)	14(56%)	9(36%)		
Walk	4(3.9%)	67(65.7%)	31(30.4%)		

Table 4.17 Factor associated with stunting of public school adolescents

Factors	Stunted	Normal	χ 2-value	p-value
Caste				
Brahmin	2(20%)	8(80%)	18.535	0.002*
Chettri	4(17.4%)	19(82.6%)		
Rai	13(34.2%)	25(65.8%)		
Limbu	2(10%)	18(90%)		
Tamang	1(2.2%)	45(97.8%)		
Magar	1(33.3%)	2(67.7%)		
Water Purification				
Yes	14(12.5%)	98(87.5%)	5.517	0.019*
No	9(32.1%)	19(67.9%)		
Source of food				
Own production	1(25%)	3(75%)	6.053	0.048*
Market	5(8.1%)	57(91.9%)		
Both	17(23%)	57(77%)		
Involvement in physical activity				
Sometimes	3(15%)	17(85%)	8.204	0.042*
Frequently	0(0%)	19(100%)		
Regularly	9(17%)	44(83%)		
Never	11(22.9%)	37(77.1%)		

Factors such as caste (p=0.002), water purification(p=0.019), source of food (p=0.048) and involvement in physical activity (p=0.042) were found to associated with the stunting among adolescents of public schools from the table 4.16. A study done in Nepal found significant associations between WASH related factors including Household water purification practice and different forms of undernutrition among under-five children (S. K. Shrestha *et al.*, 2020b).

From the table 4.17 it can be seen that various factors were found to be associated with the thinness and overweight/obesity among adolescents of public schools. Factors like Family size(p=0.009), Perception about weight(p=0.001), attempted weight loss(p=0.001), attempted weight gain(p=0.005) and consumption of fast food(p=0.043) were found to be associated.

Table 4.18 Factor associated with thinness and overweight/obesity of public school adolescents

Factors	Thin	normal	Overweight/obesity	χ 2-value	p-value
Family size					
< 5 members	4(9.3%)	26(60.5%)	13(30.2%)	9.250	0.009*
> 5 members	10(10.3%)	78(80.4%)	9(9.3%)		
Perception about weight					
overweight	0(0%)	12(48%)	13(52%)	34.083	0.001*
Normal	9(9.2%)	80(81.6%)	9(9.2%)		
Thin	5(29.4%)	12(70.6%)	0(0%)		
Attempted weight loss					
Yes	3(6.3%)	29(60.4%)	16(33.3%)	16.137	0.001*
No	11(12%)	75(81.5%)	6(6.5%)		
Attempted weight gain					
Yes	8(16%)	40(80%)	2(4%)	10.575	0.005*
No	6(6.7%)	64(71.1%)	20(22.2%)		
Consumption fast food					
Regularly	9(10.3%)	63(72.4%)	15(17.3%)	12.302	0.043*
Frequently	3(6.3%)	38(80.9%)	6(12.8%)		
Rarely	0(0%)	3(100%)	0(0%)		
Never	2(67.7%)	0(%)	1(33.3%)		

Yu *et al.* (2020) found out that in larger families, parents may have fewer resources (time, energy, finances) to devote to each child, which could contribute to thinness. Similarly, Family dynamics and parenting practices may differ between single-child and multi-child families, impacting factors like nutrition, physical activity, and Perception about weight (Anna Mason *et al.*, 2016). A higher intake of fast food is associated with an increased risk of overweight and obesity in children and adolescents (Jakobsen *et al.*, 2023). Mohammadbeigi *et al.* (2018) found that a higher intake of fast food increased the odds of overweight/obesity by 17% compared to lower intake.

PART V

Conclusion and recommendations

5.1 Conclusion

In the study, nutritional status of adolescents of private and public schools was assessed and compared. The conclusions that can be drawn from the study are:

a) Prevalence of stunting and thinness was high among public schools' adolescents, with 16.5% and 10% of them stunted and thin respectively and overweight/obesity was high among private schools' adolescents with the prevalence of 32.9%.
b) Most of the adolescents, both from private and public school had insufficient intakes of calories. Mean intake of energy by girls and boys of different age groups are insufficient. However, protein intake in most of the adolescents were adequate.
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 both private and public schools' adolescents.
d) Consumption of green leafy vegetable, attempted weight loss and caste, water purification, source of food, involvement in physical activity were found to be associated with stunting in adolescents of private and public schools respectively.
e) Age category, Perception about weight and attempted weight loss were found to be associated with thinness and overweight/obesity of private schools' adolescents while family size, Perception about weight, attempted weight loss, attempted weight gain and consumption of fast food were found to be associated with the thinness and overweight/obesity of public school's adolescents.

5.2 Recommendations

1) Cross-sectional survey should be conducted periodically with special emphasis on the nutritional status of adolescents and other unexplained factors that were not included in the present study.
2) Detailed study of adolescent obesity, dietary factors, physical activity level, nutrient intake and nutritional status and their association each other can be done.

PART VI

Summary

Adolescence refers to the transition period from childhood to adulthood in which a rapid physical, biochemical, psychological, and social growth, development, and maturation take place. Adolescent phase requires the consumption of more nutrients and energy. The adolescent years are essential for laying the basis for later periods of healthy living. As a result, adolescent health and nutritional status become significant.

