COMPARATIVE STUDY ON NUTRITIONAL STATUS OF VEGETARIAN AND NON-VEGETARIAN ADOLESCENTS OF PRANAMINAGAR, BHADRAPUR

by

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Comparative Study on Nutritional Status of Vegetarian and Non-vegetarian Adolescents of Pranami Nagar, Bhadrapur

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

by

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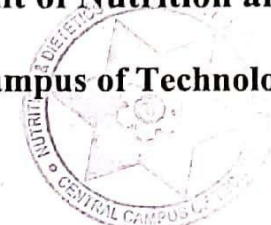
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Approval Letter

This *dissertation* entitled *Comparative Study on Nutritional Status of Vegetarian and Non-vegetarian Adolescents of Pranami Nagar, Bhadrapur* presented by **Binaya Raj Koirala** has been accepted as the partial fulfillment of the requirement for the **B.Sc. degree in Nutrition and Dietetics**

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Abstract

A community based cross sectional study was carried out to assess nutrition status of vegetarian and non-vegetarian adolescent population of Pranami Nagar, Bhadrapur. A structured questionnaire was used to collect data of 180 subjects. Anthropometric measurements were used to determine BMI z-scores and height for weight z-scores. Dietary intake was assessed using 24-hour dietary recall and food frequency questionnaire. Data collected was analyzed using WHO Anthroplus v1.0.4, SPSS 26 and Microsoft Excel. T-test, Chi-square test and fisher's exact test were used for necessary analysis.

The analysis of the study revealed, the prevalence of stunting, thinness and overweight/obesity in vegetarians was 28.95%, 13.17% and 15.79% respectively and in non-vegetarians it was 38.47%, 17.31% and 6.73% respectively. Significant differences in height, weight, BMI z-score, height for weight z-score, calorie intake and carbohydrate intake were seen among vegetarian and non-vegetarian boys. No significant difference in anthropometric measurements and dietary intakes were seen among girls. In vegetarians, place of eating, adequacy of physical activity and adequacy of protein intake were found associated with stunting while gender, occupation of father, food source, sleeping hour and adequacy of calories were associated with thinness and overweight/obesity. In non-vegetarians, ethnicity, religion, occupation of father, number of siblings, consumption of milk and milk products, green leafy vegetable and meat, fish, egg were associated with stunting. While type of family, occupation of father, family income and consumption of green leafy vegetables and other vegetables were associated with thinness. Properly planned interventions from authorities should certainly enhance the nutritional status of the target population.

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List of Abbreviations

Abbreviations	Fullform
APA	American Psychological Association
BMIZ	Body mass index z-score
CBS	Central Bureau of Statistics
CFNI	Caribbean Food and Nutrition Institute
CHO	Carbohydrates
EAR	Estimated average requirements
FCHV	Female community health volunteer
FSEM	Faculty of Sports and Exercise Medicine
HDDS	Household dietary diversity score
HRmax	Maximum heart rate
HWZ	Height for weight z-score
ICMR	Indian Council of Medical Research
IDDS	Individual dietary diversity score
MoFAGA	Ministry of Federal Affairs and General Administration
MoFALD	Ministry of Federal Affairs and Local Development
MPA	Moderate physical activity
MVPA	Moderate to vigorous physical activity
NCD	Non communicable diseases
NDHS	Nepal Demographic and Health Survey
NHRC	Nepal Health Research Council
NIN	National Institute of Nutrition
PA	Physical activity
RDA	Recommended dietary allowance
SPSS	Statistical package for the social sciences
VPA	Vigorous physical activity
WHO	World Health Organization

Part I

Introduction

1.1 Background

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, 2021a). Poor nutritional status contributes to an estimated 200 million children not reaching their full developmental potential, with more adolescents becoming stunted, wasted, and underweight because of severe undernutrition. This condition impairs cognitive and physical development while also increasing the risk of morbidity and mortality (UNICEF, 2022).

The period of rapid physical, cognitive, and emotional growth known as adolescence, which lasts from the ages of 10 to 19, is a unique period in human growth and development that comes after childhood but before adulthood (WHO, 2021a). According to the Global Nutrition Report (2020), the prevalence of underweight, overweight, and obesity in boys and girls aged 5-19 years was 31.6%, 19.2%, 7.8%, and 25.9%, 17.5%, 5.6%, respectively, worldwide. Van Tuijil *et al.* (2020) stated the prevalence of stunting and thinness among adolescents in Nepal to be 29.9% and 10.2% respectively. In eastern Nepal, a majority of adolescents were found to have abnormal body weight, with 47.3% underweight and overweight being 7.3% (Kafle *et al.*, 2020). The data regarding the nutritional status of vegetarians and non-vegetarians in Nepal is not abundant or accessible.

Vegetarianism, which excludes intake of meat and fish, has been practiced in Indian subcontinent for millennia. Veganism, which forgoes any foods with animal origins, is a more recent movement in the region (Alsdorf, 2010). There is no authentic data or enumeration for the worldwide proportion of vegetarian and non-vegetarian people and their nutritional status, however data and approximations are available for individual regions and studies. In a study by Siapco *et al.* (2019), the BMI z-score of vegetarian adolescents (0.14±0.89) was significantly lower than that of the non-vegetarian (0.42±0.97) population. While, other study concluded, vegetarians were underweight than non-vegetarians (31.3% vs 15.6%), but non-vegetarians were more likely to be overweight or obese (23.7% vs 9.9%) (Gan *et al.*, 2018). Various independent studies by researchers around the world point to vegetarians and vegans having lower average BMIs than non-vegetarian counterparts;

however, the consistent findings of low BMI in western vegetarians may not apply in non-western populations (Alexy *et al.*, 2021; Appleby and Key, 2015) for example, there was no difference in mean BMI between vegetarians and non-vegetarians in the Indian Migration Study of 7000 participants, 33% of whom were vegetarians (Agrawal *et al.*, 2014) . In recent times the benefits of vegetarianism are also well known. Vegetarians have a lower risk of hypertension, diabetes, obesity, and cancer (Jaacks *et al.*, 2016). NCDs are a matter of concern in the present world. In Nepal, NCDs as a cause of death has increased from 31.3% in 1990 to 71.1% in 2019 (Aryal *et al.*, 2016). Despite the possible benefits, a particular nutritional inadequacy like of protein, vitamin D, zinc, calcium, vitamin B12, etc. may be prevalent in vegetarians aiding undernourishment (Melina *et al.*, 2016).

Pranaminagar, also known as Pranami tole is a small area in Bhadrapur Municipality where a significant number of vegetarian families reside. The study performed a comparative study on nutritional status of vegetarian and non-vegetarian adolescents of Pranaminagar, Bhadrapur, Jhapa.

1.2 Statement of problem

Adolescence is the most critical period of human development. Marsh *et al.* (2013) states vegetarian diet may contain limited amount of one or more amino acids, but latest studies suggests that strict protein combination is not necessary if there is variety in the diet, author also states vegetarians should be encouraged to include variety of protein rich food in diet for adequate protein intake along with iron, zinc, calcium and vitamin B12.

In Asia, vegetarianism has been practiced mostly by Hindus and Buddhists for centuries (Gan *et al.*, 2018). The vegetarian population in South Asia is about 33% (Jaacks *et al.*, 2016). Nepal has a Hindu population of 81.19 % and a Buddhist population of 8.2 % (CBS, 2021). So, it is evident that the number of vegetarians in Nepal is significant.

Globally, two billion people suffer from micronutrient deficiencies, millions are stunted and millions more have impaired cognitive development related to poor nutrition. This is partly due to insufficient consumption of animal-sourced foods (ASF), which supply multiple bioavailable nutrients that are lacking in the cereal-based diets of the poor (Adegbola *et al.*, 2019). Although Nepalese are predominantly non-vegetarian, per capita consumption of meat and animal-derived food is very low that is 11.15 kg per person and malnutrition in Nepal is a major health concern (Bhatta *et al.*, 2018) . Bio-availability of nutrients in plant based diet may be low, protein digestibility in Indian was as low as 75%,

this was due to lower consumption of animal food (Mangels *et al.*, 2011). Yet, the comparitive study on nutritional status of vegetarian and non-vegetarian population hasn't been the topic of concern among the research communities in Nepal.