A cross-sectional survey was conducted to assess the nutritional status and dietary intake of adolescents studying in private and public schools of Dharan sub-metropolitan, Sunsari district. From randomly selected ten schools (5 private and 5 Public), 280 adolescents were chosen by random selection. A well designed and pretested set of questionnaires to collect information of the target population was prepared. 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 analyzed using WHO Anthro plus version 1.0.4, SPSS version 25 and Microsoft excel. Chi- square test was used to analyses the factors associated with nutritional status.

Out of total 280 adolescents, 140 adolescents were from private school and 140 were from public schools. The prevalence of stunting, thinness and overweight/obesity in adolescents of private schools was 4.3%, 4.3% and 32.9% respectively and in public school's adolescents it was 16.5%, 10% and 15.7% respectively. In private school's adolescents, consumption of green leafy vegetable and attempted weight loss were found to be associated with the stunting and age category, Perception about weight and attempted weight loss were found to be associated with the thinness and overweight/obesity. Similarly, in public school adolescent's factors like caste, water purification, source of food and involvement in physical activity were found to associated with the stunting and family size, Perception about weight, attempted weight loss, attempted weight gain and consumption of fast food were associated with the thinness and overweight/obesity. Proper intervention programs should be implemented in order to correct the nutritional status, nutrient intake and dietary habits of the target population.

References

Abdul Majid, H., Ramli, L., Ying, S. P., Su, T. T., Jalaludin, M. Y. and Abdul Mohsein, N. A.-S. (2016). Dietary Intake among Adolescents in a Middle-Income Country: An Outcome from the Malaysian Health and Adolescents Longitudinal Research Team Study **11** (5). [doi: 10.1371].

Anna Mason , Anja Rantanen , Hanne Kivimäki , Anna-Maija Koivisto and Joronen, K. (2016). Family Factors and Health Behaviour of Thin Adolescent Boys and Girls. **73** (1), 177-189. [doi: 10.1111/jan.13096].

Aryal, K. K., Mehata, R. K., Chalise, B., Mehata, S., Femila Sapkota, Dhimal, M., Jha, B. K. and Karki, K. B. (2016). Adolescent Nutrition Survey in Nepal [Report]. Ramshahpath, Kathmandu

Augusto, R. A., Cobayashi, F. and Cardoso, M. A. (2015). Associations Between Low Consumption of Fruits and Vegetables and Nutritional Deficiencies in Brazilian School Children. **18** (5), 927-935. [doi: 10.1017/s1368980014001244].

Azeredo, C. M., Levy, R. B., Peres, M. F. T., Menezes, P. R. and Araya, R. (2016). Patterns of Health-Related Behaviours Among Adolescents: A Cross-Sectional Study Based on The National Survey of School Health Brazil **6**(11).

Babar, N. F., Muzaffar, R., Khan, M. A. and Imdad, S. (2010). Impact of Socioeconomic Factors on Nutritional status in Primary School Children. **22** (4), 15-18.

Berhanu, A., Garoma, S., Arero, G. and Mosisa, G. (2022). Stunting and Associated Factors Among School-Age Children (5–14 years) in Mulo district, Oromia region, Ethiopia. **10**. [doi: 10.1177%2F20503121221127880].

Bhargava, M., Bhargava, A., Ghate, S. D. and Rao, R. S. P. (2020). Nutritional Status of Indian adolescents (15-19 years) From National Family Health Surveys 3 and 4: Revised Estimates Using WHO 2007 Growth Reference. **15** (6), e0234570. [doi: 10.1371/journal.pone.0234570].

Bhattarai, S. and Bhusal, C. K. (2019). Prevalence and Associated Factors of Malnutrition Among School Going Adolescents of Dang district, Nepal. **6** (3), 291. [doi: 10.3934%2Fpublichealth.2019.3.291].

Blossner, M., De Onis, M. and Prüss-Üstün, A. (2005). "Malnutrition: Quantifying The Health Impact at National and Local Levels". World Health Organization. [9241591870].

Büyükgebiz, B. (2013). Nutrition in Adolescents Age Group. **9** (2), 37-47.

Caleyachetty, R., Thomas, G. N., Kengne, A. P., Echouffo-Tcheugui, J. B., Schilsky, S., Khodabocus, J. and Uauy, R. (2018). The Double Burden of Malnutrition Among Adolescents: Analysis of Data from The Global School-Based Student Health and Health Behavior in School-Aged Children Surveys in 57 Low- and Middle-Income Countries. **108** (2), 414-424. [doi: 10.1093/ajcn/nqy105].

Casadei, K. and Kiel, J. (2019). Anthropometric Measurement.

den Hartog, A. P., van Staveren, W. A. and Brouwer, I. D. (2006). Measurement of Food Consumption. *In:* "Food Habits and Consumption in Developing Countries" (1st ed.).). pp. 101-113. Wageningen Academic. [9086866670].

Devkota, S. C., De, A. and Sathian, B. (2015). Nutritional Deficiencies: Major Public Health Problem in Nepal. **3** (4A), 1-5. [doi: 10.12691/ajphr-3-4A-1].

Dhobi, S. and Giri, M. (2022). Food Habits and Nutritional Status of Adolescents in Malangwa Municipality, Sarlahi, Nepal: A Cross-sectional Study. **1**, 20-24. [doi: 10.3126/mjmms.v1i1.42997].

Elmadfa, I. and Meyer, A. L. (2014). Developing Suitable Methods of Nutritional Status Assessment: A Continuous Challenge. **5** (5), 97-108.

Engeland, A., Bjørge, T., Tverdal, A. and Søgaard, A. J. (2004). Obesity in Adolescence and Adulthood and The Risk of Adult Mortality. **15** (1), 79-85. [doi: 10.1097/01.ede.0000100148.40711.59].

Evans, Y. N. and Docter, A. D. (2020). "Adolescent Nutrition: Assuring The Needs of Emerging Adults". Springer Nature. [[ISBN 978-3-030-45102-8]].

FAO. (2004). Uses of Food Consumption and Anthropometric Surveys in the Caribbean: How to Transform Data Into Decision-making Tools [Report]. FAO.

FAO. (2009). "Methods to monitor the Human Right to adequate food-Volume II".[[ISBN 978-92-5-106066-7]].

Feldman, R. S. (2017). "Discovering The Life Span" (4th ed.). Pearson Philadelphia, PA, U.S.A. [[ISBN 978-0134577654]].

Freeman, M. C., Garn, J. V., Sclar, G. D., Boisson, S., Medlicott, K., Alexander, K. T., Penakalapati, G., Anderson, D., Mahtani, A. G. and Grimes, J. E. (2017). The Impact of Sanitation on Infectious Disease and Nutritional Status. **220** (6), 928-949. [doi: 10.1016/j.ijheh.2017.05.007].

Fryar, C. D., Carroll, M. D. and Ogden, C. L. (2014). Prevalence of Overweight and Obesity Among Children and Adolescents: United States, 1963–1965 through 2011–2012.

FSAU and UNICEF. (2007). NUTRITION ASSESSMENT REPORT [Report].
Gibson, R. (1998). "Determining Nutritional Status: Essential of Human Nutrition". Oxford University Press. Oxford. [978-0-19-262756-8].

Gibson, R. S. (1993). "Nutritional Assessment: A Laboratory Manual".

Oxford University Press. [[ISBN: 0195085477]].

Gropper, S. S. and Smith, J. L. (2013). "Advanced Nutrition and Human Metabolism". Cengage Learning. [[ISBN 1133104053]].

Haddad, L., Achadi, E., Bendech, M. A., Ahuja, A., Bhatia, K., Bhutta, Z., Blössner, M., Borghi, E., Colecraft, E. and De Onis, M. (2014). The Global Nutrition Report 2014: Actions and Accountability to Accelerate the World's Progress on Nutrition. **145** (4), 663-671. [doi:10.3945/jn.114.206078].

Hammoud, A. O., Gibson, M., Peterson, C. M., Meikle, A. W. and Carrell, D. T. J. F. (2008). Impact of Male Obesity on Infertility: A Critical Review of The Current Literature. **90** (4), 897-904. [doi:10.1016/j.fertnstert.2008.08.026].

Hargreaves, D., Mates, E., Menon, P., Alderman, H., Devakumar, D., Fawzi, W., Greenfield, G., Hammoudeh, W., He, S. and Lahiri, A. (2022). Strategies and Interventions for Healthy Adolescent Growth, Nutrition, and Development. **399** (10320), 198-210. [doi:10.1016/S0140-6736(21)01593-2].

Holmes, B., Dick, K. and Nelson, M. (2008). A Comparison of Four Dietary Assessment Methods in Materially Deprived Households in England. **11** (5), 444-456.

Insel, P. M., Ross, D., McMahon, K. and Bernstein, M. (2014). "Nutrition" (5th ed.). Jones & Bartlett Publishers. [1449649246].

Jakobsen, D. D., Brader, L. and Bruun, J. M. (2023). Association Between Food, Beverages and Overweight/Obesity in Children and Adolescents-A Systematic Review and Meta-Analysis of Observational Studies. **15** (3). [doi: 10.3390/nu15030764].

Jelliffe, D. B. (1996). The Assessment of the Nutritional Status of the Community. **13**, 6-21.
Joshi, S. A. (2002). "Nutrition and Dietetics" (4th ed.). McGraw-Hill Education. chennai, India. [9339220161].

Joshi, S. A. (2015). "Nutrition and dietetics: Within Indian Case studies" (4th ed.). McGraw-Hill Education. [9339220161].

Kansra, A. R., Lakkunarajah, S. and Jay, M. S. (2021). Childhood and Adolescent Obesity: A Review. **8**, 866. [doi: 10.3389/fped.2020.581461].

Kapur, S. (2015). Adolescence: The Stage of Transition. **2** (3), 233-250.

Katoch, O. R. N. (2023). Urgent Call to Address Child Malnutrition: A Matter of Life and future. **116**. [doi: 10.1016/j.nut.2023.112236].