Adolescence being important period of life, it is necessary to address the aspects affecting the nutritional status at this period. Hence, the study among the population of 10-19 years of age of Pranami tole, Bhadrapur and was carried out to figure out the significant gaps in nutritional status between vegetarians and non-vegetarians and associated factors affecting them.

1.3 Objectives

1.3.1 General Objectives

To assess and compare the nutritional status of vegetarian and non-vegetarian adolescents of Pranami Nagar, Bhadrapur.

1.3.2 Specific Objectives

a) To assess the nutritional status of vegetarian and non-vegetarian adolescents of Pranami Tole, Bhadrapur.
b) To investigate if there is significant nutritional gap between vegetarian and non-vegetarian population of targeted age group
c) To find out factors associated with nutritional status.

1.4 Research Questions

a) What is the nutritional status of vegetarian and non-vegetarian adolescents of Pranami tole, Bhadrapur ?
b) Is there any significant difference in nutritional status of vegetarian and non-vegetarian population of the targeted age group ?
c) What are the factors associated with nutrition status in the targeted age group ?

1.5 Significance of study

a) Acknowledge about the nutritional status of adolescents.
b) Acknowledge either vegetarian is more prone to improper nutrition and nutritional status or non-vegetarian ones are or there is no significant difference.

c) Discover problems related to vegetarian or non-vegetarian diet and food consumption practices in the area.

d) Serve as a helpful guide for local people to improve the present nutritional status.

1.6 Framework of the study
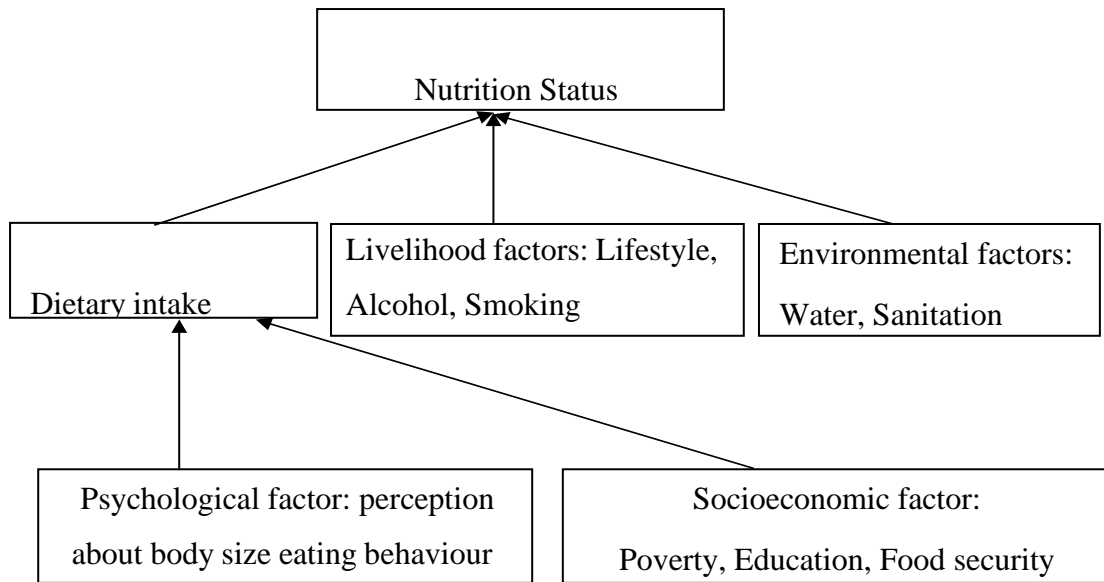
Figure 1.1 Framework of study

Adapted from: UNICEF (2017)

1.7 Limitations of study

a) 24 hours dietary recall was employed instead of 3-days dietary recall.

b) Biochemical and clinical assessment could not be employed.

PART- II

Literature Review

2.1 Malnutrition

"Malnutrition is a state in which a prolonged lack of one or more nutrients retards physical development or causes specific clinical disorders"(Joshi, 2015). WHO(2021b) states "Malnutrition refers to deficiencies, excesses, or imbalances in a person's intake of energy and/or nutrients."

2.2 Forms of Malnutrition

According to WHO(2021b) malnutrition is of major three types: undernutrition, which includes wasting (low weight-for-height), stunting (low height-for age) and underweight (low weight-for-age).

Micronutrient-related malnutrition, which includes micronutrient deficiencies (a lack of important vitamins and minerals) or micronutrient excess; and overweight, obesity and diet-related noncommunicable diseases (such as heart disease, stroke, diabetes and some cancers)."

2.3 Adolescence

"Adolescence is characterized by exceptionally rapid growth and development. During this stage, the body develops in size, strength and reproductive capabilities, and the mind becomes capable of more abstract thinking. There is also an increase in emotional control"(WHO, 2010).Adolescents experience changes related to growth of body, growth of brain (prefrontal cortex), cognition (ability to get knowledge through different ways of thinking), psychology and society, family and society(WHO, 2010).

2.3.1 Early adolescence

Early adolescence is the age group of 10-15 years. In this time secondary sexual characters appear, person start to use concrete thinking, does not understand how present action will affect his/her future, frequent changes in mood is seen, argues and is disobedient (WHO, 2010)

2.3.2 Middle adolescence

Middle adolescence is the age group of 14-17 years. In this time secondary sexual characteristics advance, person reaches approximately 95% of adult growth, they think a lot about impractical dreams, feels very powerful, they have emerging sexual drives and form stable relationships(WHO, 2010).

2.3.3 Late adolescence

Late adolescence is the age group of 16-19 years. During this period person leads towards physical maturity, develops abstract thinking, and plans for future, starts to understand right from wrong (morally and ethically) (WHO, 2010) .

2.4 Changes during adolescence

2.4.1 Physical changes

Physical changes in adolescence are characterized by onset of puberty. It is characterized by increase in height, change in voice, development of sexual desires, growth of body hairs, development of beard and moustaches (in boys), menarche (in girls), development of sex hormones begins and development of secondary sexual characteristics occurs. Rapid changes in the body can be exciting, scary, and/or confusing. Some adolescents may mature early while others experience late maturation, both of which can cause added stress of standing out as different. This can be particularly distressing because adolescence is the peak developmental window for wanting to fit in with peers (Rathus, 2017).

2.4.2 Cognitive changes

Adolescent observe increased intellectual capabilities in them it changes the way they approach the world. The cognitive changes of adolescence influence how adolescents view themselves and their families and friends and how they deal with broader social and moral questions(Rathus, 2017). Adolescence is known for being a time for teens to assert their independence from family and begin to make decisions on their own. This is largely due to developmental changes in the brain that create significant advances in cognitive abilities. What is occurring during this time is large numbers of neurons are growing rapidly and there is an increase in interconnectedness between neurons, which allows for more complex and sophisticated thinking (Feldman, 2008).

2.4.3 Psycho-social changes

Adolescence involves development of identity, changes in time spending with parents and peers, increased development of relationship in society, development of autonomy, development of sexual orientation etc. An adolescence may get involved in juvenile delinquency (Rathus, 2017). During this time, adolescents have more complex thinking abilities and can start to see how they are different from others and from their family. Issues around self-esteem are common as they begin to differentiate themselves from others while also experiencing physical changes in their body. Self-esteem can be a complex experience as some adolescents may have high self-esteem in their family life but low self-esteem among their peers, or in their academic performance (Feldman, 2008).

2.5 Vegetarian and non-vegetarian diet

The simple definition of a vegetarian is the absence of meat from the diet, or more strictly the absence of all animal products. This simple definition is also confusing because of the variety of diet practices thought to be vegetarian across the globe. "Some nutritional societies have been reluctant to publish dietary recommendations for a vegetarian diet as its definition was considered insufficiently specific" (Fraser, 2016). Hence, they are broadly categorized into lacto-vegetarians, lacto-ovo-vegetarians and ovo-vegetarians; lacto-vegetarian community who only consumes dairy products and plant-based foods; lacto-ovo-vegetarian are those who consume milk, dairy products and eggs; ovo vegetarian consumes both eggs and plant-based foods whereas non-vegetarians consume meat, fish and egg as well(Yadav *et al.*, 2020). Adolescents in developing countries however mainly depend on plant based diet (Ochola and Masibo, 2014).

2.6 Nutritional requirement in adolescence

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 boys and girls respectively.

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

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

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

Nutrients	Age(in years)		
	10 to 12	13 to 15	16 to 18
Protein (g)	33	43	46
Calcium (mg)	850	1000	1050
Iron (mg)	28	30	32
Vitamin A (µg)	790	890	860
Thiamine (mg)	1.4	1.6	1.7
Riboflavin (mg)	1.9	2.2	2.3
Niacin (mg)	14	16	17
Pyridoxine (mg)	1.9	2.2	2.3
Ascorbic Acid (mg)	50	65	70
Dietary folate (µg)	225	245	270
Vitamin B12 (µg)	2.2	2.2	2.2
Magnesium (µg)	250	340	380
Zinc (mg)	8.5	12.8	14.2

2.7 Factors affecting adolescent nutrition status

2.7.1 Dietary inadequacies

Adolescent health and development that is carried to adulthood is related to the diet they consume. Inadequate energy, macro or micro-nutrient intakes during adolescent period may have adverse long-term effects. Improper nutrition during adolescent may also lead to disordered eating patterns, related to dieting or restriction, poor body image, or a disrupted relationship with food this in-turn may lead to more inadequacy in diet (Evans and Docter, 2020). Adequate nutrition is determined by two factors, one is availability and second is ability to eat, digest, absorb and utilize food (WHO, 2006).

In developing countries with starchy staples and monotonous intake of seasonally available certain types of foods and food insecurity dietary inadequacy becomes prominent (Maziya *et al.*, 2013). Most of the female adolescent in Pokhara were not taking adequate calories (Subedi and Yadav, 2018).

2.7.2 Physiological condition and lifestyles

Dietary intake, physical activity, infection and early pregnancy are the physiological determinants of adolescent health and nutrition (Christian and Smith, 2018). Rapid growth and puberty escalates the physiological demand of nutrients, this coupled with inadequate calorie and nutrient intake leads to malnutrition (Oddo *et al.*, 2017). Studies have shown the level of physical activity tends to fall significantly at the time of adolescence. Studies have reported that the average American college student fails to meet the current physical activity recommendations of the American College of Sports Medicine, which involve at least three times per week of vigorous activities for cardio respiratory endurance, a minimum frequency of three times a week for flexibility exercises, and twice a week for strength/endurance activities (WHO, 2005). Additionally, habitual physical activity is a key determinant in energy expenditure and long-term weight control(Wier *et al.*, 2001). In developing countries, adolescents are compelled to involve in heavy works, leading to increased nutritional need without appropriate supply of nutrients (WHO, 2005).

2.7.3 Psycho-social factor

According to APA (2023), psycho-social factors are social, cultural, and environmental phenomena and influences that affect mental health and behavior. It is common during adolescence and young adulthood for eating habits to vary, not only driven by social changes that occur from school age to adolescence, i.e. transition of eating predominantly at home to eating with peers or on campus, but also as a form of identity exploration during this time. . Bhattarai and Bhusal (2019) in a study in Dang district, Nepal stated significant association of religion, gender, family type, school type, daily intake of green leafy vegetables and school sports with the underweight and overweight/obesity in adolescents. Thapa *et al.* (2020), in a study in Kathmandu found majority of the adolescents lack the healthy eating behavior. Social, other predisposing, and reinforcing factors were important determinants of eating habits among adolescent students. Likewise, in present time social media messages persuade adolescents to believe, thinness and fitness were a prerequisite for social, personal and professional success, so much so that adolescents willing to compromise physical, emotional and mental health. In addition, certain individuals may experience "thin privilege" where they are not subject to body biases because they meet societal expectations of body type and are therefore less likely to suffer from an eating disorder or associated psychological

factors. Consequently, weight bias from social circles and health care providers can have a long-term impact on a teen's health (Evans and Docter, 2020).

2.7.4 Food security

Household food insecurity appears to be associated with higher risk of stunting and being underweight among children and adolescents. In addition, the intensification of the level of food insecurity and the increased age of children may increase the risk of stunting or being underweight in food-insecure households (Moradi *et al.*, 2019). Among adolescents, food insecurity was significantly associated with not consuming breakfast daily, getting less than 8 hours of sleep per day, currently smoking, and currently drinking alcohol. Food insecurity in adolescents may serve as an important precursor to poor cardiometabolic health (Robson *et al.*, 2017). Food insecurity always leads to malnutrition that is reflected by the deteriorated health standard of the victim (Deore, 2022).

2.7.5 Health, water and sanitation

Malnutrition is associated with quality of health facilities available, health knowledge and practices, water and hygiene practices (Danjin *et al.*, 2021). Water, sanitation, and hygiene plays a key role in reducing malnutrition, as evidence across low and middle-income countries shows that higher open defecation rates are associated with stunting and higher overall incidence of poverty. Access to food, health service and a healthy environment, and good caring practices are considered essential for good nutrition outcomes. But no one of these three essential elements (food, health or care), is sufficient in and of itself. For example, an abundance of food may do little to nourish communities that are in constant contact with fecal germs, where water and excreta-related diseases are spread as a result of inadequate sanitation, water supply and hygiene practices. Malnutrition can be widespread even in regions with plentiful supplies of affordable food because this food is not well absorbed by the body (Soulichanh, 2019).

2.7.6 Socio-economic and political condition

Poverty, low literacy rate, large families, food insecurity, food safety, women's education appear to be the important underlying factors responsible for poor health status of children from low socioeconomic class. It requires economic, political and social changes as well as changes for personal advancement mainly through educational opportunities to improve the nutritional status ((Babar *et al.*, 2010). In Syria, nutritional status of children and adolescents

had been severely impacted by war, meanwhile among the refugees those taking refuge in the country with better socio-economic status had been impacted by obesity (Pehlivanturk-Kizilkan *et al.*, 2020). Nepal's average family income was Rs 30,125 (NRB, 2016), with GDP per capita and PCI among the lowest in the world (IMF, 2022). Factors like rural residence and family income are associated with malnutrition in adolescents. (Kebede *et al.*, 2021; Melaku *et al.*, 2015). Van Tuijil *et al.* (2020) in a study concluded, in Nepal paternal occupation and education, household income, number of earning household members, geographical place of residence, caste/ethnicity and nutritional knowledge were found associated with malnutrition in adolescents.

2.8 Status of vegetarian and non-vegetarian adolescents

There has not been any comprehensive research carried out across Nepal enumerating the figures of total vegetarian and non-vegetarian population. NDHS(2016), does include data about the consumption of meat, fish, dairy and vegetables by children below 5 years of age and Aryal *et al.* (2016) includes some data related to vegetarian and non-vegetarian adolescents collected through a survey which ultimately does not represent the entire targeted population across the country. Although several small locational cross-sectional studies have been carried out by various authors to find out correlation of vegetarian versus non-vegetarian diet against various contemporary health issues, nationwide data on the actual status of vegetarian and non-vegetarian population is still lacking.