Kennedy, G., Ballard, T. and Dop, M. (2011). Guidelines for Measuring Household and Individual Dietary Diversity [Report]. Rome, Italy, Retrieved from https://www.fao.org/fileadmin.

Killip, S., Bennett, J. M. and Chambers, M. D. (2007). Iron Deficiency Anemia. **75** (5), 671-678.

Koca, B. and Arkan, G. (2021). The Relationship Between Adolescents' Nutrition Literacy and Food Habits, and Affecting factors. **24** (4), 717-728.

Kothari, C. R. (2004). "Research methodology: Methods and techniques". New Age International. [8122415229].

Kubik, E. K., Hecker, J. E. and Righthand, S. (2003). Adolescent Females Who Have Sexually Offended: Comparisons with Delinquent Adolescent Female Offenders and Adolescent Males Who Sexually Offend. **11** (3), 63-83.

Maehara, M., Rah, J. H., Roshita, A., Suryantan, J., Rachmadewi, A. and Izwardy, D. (2019). Patterns and Risk Factors of Double Burden of Malnutrition Among Adolescent Girls and Boys in Indonesia. **14** (8). [doi: 10.1371/journal.pone.0221273].

Maleta, K. (2006). Undernutrition. **18** (4), 189.

Martins, V. J., Toledo Florêncio, T. M., Grillo, L. P., Franco, M. d. C. P., Martins, P. A., Clemente, A. P. G., Santos, C. D., Vieira, M. d. F. A. and Sawaya, A. L. (2011). Long-lasting effects of undernutrition. **8** (6), 1817-1846.

MoFAGA. (2024).

Mohammadbeigi, A., Asgarian, A., Moshir, E., Heidari, H., Afrashteh, S., Khazaei, S. and Ansari, H. (2018). Fast Food Consumption and Overweight/Obesity Prevalence in Students and its Association with General and Abdominal obesity. **59** (3), E236-e240. [doi: 10.15167/2421-4248/jpmh2018.59.3.830].

MOHP. (2004). "National Nutrition Policy and Strategy". Nutrition section(Ministry of Health and Population) pp. 1-58.

MOHP. (2022). "Nepal Demographic and Health Survey". MOHP

Moradi, S., Mirzababaei, A., Mohammadi, H., Moosavian, S. P., Arab, A., Jannat, B. and Mirzaei, K. (2019). Food Insecurity and The Risk of Undernutrition Complications Among Children and Adolescents: A Systematic Review and Meta-Analysis. **62**, 52-60. [doi: 10.1016/j.nut.2018.11.029].

Nicolucci, A. and Maffeis, C. (2022). The Adolescent With Obesity: What Perspectives For Treatment? **48** (1), 9.

NIN. (2020). Nutrient Requirements for Indians: The Recommended Dietary Allowances (RDA) and The Estimated Average Requirements (EAR) [Report]. ICMR.

NRB. (2016). Fifth Household Budget Survey Findings Dissemination Program [Report]. kathmanadu, Nepal,

NRC. (1989). "Recommended Dietary Allowances" (10th ed.). National Academy Press. [[ISBN 0-309-53606-5]].

Ochola, S. and Masibo, P. K. (2014). Dietary Intake of Schoolchildren and Adolescents in Developing Countries. **64** (Suppl. 2), 24-40. [doi: 10.1159/000365125].

Pandey, M. (2018). ASSESSMENT OF NUTRITIONAL STATUS AND DIETARY INTAKE OF ADOLESCENTS STUDYING IN SCHOOLS OF KOHALPUR MUNICIPALITY, BANKE DISTRICT.

Rathus, S. A. (2017). "Childhood and Adolescence: Voyages in Development" (6th ed.). Wadsworth/Thomson Learning. [[ISBN : 978-1-305-50459-2]].

Ritchie, H. and Roser, M. (2017). Micronutrient Deficiency: Our World in Data.

Robson, S. M., Lozano, A. J., Papas, M. and Patterson, F. J. P. C. D. (2017). Food Insecurity and Cardiometabolic Risk Factors in Adolescents. **14**. [doi: 10.5888/pcd14.170222].

Sachan, B., Idris, M., Jain, S., Kumari, R. and Singh, A. (2013). Nutrient Intake Among School Going Adolescent Girls in Lucknow District, India. **2** (4), 20-25.

Sawyer, S. M., Azzopardi, P. S., Wickremarathne, D. and Patton, G. C. (2018). The Age of Adolescence. **2** (3), 223-228. [doi: 0.1016/S2352-4642(18)30022-1].

Sealey-Potts, C. and Potts, A. (2014). An Assessment of Dietary Diversity and Nutritional Status of Preschool Children. **2** (7), 1040.

Sharma, A., Shukla, D. and Kannan, D. J. I. J. o. C. M. (2005). Calorie and Protein Intake and its Determinants Among Adolescent School Girls in Delhi. **30** (1), 8.

Sherpa, A., Singh, N., Basnet, P. B. and Sherpa, M. (2019). Nutritional Status Assessment of Adolescent School Going Children in Solukhumbu, Nepal. **2**. [doi: 10.3126/nmj.v2i1.24488].