According to Aryal *et al.* (2016), the percentage of vegetarian adolescents in surveyed sample population was 6.2%, 0.8% were eggetarian and rest were non-vegetarian. CBS (2021) stated 12,705 adolescents were present in Bhadrapur municipality, but no any surveys or censuses distinctly classified vegetarians and non-vegetarian population and explained their characteristics. According to Jha *et al.* (2021), vegetarian students of Kathmandu University School of Medical sciences had lower BMI than non-vegetarian students. Whereas, Borude (2019) states it is not necessary that vegetarian diet be related with lower incidence of obesity. But, Tripathi *et al.* (2010) states there was no significant difference in BMI of vegetarians and non-vegetarians of same geographical regions, whereas BMI of subjects in plain regions were significantly higher than those in hills. Siapco *et al.* (2019) states in an assessment of adolescents calorie intake in vegetarians were found to be higher, which is different from the findings of Tripathi *et al.* (2010) where non-vegetarians had higher calorie intakes than vegetarians this may be because in west health conscious people

tend to be vegetarian (Shickle *et al.*, 1989) whereas in developing nations vegetarianism is often associated with lower calorie intake (Sharma *et al.*, 2019; Yakub *et al.*, 2010).

2.9 Advantages and concerns to nutrition and health

2.9.1 Advantages of vegetarian diet and concerns for non-vegetarian diet

Vegetarians has better nutrient intake, blood pressure levels, low unhealthy body fat and abdominal obesity in comparison to non-vegetarians (Gan *et al.*, 2018). Appropriate and acceptable vegetarian diet is not inferior to non-vegetarian diet but special attention is required to fulfill the dietary necessity of different age group; it is known that there is less incidence of chronic degenerative disease occurrence in those whose childhood diet is predominantly vegetarian (Jacobs and Dwyer, 1988). When a person switches from normal diet to vegetarian diet reduction in serum total and low density lipoprotein level is observed; vegetarians have overall lower cancer risk rate; vegetarians has relatively lower BMI and has low risk of developing type 2 diabetes (Criag, 2010). Consumption of citrus and green leafy vegetables was greater in vegans and vegetarians, vegetarians' tendency to consume fried potatoes was significantly lower to that of non-vegetarians; vegetarians were found to consume considerably more legumes, soyabeans and tofu, and soya milk when compared with non-vegetarians. They consumed moderately more peanut butter, but similar amounts of peanuts; more tree nuts and seeds when compared with non-vegetarians, with vegans consuming notably increased amounts, which may be due to their inclination towards vegetarian diet concerning better health, environmental concern etc.(Orlich *et al.*, 2014). Vegetarians had lower calorie intakes than non-vegetarians (Alexy *et al.*, 2021; Clarys *et al.*, 2014; Meirelles *et al.*, 2001), Siapco *et al.* (2019) found calorie intake in vegetarians to be higher. Non-vegetarians have high BMI values, higher obesity rates, comparatively more usage of tobacco and alcohol, higher rate of incidence of chronic disease and higher rate of cancer occurrence (Rizzo *et al.*, 2013). However, idea that vegetarians have low BMI is not supported by all the studies Nawab *et al.* (2014) in a study among adolescents in Aligarh found vegetarians are obese than non-vegetarians.

2.9.2 Advantages of non-vegetarian diet and concerns for vegetarian diet

Protein of animal source has higher protein quality, higher biological value and net protein utilization (Hoffman and Falvo, 2004). Vitamin B12 requirement cannot be met without animal based food intake or supplementation (Stanisic *et al.*, 2018). Nutrient intake,

hemoglobin level, endurance time was better in non-vegetarians than lacto, ovolacto vegetarians (Khanna *et al.*, 2006). The intake of vitamin D is considerably low in vegans; lacto-ovo-vegetarians can derive vitamin B12 necessary from diary and egg but vegans need additional supplementation; in contrast vegetarians tend to have lower level of long chain omega 3 fatty acids; calcium intake in vegans is a matter of concern; there is no significant difference in iron deficiency anemia between vegetarian and non-vegetarian cases; although zinc deficiency has not been plainly apparent in vegetarians zinc level in those subjects might be considerably low (Criag, 2010). The intake of total protein is lower in vegetarian subjects (Ingenbleek and McCully, 2012; Rizzo *et al.*, 2013). Vegan population shows the higher tendency of development of anemia because of less bio available iron. Problems related to anorexia nervosa is found out to be observed more in vegetarian population (Stanisic *et al.*, 2018).

2.9.3 The realistic approach

In the absence of adequate evidence, it is not wise to conclude the superiority of any of the vegetarian or non-vegetarian diet forms. The superiority of vegetarian food, particularly their restrictive forms are overly exaggerated; every diet that contains limited processed foods, moderate amount of animal foods, and abundance of fruits, vegetables and whole cereals is beneficial from nutritional and health point of view (Stanisic *et al.*, 2018). For instance Weder *et al.* (2019) in a study found vegetarians to be stunted but Sabate *et al.* (1991) found vegetarians to be taller. Various studies had concluded, vegetarian/non-vegetarian diet independently is not related to overall health and wellbeing (Kesuma *et al.*, 2020; Marsh *et al.*, 2011).

2.10 Nutritional assessment

Nutritional assessment is measures to confer if there is undernutrition or not and determine the severity of the condition to better plan the most appropriate intervention and mostly follow up the effectiveness of the feeding therapy regimen(Correia, 2018). 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 (FAO, 2022).

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

a) Direct Method
    - Anthropometric method
    - Biochemical methods
    - Clinical methods
    - Dietary procedures

b) Indirect Method
    - Vital statistics
    - Ecological factors

2.10.1 Direct method

Direct method includes four types that can be used in collaboration or unilaterally according to purpose.

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

Advantages of anthropometry (Benjamin, 2014):

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

Table 2.3 Anthropometric indicators of nutritional status for adolescents (WHO, 2022a)

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

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

iii) Clinical appraisal: Clinical appraisal try to seek out the symptoms of specific nutritional deficiency. Presence of two or more clinical signs increases the diagnostic significance (Shrivastava *et al.*, 2014).

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

2.10.2 Indirect Method

Vital statistics: Vitals statistics such as records related to birth and death of infants, death of mother etc. might be used to evaluate the prevalence rate, sort out the risk groups and has higher public health importance (Shrivastava *et al.*, 2014).

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

2.11 Dietary assessment

Dietary survey is a scientific assessment of eating pattern that could detect nutrient deficiency. There are many methods to do dietary surveys at region/state/country level, household level and individual level. Method like, food balance sheet is used for dietary survey at national/regional levels, inventory method is used for dietary surveys at institutional level or when there is homogenous population, and weighment method, 24hr dietary recall, food frequency questionnaires are used at individual levels (Shrivastava *et al.*, 2014)).

2.11.1 Methods for household dietary assessment

The principle methods of dietary assessment at the household level are: food accounts, inventories and household recall. Data generated by these methods are useful for comparing food availability among different communities, geographic areas and socioeconomic groups, and for tracking dietary changes in the total population and within population subgroups.

However, these data do not provide information on the distribution of foods among individual members of the household (FAO, 2009). Household dietary diversity Score (HDDS) method can be used as qualitative method for the assessment (Kennedy *et al.*, 2011).

2.11.2 Methods for individual dietary assessment (CFNI, 2004; FAO, 2009; Hartog *et al.*, 2006)

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

24-hour recall

This widely used method involves asking subjects to recall and describe all intakes of foods and drinks in the previous 24 hours. This method usually requires a trained fieldworker/dietician/nutritionist to interview subjects, to assess portion weights and make appropriate enquires about types of food and drinks consumed and possible omissions of, for example, snacks. It is a much-used dietary assessment method because it is simple, quick and inexpensive, but it is prone to reporting errors, including biased or inaccurate recalls of food intake and portion sizes. It requires a good methodological knowledge in order to transform the interview data of the dietary intake to nutrients. Applied once, it yields no information on day-to-day variation on food or nutrient intake.

Food frequency questionnaires (FFQ)

These questionnaires provide information about how often certain foods or foods from given food groups, were eaten during a time interval in the past, usually day, by either the household or an individual. The questionnaire can be self-administered or be administered through a short personal interview. FFQ can be qualitative with no information on portion size, semi-qualitative with standardized portion size estimates (as predetermined by the interview team), or quantitative where the respondents estimate portion size. The advantages include simpler and quicker administration and processing, and subsequently lower costs as well as less burden for the respondents than alternative methods. The method is generally accepted as being suitable for measuring typical diets and with the purpose of ranking

individuals according to intake. Inaccuracies may result from an inadequate listing of possible foods, errors in estimating portion size and the usual frequency of food consumption.

Weighed food record

The weighing method assesses the cooked weight of total food served, individual portions and leftovers. The ingredients and amount used in dish preparation is also measured. This method may require supervision. Educated person may carry out the procedure by self, with less educated people supervision may be required. It is more accurate than other methods. However, it is more time taking and expensive.

Estimated record

An estimated record is a list of all foods eaten by an individual during a specified period, given in terms of household measures or compared in size to food models. Supervision by a dietician at the beginning and end of a period is necessary. Details overlooked or omitted reduce the accuracy with which measurements can be converted to mass. The advantage of this method is that it provides detailed dietary intake data that are more representative of usual intake than a single 24-hour recall. The disadvantages are that a high degree of respondent cooperation is necessary, and the act of recording may alter the usual diet.

Dietary history

The dietary history method is a technique for estimating usual dietary intake. The technique is based on the premise that people have a constant daily pattern in their food habits. The method was originally developed to measure diets over a period of time for research on human growth and development. The rationale was that long-term food habits may yield clinical and laboratory signs and findings.

2.11.3 Dietary diversity score

A data collected by dietary diversity questionnaire can be analyzed by dietary diversity score, which is sum of different food groups consumed. The dietary diversity scores consist of a simple count of food groups that a household or an individual has consumed over the preceding 24 hours (Kennedy *et al.*, 2011).

The HDDS is meant to provide an indication of household economic access to food, thus items that require household resources to obtain, such as condiments, sugar and sugary foods, and beverages, are included in the score (Kennedy *et al.*, 2011).

Individual dietary diversity score (IDDS) is a measure of the nutrient adequacy of the diet. Individual scores are meant to reflect the nutritional quality of the diet. The FAO has set guidelines for the measurement of dietary diversity(Kennedy *et al.*, 2011).

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

a) Grains, roots and tubers
b) Legumes and nuts
c) Dairy products (milk, yogurt, cheese)
d) Flesh foods (meat, fish, poultry and liver/organ meats)
e) Eggs
f) Vitamin-A rich fruits and vegetables
g) Other fruits and vegetables

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

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

2.12 Physical activity for adolescents

Physical activity is any bodily movement produced by skeletal muscles that requires energy expenditure. Physical activity refers to all movement including during leisure time, for transport to get to and from places, or as part of a person's work. Both moderate- and vigorous-intensity physical activity improve health (WHO, 2022b). In adolescents, high levels of sedentary behavior such as time spent lying and sitting (e.g. playing electronic games) during waking hours are associated with poor health. In contrast, moderate-to-vigorous PA (MVPA) is associated with benefits to health and well-being (FSEM, 2022). FSEM (2022) also suggests, physical activity tend to have positive impact on cardiorespiratory fitness, tend to prevent obesity, enhance cardiovascular and metabolic health, improves muscle and bone strength and overall wellbeing.

2.12.1 Cut-off of physical activity for adolescents

According to FSEM (2022), adolescent are recommended to accumulate an average of at least 60 minutes of moderate-vigorous physical activity per day including bouts of vigorous physical activity of at least 5-10 min duration. Moderate physical activity is broadly equivalent to brisk walking (140 beats per minute or 70% of HRmax) and vigorous physical activity is broadly equivalent to jogging (160 beats per minute or 80% of HRmax). Birtwistle *et al.* (2021) and WHO (2020) also has similar recommendations.

PART III

Materials and Methods

3.1 Research design

A community based cross sectional study was carried out to assess the nutritional status of vegetarian and non-vegetarian population of targeted age group:

1.Anthropometric measurement of adolescent population in Pranami Nagar, Bhadrapur.

2.Household interview with the help of questionnaire.

3.Comparative analysis of the data of the targeted age group in selected area.

3.2 Study site

Bhadrapur is the headquarter of Jhapa district, Nepal. The study site is situated towards northern belt of Bhadrapur municipality; 6 kilometers south of Mahendra Highway in the continuation of Mechi Highway. Pranami tole (also called Pranaminagar) is a locality situated in Bhadrapur, Jhapa. The area is center of the religious site *Pranami mandir,* around which vegetarian population resides in significant numbers. The area also consists of non-vegetarian households.

3.3 Study variables:

1. Dependent variables: Anthropometric indices, height for age, BMI for age.

2. Independent variables:

i) Demographic and socio-economic factors: Ethnicity, family size, family income, parent's occupation, education, number of siblings, number of adolescents in the family, source of food.

ii) Adolescent's characteristics: Age, sex, physical activity, sleeping hours

iii) Dietary habit: Food frequency, food habit related variables, nutrient intake

iv) Nutrition related knowledge: Malnutrition; balanced diet; sources of protein, vitamin-A and iron

3.4 Target population

Adolescents who were residing in Pranami tole, Bhadrapur for more than 6 months were included in the study after random selection as per the sampling procedure.

3.4.1 Selection criteria

Inclusion criteria:

1. Must be an adolescent (10-19 years of age).

2. Resident in the study site for 6 months or more.

3. Participant who gave consent for the study.

Exclusion criteria:

1. Resident who were absent from locality during the time of the study.

3.5 Sample Size

The sample size was determined by using simple proportional formula assuming rate of prevalence of malnutrition to be 55% (Kafle *et al.*, 2020) and margin of error 6%. Confidence interval was taken 95% with non-response rate 10%.

Mathematically,

$n_0 = z^2pq/e^2$; (Kothari, 2004)

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

So,

$n_0 = 1.96^2 \times 0.55 \times (1 - 0.55) / 0.06^2$

$= 264.11 \approx 264$

From the data given by Municipality ward office, the total adolescents in the Pranami Nagar including surrounding small villages was 427. Hence, N=427 and using the formula for finite population we have

$$n = \frac{n_o}{1 + (n_o-1)/N}$$

$$= \frac{264}{1+(264-1)/427}$$

$$= \frac{264}{1+0.62}$$

$$= 162.96 \approx 164$$

With addition of non-response rate of 10% sample size becomes,

$$164+10\% \times 164 = 180.4 \approx 180$$

3.6 Sampling technique

For sampling, proportionate stratified random sampling was used. Out of 427 adolescents, 248 were non vegetarian and 179 were vegetarian. So, number of samples from non-vegetarian strata was :

Sample size of non-vegetarian

$$= \frac{\text{Population of non-vegetarian adolescents}}{\text{Total population of adolescents}} \times \text{Total sample size}$$

$$= 248/427 \times 180$$
$$= 104$$

The number of samples from non-vegetarian strata was :

$$\text{Sample size of vegetarian} = \frac{\text{Population of vegetarian adolescents}}{\text{Total population of adolescents}} \times \text{Total sample size}$$

$$= 179/427 \times 180$$

$$= 76$$

3.7 Research instruments

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

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

c) Questionnaire: Well designed and pretested set of questionnaires to collect information on adolescent characteristics, demographic variables, socio-economic condition, dietary practices, physical activity and nutrition related knowledge of the targeted participants.

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

e) Standardized cup sets.

3.8 Pretesting

The site was visited, and the prepared questionnaire and anthropometric sets were tested among a few parents/caretakers and participants from the 10-19 years age group. Pretesting was done to check accuracy and consistency in the interpretation, clarity of the question, and to identify the ambiguous ones. After pretesting the ambiguous and wrongly interpreted questions were removed and the questionnaire were revised as per the findings of pretesting.