Shrestha, A., Six, J., Dahal, D., Marks, S. and Meierhofer, R. (2020a). Association of Nutrition, Water, Sanitation and Hygiene Practices with Children's Nutritional status,

Intestinal Parasitic Infections and diarrhoea in rural Nepal: A Cross-Sectional Study. **20** (1), 1241. 10.1186/s12889-020-09302-3.

Shrestha, S. K., Vicendese, D. and Erbas, B. (2020b). Water, Sanitation and Hygiene Practices Associated with Improved Height-for-Age, Weight-for-Height and Weight-for-Age z-scores Among Under-Five Children in Nepal. **20** (1), 134. [doi: 10.1186/s12887-020-2010-9].

Shrivastava, S. R., Shrivastava, P. S. and Ramasamy, J. (2014). Assessment of Nutritional Status in The Community and Clinical Settings. **34** (5), 211-213. [doi: 10.4103/1011-4564.143648].

Sigulem, D. M., Devincenzi, M. U. and Lessa, A. C. (2000). Diagnosis of Child and Adolescent Nutritional Status. **76** (Suppl 3), 3-10.

Singh, D. R., Sunuwar, D. R., Dahal, B. and Sah, R. K. (2021). The Association of Sleep Problem, Dietary Habits and Physical Activity with Weight Status of Adolescents in Nepal. **21**, 1-17. [doi: 10.1186/s12889-021-10985-5].

Sreenivasa Rj. (2018). "Green Leafy Vegetables, Vegetable and Fruits Consumption Helps to Eradicate Micronutrient Deficiencies".

Srilakshmi, B. (2006). "Nutrition Science" (4th ed.). New Age International. [[ISBN 8122416330]].

Srivastava, M. (2008). "Assessment of Nutritional Status in Basics of Clinical Nutrition" (2nd ed.). Jaypee Brothers Medical PublishersNew Delhi, India.

Subedi, S. and Yadav, D. K. (2018). Food Consumption Practice and Nutritional Status of Adolescent Girls from Urban areas of Pokhara, Nepal. **7** (1), 8-14. [doi:10.37107/jhas.17].

Thompson, J. L. and Manore, M. M. (2009). "Nutrition: An Applied approach" (2nd ed.). Benjamin Cummings/Pearson. [[ISBN:9780321512185]].

Tulchinsky, T. H. (2010). Micronutrient Deficiency Conditions: Global Health Issues. **32**, 243-255.

UNICEF. (1990). Strategy For Improved Nutrition of Children and Women in Developing Countries [Report]. UNICEF. New York, N.Y., USA, [Accessed 2024-06-17].

UNICEF. (2011). "The state of The World's children 2011: Adolescence an Age of Opportunity". UNICEF. [9280645587].

Utter, J., Izumi, B. T., Denny, S., Fleming, T. and Clark, T. (2018). Rising Food Security Concerns Among New Zealand adolescents and Association with Health and Wellbeing. **13** (1), 29-38. [doi: 10.1080/1177083X.2017.1398175].

Vuckovic, N., Ritenbaugh, C., Taren, D. L. and Tobar, M. (2000). A Qualitative Study of Participants' Experiences with Dietary Assessment. **100** (9), 1023-1028. [doi:10.1016/S0002-8223(00)00301-1].

WHO. (1977). "Health Needs of Adolescents: Report of a WHO Expert Committee ". World Health Organization. Switzerland [[ISBN: 9241206098]].

WHO. (1993). "The Health of Young People: A Challenge and a Promise". World Health Organization. [9241561548].

WHO. (1998). Physical Status: The Use and Interpretation of Anthropometry. [Report]. 1469-7599. Vol. 30. WHO. Geneva

WHO. (2002). Improvement of Nutritional Status of Adolescents [Report]. New Delhi

WHO. (2005). Nutrition in Adolescence–Issues and Challenges for the Health Sector [Report].

WHO. (2006). Adolescent Nutrition: A Review of The Situation in Selected South-East Asian countries [Report]. WHO.

WHO. (2010). "Global Recommendations on Physical Activity for Health". World Health Organization. Geneva, Switzerland. [9241599979].

WHO. (2011). Haemoglobin Concentrations For The Diagnosis of Anaemia and Assessment of Severity [Report]. World Health Organization.

WHO. (2024). "The Adolescent Health Indicators ". World Health Organization. [[ISBN: 978-92-4-009219-8]].