3.9 Validity and Reliability

The accuracy of a measure is its validity. The validity of the instruments and techniques were ascertained. The consistency or repeatability of the measure is reliability, utmost priority was given to reduce the bias and mistakes of both researcher and participant so that reliability can be attained to its maximum.

3.10 Data collection techniques

Primary data was collected by door-to-door method, using questionnaire and anthropometric measurement methods. Interview with parents/caretaker was done to collect related associated information.

Secondary data was obtained from the municipality office, Nepal Demographic and Health Survey (NDHS), Central Bureau of Statistics (CBS), local leaders, FCHVs, etc.

A structured questionnaire was used for data collection. The questionnaire consisted of questions related to anthropometry, nutritional knowledge, demographic variables, socio-

economic condition, dietary practices and habits. The measures for assessment of the nutritional status of the target population include:

3.10.1 Date of Birth

The date of birth was asked to the participant and parents/guardian, 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

Stadiometer was used to measure the height (stature). When being measured with the stadiometer, the subject was made barefoot and asked to wear minimal clothing to facilitate correct positioning of the body. Hair was unbraided. The subject was made to stand with heels together, arms to the side, legs straight, shoulders relaxed, and head in the Frankfort horizontal plane ("look straight ahead"). Heels, buttocks, scapulae (shoulder blades), and back of the head should, if possible, was made against the vertical surface of the stadiometer. Some people if not able to touch all four points against the stadiometer because of obesity, protruding buttocks, or curvature of the spine, two or three of the four points were touched to the vertical surface of the stadiometer. Just before the measurement was taken, the subject was asked to inhale deeply, hold the breath, and maintain an erect posture ("stand up tall") while the headboard lowered on the highest point of the head with enough pressure to compress the hair. The measurement was read to the nearest 0.1 cm or 1⁄8 in. and with the eye level with the headboard to avoid errors caused by parallax (CDC, 2021; Lee and Nieman, 2013).

3.10.3 Weight

Weight was measured by a reliable electronic weighing scale with the nearest 0.1kg reading. Proper calibration was done before the usage of the machine. Subject was asked to remove shoes and heavy clothing, such as sweaters and was made to stand still in the middle of the scale's platform without touching anything and with the body weight equally distributed on both feet. Measurement was recorded if agreed two successive measurements agreed within 100 g (0.1 kg) or 0.2 lb. (CDC, 2021; Lee and Nieman, 2013).

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, iron, and total calories by using 'Nepalese food composition table 2017'. The nutrient adequacy was determined based on NIN (2020) recommendations. A range of standardized cups were used for estimation.

The amount of ingredients required to prepare fast foods were estimated by asking with the local restaurants in Bhadrapur. The nutrient contents of packaged foods consumed were estimated by using nutritional information provided by manufacturers.

3.10.5 Physical activity

The guidelines of physical activity for adolescents differ from those of adults. The available IPAQ questionnaire only address age group above 15; questionnaire was modified for convenience. FSEM (2022) recommends, adolescents need at least 60 minutes of moderate-vigorous physical activity (MVPA) per day including 5-10 minutes of vigorous physical activity (VPA). Moderate physical activity (MPA) is broadly equivalent to brisk walking and VPA is broadly equivalent to jogging. In this, adolescents should involve in resistance exercise to enhance muscle strength and weight-bearing and other high impact physical activity to promote skeletal health 2-3 days a week. Same is recommended by WHO (2020) guidelines. The subjects whose physical activity meets the guidelines are categorized under adequate physical activity and those whose physical activity does not meet the guidelines are categorized under inadequate physical activity.

3.11 Data analysis

The collected data were first checked for completeness and consistency; edited, organized, coded, and entered in Microsoft Excel 365. The data were then entered into the statistical package for social science (SPSS 26) and WHO Anthroplus (v1.0.4). 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. T-test was used to compare the nutrition status of vegetarian and non-vegetarian population, chi-square and fisher's exact was applied to test the association between dependent and independent variables.

3.12 Ethical consideration

Permission to conduct the survey was obtained from the office of Bhadrapur municipality. Before the study, oral and written consent was obtained from the participants of the survey. Privacy and confidentiality of the survey were assured at all levels.

PART- IV

Result and Discussion

The study explores comparative nutritional assessment of vegetarians and non-vegetarian adolescents of Pranaminagar, Bhadrapur. The results are explained under following headings:

4.1 Adolescent characteristics

The survey revealed that the age group 13-15 years comprised highest proportion in the total adolescent population as well as vegetarian and non-vegetarian sub-groups followed by 10-12 years age group and 16-18 years age group as shown in table 4.1

Table 4.1 Percentage distribution of vegetarians and non-vegetarians adolescent by age (n=180)

Age (in years)	Vegetarian	Non-vegetarian	Total
10-12	12.78% (23)	21.67% (39)	34.45%(62)
13-15	17.22% (31)	22.22% (40)	39.44% (71)
16-18	12.22% (22)	13.89 % (25)	26.11% (47)
Total	**42.22%(76)**	**57.78%(104)**	**100%(180)**

Note: Values in the parentheses represent frequency distribution of sample

Of total 180 adolescents, 47.22% were male and 52.78 % were female. Out of these adolescents, vegetarian males and females were in same percentage. Likewise, non-vegetarian females were in greater number than non-vegetarian boys shown in table 4.2

Table 4.2 Distribution of vegetarians and non-vegetarians by gender (n=180)

Gender	Boys	Girls	Total
Vegetarian	21.11% (38)	21.11% (38)	42.22%(76)
Non-vegetarian	26.11% (47)	31.67% (57)	57.78%(104)
Total	**47.22% (76)**	**52.78% (104)**	**100% (180)**

Note: Values in the parentheses represent frequency distribution of sample

Table 4.3 shows the adolescent characteristics of vegetarian and non-vegetarian adolescents. Most of the families had single adolescents and 2 siblings.

Table 4.3 Frequency distribution of adolescent characteristics (n=180)

Variables	Frequency	
	Vegetarian(n=76)	Non-Vegetarian(n=104)
No. of adolescents in family		
1	50(65.79%)	50(48.1%)
2	24(31.58%)	53(41.3%)
3	2(2.63%)	11(10.6%)
No. of siblings		
0	1(1.31%)	2(1.9%)
1	9(11.84%)	13(12.5%)
2	52(68.42%)	51(49.0%)
3 or more	14(18.42%)	38(36.5%)

Note: Values in the parentheses represent percentage distribution of sample

4.2 Demographic characteristics

Table 4.4 shows ethnic composition of sample population. The majority of the population were from *Khas-Arya* ethnicity. Most of the vegetarians were *Khas-Arya* followed by *Aadibasi* and *Dalit*. Most of the non-vegetarians were from *Aadibasi* community followed by *Khas-Arya*, *Janajati* and *Dalit.*

The population in the area was predominantly Hindu. Both the majority of vegetarians and non-vegetarians were Hindus. All the Christians were non-vegetarians. Most of the families were nuclear and most of the family had the family size above or equal to 5 family members.

Table 4.4 Frequency distribution of demographic characteristics of study population (n=180)

Variables	Vegetarians	Non-Vegetarians	Total
Ethnicity			
Khas-Arya	40.55% (73)	16.67% (30)	57.22%(103)
Janajati	0% (0)	6.11%(11)	6.11% (11)
Aadibasi	1.11% (2)	30% (54)	31.11% (56)
Dalit	0.55% (1)	5% (9)	5.56% (10)
Religion			
Hinduism	41.67% (75)	45% (81)	86.67%(156)
Christianity	0% (0)	10.56% (19)	10.56%(19)
Others	0.56% (1)	2.22%(1)	2.77%(5)
Family type			
Nuclear	20% (36)	36.67% (66)	56.67%(102)
Extended	18.33% (33)	13.33% (24)	31.67%(57)
Joint	3.89% (7)	7.78% (14)	11.67% (21)
Family size			
Below 5	18.89% (34)	24.44% (44)	43.33%(78)
Above or equal to 5	23.33% (42)	33.33% (60)	56.67% (102)

4.3 Socio-economic characteristics

From the table 4.5, it can be known the education level of parents of vegetarian adolescents was better than that of non-vegetarian adolescents. Most of the fathers of vegetarian adolescents had secondary level of education while most of the non-vegetarian adolescent's fathers only had basic level of education. Among vegetarian adolescents, most of the mothers had secondary education while most of the non-vegetarian adolescents' mothers had only some kind of informal education. Illiteracy was high among non-vegetarian parents.