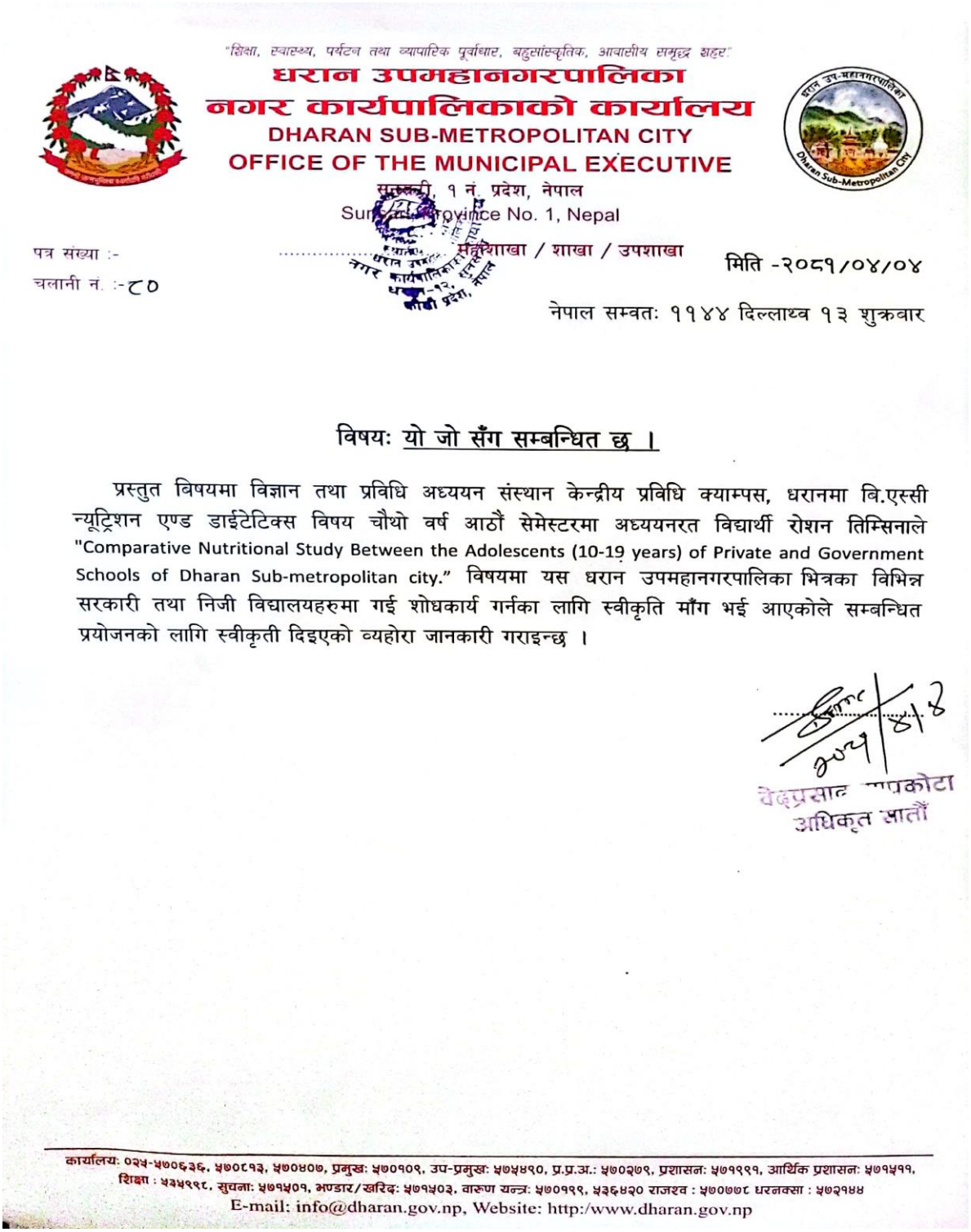
Yilma, B., Endris, B. S., Mengistu, Y. G., Sisay, B. G. and Gebreyesus, S. H. (2021). Inadequacy of Nutrient Intake Among Adolescent Girls in South Central Ethiopia. **10**, e90.

Yılmazer, T. (2013). National and Global Adolescent Health. **4** (1), 1-6.

Yu, T., Chen, C., Jin, Z., Yang, Y., Jiang, Y., Hong, L., Yu, X., Mei, H., Jiang, F., Huang, H., Liu, S. and Jin, X. (2020). Association of Number of Siblings, Birth Order, and Thinness in 3- to 12-year-old Children: A Population-Based Cross-Sectional Study in Shanghai, China. **20** (1), 367. [doi: 10.1186/s12887-020-02261-z].

Appendices

Appendices A Consent letter from Dharan sub-metropolitan city



"शिक्षा, स्वास्थ्य, पर्यटन तथा व्यापारिक पूर्वाधार, बहुसांस्कृतिक, आवासीय समृद्ध शहर"

धरान उपमहानगरपालिका
नगर कार्यपालिकाको कार्यालय
DHARAN SUB-METROPOLITAN CITY
OFFICE OF THE MUNICIPAL EXECUTIVE
सुनसरी, १ नं. प्रदेश, नेपाल
Sunsari, Province No. 1, Nepal

पत्र संख्या :-
चलानी नं. :-८०

.....मन्त्रालय / शाखा / उपशाखा

मिति -२०८१/०४/०४

नेपाल सम्वतः ११४४ दिल्लाथ्व १३ शुक्रवार

विषयः यो जो सँग सम्बन्धित छ ।

प्रस्तुत विषयमा विज्ञान तथा प्रविधि अध्ययन संस्थान केन्द्रीय प्रविधि क्याम्पस, धरानमा वि.एस्सी न्यूट्रिशन एण्ड डाईटेटिक्स विषय चौथो वर्ष आठौं सेमेस्टरमा अध्ययनरत विद्यार्थी रोशन तिम्सिनाले "Comparative Nutritional Study Between the Adolescents (10-19 years) of Private and Government Schools of Dharan Sub-metropolitan city." विषयमा यस धरान उपमहानगरपालिका भित्रका विभिन्न सरकारी तथा निजी विद्यालयहरुमा गई शोधकार्य गर्नका लागि स्वीकृति माँग भई आएकोले सम्बन्धित प्रयोजनको लागि स्वीकृती दिइएको व्यहोरा जानकारी गराइन्छ ।