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Table 4.5 Frequency distribution of education level of parents of adolescents

Variables	Frequency	
	Vegetarians(n=76)	**Non-vegetarians(n=104)**
Education of father		
University	15 (19.7%)	4(3.8%)
Secondary	41 (53.9%)	24(23.1%)
Basic	14 (18.4%)	39(37.5%)
Informal	2 (2.7%)	25 (24.1%)
Illiterate	4 (5.3%)	12 (11.5%)
Education of mother		
University	7 (9.2%)	2(1.9%)
Secondary	40 (52.6%)	22(21.2%)
Basic	19 (25%)	27(26.0%)
Informal	5 (6.6%)	34(32.7%)
Illiterate	5 (6.6%)	19(18.3%)

Table 4.6 shows the frequency distribution of economic characteristics of families. Most of the vegetarian families had an average monthly income of more than Rs. 30,000 but most of the non-vegetarian families had an average monthly income of less than Rs. 30,000. Most mothers of both vegetarian and non-vegetarian adolescents were involved in agriculture. Fathers of vegetarian adolescents were mostly involved in agriculture whereas those of non-vegetarian adolescents were involved in labour works for livelihood.

The average household earnings in Nepal was Rs, 30,125 (NRB, 2016) which was used as the reference for comparison of earnings.

Table 4.6 Frequency distribution of economic characteristics of adolescents

Variables	Frequency	
	Vegetarians(n=76)	Non-vegetarians(n=104)
Monthly family income		
Below 30,000	18 (23.7%)	83(79.80%)
Above 30,000	58 (76.3%)	21(20.19%)
Occupation of father		
Agriculture	32 (42.1%)	12(11.5%)
Service	19 (25.0%)	10(9.6%)
Labour	1 (1.3%)	56(53.8%)
Business/ Trade	9 (11.8%)	8(7.7%)
Foreign Employment	8 (10.5%)	8(7.7%)
Others	7 (9.2%)	10(9.6%)
Occupation of mother		
Agriculture	57 (75%)	49(47.2%)
Service	4 (5.3%)	3(2.9%)
Labour	1 (1.3%)	37(35.6%)
Business/ Trade	8 (10.5%)	10(9.6%)
Foreign Employment	5 (6.6%)	2(2.9%)
Others	1 (1%)	3(1.9%)

4.4 Physical activity level

Table 4.7 shows the adequacy levels of physical activity between vegetarians and non-vegetarians. Out of total population 48.7% of vegetarians and 46.2% of non-vegetarians had inadequate physical activity levels. In the national health survey of Scotland, it was found out that 71% of all children aged 5-15 met the physical activity guidelines of at least 60 minutes on average per day (Birtwistle *et al.*, 2021). WHO (2019), found that more than 80% of school-going adolescents globally did not meet current recommendations of at least one hour of physical activity per day including 85% of girls and 78% of boys.

Table 4.7 Frequency distribution of physical activity level of adolescents

Variables	Frequency	
	Vegetarians(n=76)	Non-vegetarians(n=104)
Physical activity		
Adequate	39 (51.3%)	56 (53.8%)
Inadequate	37 (48.7%)	48 (46.2%)

4.5 Dietary habit and behaviors

Table 4.8 shows the frequency distribution of diet related behaviors of adolescents. Only 15 vegetarians and 22 non-vegetarians said they have the habit of meal skipping. Most of them had their food in the kitchen.

Table 4.8 Frequency distribution of diet related behaviors of adolescents.

Variables	Frequency	
	Vegetarians(n=76)	Non-vegetarians(n=104)
Skipping of meal		
Yes	15 (19.7%)	22 (21.2%)
No	61 (80.3%)	82 (78.8%)
Frequency of meal skipped weekly		
1-2 times	7 (46.67%)	9(41%)
3-4 times	5 (33.33%)	11(50%)
5 or more	3 (20%)	2(9%)
Place to eat in home		
Kitchen	49 (64.5%)	85 (81.7%)
Watching TV/Mobile/Bedroom	27 (35.5%)	19 (18.3%)

Thapa *et al.* (2020) in the findings of a study states most of the adolescents from the sample taken in Kathmandu had unhealthy eating behavior, In the same study, it was found out that 45% adolescents often skipped their meals of which breakfast meal was mostly skipped, 56% of adolescents had habit of watching TV that affect their eating behavior.

4.6 Consumption of food groups

From table 4.9 we can compare the vegetarian and non-vegetarian consumption of food items from different food groups; on daily basis, frequently (2-6 times a week), rarely (less than once a week) and never. All adolescents said they consume cereals daily. A greater proportion of vegetarians consume pulses, green leafy vegetables, other vegetables, fruits and tea/coffee daily than their non-vegetarian population group. Consumption of fast food/packaged food was high in both population groups. Most adolescents consume soft drinks less frequently, most of whom consume it once in a week or less.

Table 4.9 Frequency of consumption of different food groups by adolescents

Variables	Frequency	
	Vegetarians (n=76)	Non-vegetarians(n=104)
Consumption of cereals and its products		
Regularly	76 (100%)	104 (100%)
Consumption of pulses and legumes		
Regularly	57 (75.0%)	30 (28.8%)
Frequently	14 (18.4%)	57 (54.8%)
Rarely	5 (6.6%)	16 (15.4%)
Never	0 (0%)	1 (1%)
Consumption of milk and milk products		
Regularly	69 (90.8%)	40 (38.5%)
Frequently	4 (5.3%)	15 (14.4)
Rarely	2 (2.6%)	48 (46.2%)
Never	1 (1.3%)	1 (1%)
Consumption of meat,fish,egg		
Frequently	-	68 (65.4%)
Rarely	-	36 (34.6%)

Consumption of green leafy vegetable

Regularly	70 (74.4%)	65 (62.5%)
Frequently	4 (23.4%)	37 (35.6%)
Rarely	0 (0%)	2 (1.9%)
Never	2 (2.6%)	0 (0%)

Consumption of other vegetable

Regularly	66 (86.8%)	73 (70.2%)
Frequently	7 (9.2%)	31 (29.8%)
Rarely	1 (1.3%)	0 (0%)
Never	2 (2.6%)	0 (0%)

Consumption of fruit

Regularly	20 (26.3%)	15 (14.4%)
Frequently	30 (39.5%)	21 (20.2%)
Rarely	26 (34.1%)	68 (65.4%)

Consumption of tea/coffee

Regularly	69 (90.8%)	89 (85.6%)
Frequently	0 (0%)	10 (9.6%)
Rarely	0 (0%)	5 (4.8%)
Never	7 (9.2%)	0 (0%)

Consumption of fast food/ packaged food

Regularly	67 (88.2%)	97 (93.3%)
Frequently	9 (11.8%)	7 (6.7%)

Consumption of soft drinks

Regularly	0 (0%)	1(1%)
Frequently	3 (3.9%)	3 (2.9%)
Rarely	72 (94.8%)	98 (94.2%)
Never	1 (1.3%)	2 (1.9%)

Ochola and Masibo (2014) on dietary intake of school children and adolescents in developing countries reported school-age children are mainly consuming plant-based diets

which were predominantly from cereals, roots and tubers with limited animal source foods, cereals were main source of energy, intake of milk and milk products were only in 50% of the adolescents, in Bangladesh 33% of the school aged adolescents did not drink milk and 23% of them did not ate green leafy vegetables in last 7 days. Fruits and vegetables were rarely eaten by 56 and 48% adolescents in Ghana, there was high seasonal variability in variety of food intake.