वेदप्रसाद [illegible]कोटा
अधिकृत सातौं

कार्यालय: ०२५-५७०६३६, ५७०८१३, ५७०४०७, प्रमुख: ५७०१०९, उप-प्रमुख: ५७५४९०, प्र.प्र.अ.: ५७०३७९, प्रशासन: ५७१९९१, आर्थिक प्रशासन: ५७१५११, शिक्षा : ५३५९९८, सुचना: ५७१५०१, भण्डार/खरिद: ५७१५०३, वारुण यन्त्र: ५७०१९९, ५३६५३० राजश्व : ५७०७७८ धरनक्सा : ५७२१४४
E-mail: info@dharan.gov.np, Website: http:/www.dharan.gov.np

Appendices B Consent form

Namaste! I, Mr. Roshan Timsina, a graduate student of Nutrition and Dietetics in Central Campus of Technology, Dharan; am going to conduct dissertation work in Dharan sub-metropolitan city for the degree of Bachelor of Science in Nutrition and Dietetics.

The topic for the study is **"COMPARATIVE STUDY ON NUTRITIONAL STATUS OF PRIVATE AND PUBLIC SCHOOL ADOLESCENTS OF DHARAN SUB-METROPOLITAN CITY.**"

Under this study, nutritional status, factors affecting dietary status and dietary pattern of adolescents aged 10 to 19 years of age will be surveyed.

Congratulations, you have been selected for the survey. You will be asked some general questions related to your family, socio-economic condition, dietary intakes, physical activity and nutritional knowledge. Your height and weight will also be measured. Some questions might be personal. Privacy of the respondent will not be misused. Your participation in the study is important. You may not answer some or all of the questions if you find them personal or sensitive. I hope you will cooperate.

Would you like to participate in the study?

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

Signature of participant: Signature of surveyor:

Date: Date:

Place: Place:

Appendices C Survey questionnaire

A. GENERAL INFORMATION

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

Student's Code No. Class:

1. Name of child: _____
2. Age (in years): _____ Date of birth (B.S.): | Y | M | D |
3. Address: Dharan Sub-metropolitan city
   Ward no: _____ Tole: _____
4. Gender:
   a) Male b) Female c) Other
5. Caste/Ethnicity:
   a) Brahmin b) Chettri c) Rai d) Magar
   e)Limbu f) Tamang g) Others: _____
6. Religion:
   a) Hindu b) Christian c) Kirat d) Buddhist
   e) Others: _____

B. ANTHROPOMETRIC INFORMATION

DATA	Reading 1	Reading 2	Reading 3	Average
Height (cm)				
Weight (kg)				

C. FAMILY INFORMATION

1. Type of family:
   a) nuclear b) Joint

2. Number of family members: _____
3. Number of male members: _____
4. Number of female members: _____
5. Number of children (0-10 years) _____
6. Number of adolescents (10-19 years) _____
7. How many siblings do you have (siblings from same parents)?

   Total: _____ Brothers: _____ Sisters: _____
8. Your sequence among siblings (from the eldest): _____
9. Occupation of father:

   a) Agriculture b) Service c) Labour

   d) Business e) Foreign employment f) Others: _____
10. Occupation (of mother):
    a) Agriculture b) Service c) Labour d) Business
    e)Foreign employment f) house wife g) Others_____
11. Family income:

    a) Less than Rs. 30000 monthly b) Equal to or more than Rs. 30000 monthly
12. Father's Education level

    a) Higher secondary or above b) Secondary c) primary

    d) Informal e) Illiterate
13. Mother's education level:

    a) Higher secondary or above b) Secondary c) primary d) Informal e) Illiterate
14. Which is your main source of drinking water in your family?

    a) water tap b) River c) pond d) other _____
15. Is the water purified?

    a) yes b) no

16. Do you have toilet facility in your house?

a) yes b) no

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

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

D. PHYSICAL ACTIVITIES

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

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

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

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

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

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

4. What do usually do at school breaks?

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

c)Running or playing game

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

a) Yes b) No

- If yes, what type?

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

e) Running/jogging f) Walking g) Yoga

- In a day, how much time do you do such activity? ____ Hrs./Minutes
- How frequently in a week? _____

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

1) Yes 2) No

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

E. **DIETARY INTAKE AND FOOD HABITS**

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

a) Yes b) No

2. Do you skip any meal?

a) Yes b) No

- If yes, which meal does you skip?

a) Breakfast b) Lunch c) Dinner

3. How often do you skip this meal?

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

4. At home, where do you usually eat?

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

d) other places _____

5. What are you?

a) Vegan b) Vegetarian c) non-vegetarian

- If you are a vegan/vegetarian, how long has it been…….

- What influenced you to be vegan/vegetarian

a) social media b) friends c) parents d) others…….

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

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

7. Do you have daily pocket money?

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

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

a) Yes b) No

If yes, what do you usually buy? _____

9. How do you feel about your figure?

a) Overweight b) Right weight c) Thin

10. Have you ever tried losing weight?

a) Yes b) No

11. Have you ever tried gaining weight?

a) Yes b) No

12. Do you monitor your weigh or height?

a) Yes b) No

13. Do you smoke?

a) Yes b) No

14. Do you drink alcoholic beverages?

a) Yes b) No

15. Have you ever been body shamed about your weight or height?

a) Yes b) No

16. Do you know about malnutrition?

a. Yes b. No

If yes, what is the cause of malnutrition?

a. Inadequate food
b. Superstition
c. Unhygienic food practices
d. Others ……

F. **FOOD FREQUENCY TABLE**

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

G. 24- hour diet recall

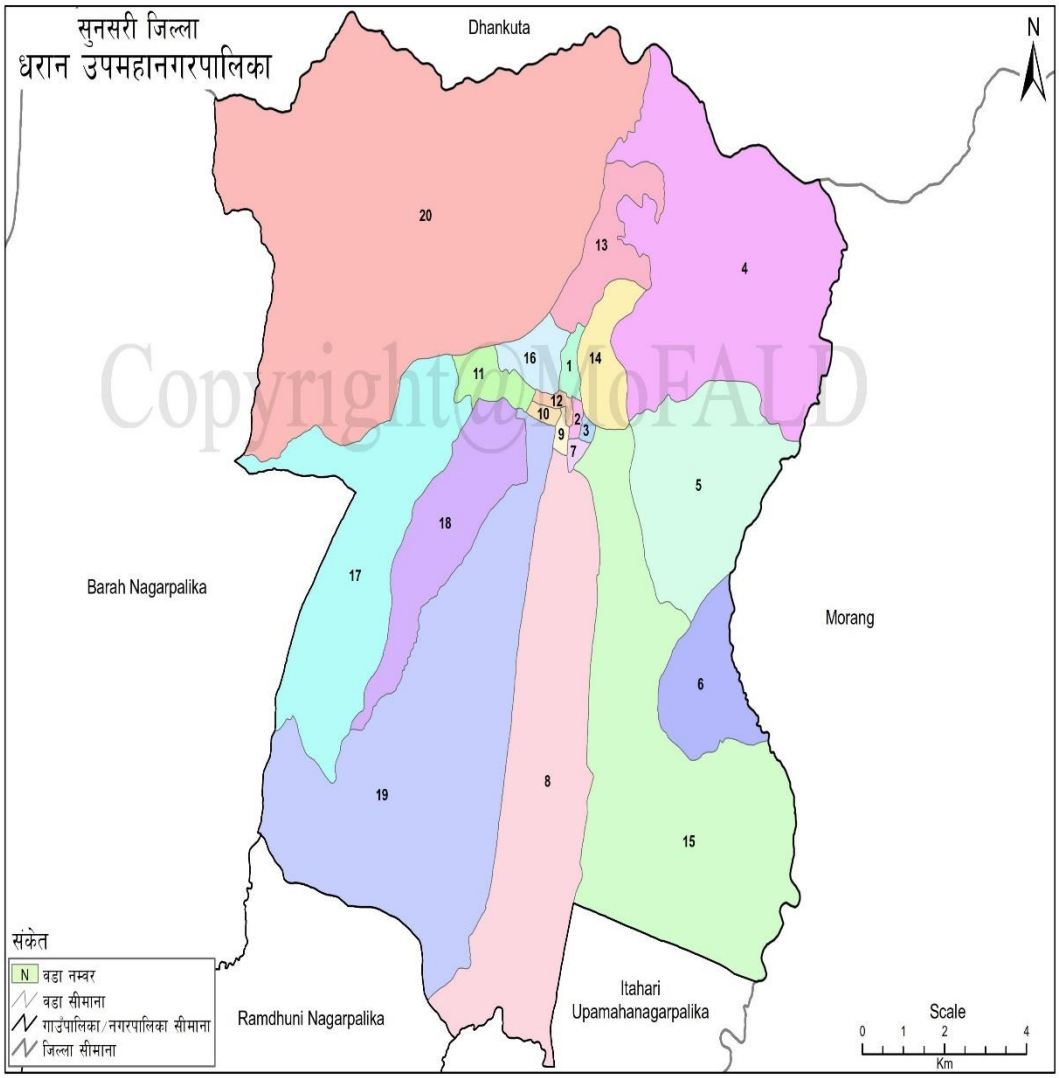
Time	Description of food	Portion	Amount	Remarks
Breakfast (6-8 am)				
Lunch (9-11am)				
Midday Snacks (12-3pm)				
Evening snacks (4-6 pm)				
Dinner (7-10pm)				

Appendices D Photo gallery

Measuring height

Filling Survey questionnaire

Appendices E Survey site



Source: MoFAGA (2024)