4.7 Dietary diversity score

The mean dietary diversity score of total participants was found out to be 3.87±1.43 with minimum of 1 to maximum of 6 types of food out of 7. This means in average a person gets less than 4 varieties of food group in a day. 42.22% of total adolescents were eating less than 4 types of foods groups. Meanwhile, 2.2% adolescents were only eating single type of food across the day and 20% adolescents were eating only two types of foods across the day. The result of variety of food group intake is unsatisfactory, which is primarily influenced by eating habits of marginalized and backward groups predominantly non-vegetarian.

Table 4.10 shows the frequency distribution and percentage values of individual dietary diversity score categories for adolescents. The mean dietary diversity score of vegetarian participants was found out to be 4.63±0.94 with minimum of 3 to maximum of 6 types of food out of 7. This means an average vegetarian adolescent eats food from more than 4 varieties of food group. The mean dietary diversity score of non-vegetarian participants was found out to be 3.28±1.44 with minimum of 1 to maximum of 6 types of food out of 7. This means an average non-vegetarian adolescent eats food from less than 4 varieties of food group.

Table 4.10 Frequency distribution of IDDS categories of adolescents

IDDS categories	Frequency	
	Vegetarians(n=76)	Non-vegetarians (n=104)
Below 4	11(14.47%)	67 (64.43%)
Equal to or more than 4	65(85.52%)	37 (35.57%)

4.8 Dietary intake

Table 4.11 shows the adequacy of nutrients among vegetarian and non-vegetarian adolescents in the community. It was observed that most of the adolescents had inadequate calories and fat consumption whereas protein intake was adequate in most of the adolescents. In comparison, calorie adequacy was slightly better among vegetarians and fat intake was better among non-vegetarians.

Subedi and Yadav (2018) in their study showed, most of (63.1%) adolescent girls of urban Pokhara had inadequate calorie intakes. Ochola and Masibo (2014) in a study mentioned most of the adolescents in developing countries does not meet recommended calorie intake. Calorie intake was inadequate in 50-64% of Bahraini school students, in Libya 76% of the students attained minimum calorie requirements and in Mexico 88% of the students attained the minimum recommended level of calories.

Table 4.11 Adequacy of nutrient intake in study population

Variables	Frequency	
	Vegetarian (n=76)	Non-vegetarian (n=104)
Adequacy of calorie intake		
Inadequate	65 (85.5%)	97 (93.3%)
Adequate	11 (14.5%)	7 (6.7%)
Adequacy of protein intake		
Inadequate	25 (32.9%)	36 (34.6%)
Adequate	51 (67.1%)	68 (65.4%)
Adequacy of fat intake		
Inadequate	57 (75%)	68 (65.4%)
Adequate	19 (25%)	36 (35.6%)
Adequacy of iron intake		
Inadequate	66(86.84%)	101(97.11%)
Adequate	10(13.16%)	3(2.89%)

4.8.1 Mean nutrient intake

Table 4.12 and 4.13 displays the average nutrient intake among vegetarian and non-vegetarian adolescents respectively. Calorie intake in all the age and gender groups were low as per the requirements, and all except for girls aged 16-18, met the requirements of protein intake. None of the groups met the recommended total fat and iron intake levels.

Ochola and Masibo (2014) also 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.

Table:4.12   Mean values of nutrient intakes by vegetarian adolescents

Gender (age in years)	Calorie (Kcal)	Protein (g)	Total Fat (% of total calories)	Iron (mg)
Boys				
10-12	1947.2±627.4 (88%)	51.8±21.4(160%)	20.10±9.9(80%)	13.2±6.7(83%)
13-15	1858.4±544.3 (65%)	51.8±13.5(115%)	18.7±7.6(75%)	16.±7.5(73%)
16-18	2069.1±496.7 (62%)	63.7±11.8(115%)	15.7±7.3(63%)	17.3±9.7(67%)
Girls				
10-12	1388.6±423.1(67%)	42.2±14.5(127%)	18.6±8(74%)	12.5±4.8(45%)
13-15	1668.7±435.1 (70%)	50.7±13.2(117%)	19.3±7.4(77%)	15.8±4.5(53%)
16-18	1618.4±238.5 (65%)	36.6±12.3(80%)	20.1±7.4(81%)	16.6±7.9(51%)

Values in the parentheses are percentage of EAR (for calorie) and RDA of mean nutrient intakes.

Table:4.13   Mean values of nutrient intakes by non-vegetarian adolescents

Gender (age in years)	Calorie (Kcal)	Protein (g)	Total Fat (% of total calories)	Iron (mg)
Boys				
10-12	1484.6±308.4 (67%)	43.9±14.6 (137%)	21.4±7.1 (86%)	10.09±4.6 (63%)
13-15	1899.3±588.9 (66%)	57.4±22.4 (127%)	20.6±7.1 (82%)	16.09±5.9 (73%)
16-18	1935.4±465.4 (58%)	56.9±22.6 (103%)	19.1±7.1 (77%)	16.1±6.1 (62%)
Girls				
10-12	1455.1±319.7 (71%)	35.5±12.7 (107%)	22.8±8.01 (91%)	13.05±5.4 (47%)
13-15	1744.6±502.3 (73%)	46.9±12.9 (109%)	23.3±8.6 (93%)	16.5±7.6 (55%)
16-18	1774.6±553.4 (71%)	41.04±18.5 (89%)	21.4±8.7 (86%)	20.9±9.1 (65%)

Values in the parentheses are percentage of EAR (for calorie) or RDA of mean nutrient intakes.

The average intake of calories and protein was observed to be in decreasing trend among girls aged past 16 years in an study by Maliye *et al.* (2010) in Wardha district of Maharastra, India which was similar to the findings observed among girls of Pranami Nagar.

Studies by Alexy *et al.* (2021) and Clarys *et al.* (2014) among German vegetarians showed vegetarians consumed lower calories than non-vegetarians. In contrast, Siapco *et al.* (2019), in the study among middle and high school adolescents in Michigan and Southern California found average calorie intake in vegetarians were higher than non-vegetarians. The findings of prior studies are inconclusive about the type of diet and calorie intake so does the findings of this study.

Same studies by Alexy *et al.* (2021); Clarys *et al.* (2014); Siapco *et al.* (2019), had common conclusion regarding intakes of protein, total fat and iron. Findings of these studies showed, mean protein and fat intake were high among non-vegetarians and iron intakes were high among vegetarians. In the study, vegetarians had higher mean protein intakes which contrasted to literatures, non-vegetarians had higher mean total fat intakes and non-

vegetarian girls seem to have slightly higher mean iron intakes in comparison to vegetarian girls.

4.9 Nutrition related knowledge

Most of the adolescents did not have clear concept on malnutrition and balance diet, and has no idea about protein, vitamin-A and iron rich food. That too nutrition literacy was lower among non-vegetarians. Table 4.14 shows the frequency distribution of nutrition related knowledge in adolescents.

Table 4.14 Frequency distribution of nutrition related knowledge in adolescents

Variable	Frequency	
	Vegetarians (n=76)	**Non-vegetarians (n=104)**
Know about malnutrition		
Yes	34 (44.7%)	12 (11.5%)
No	42 (55.3%)	92 (88.5%)
Know about balanced diet		
Yes	34 (44.7%)	13 (12.5%)
No	42 (55.3%)	91 (87.5%)
Know sources of Protein		
Yes	28 (36.8%)	15 (14.4%)
No	48 (63.2%)	89 (85.6%)
Know sources of Vitamin A		
Yes	20 (26.3%)	14 (13.5%)
No	56 (73.7%)	90 (86.5%)
Know sources of iron		
Yes	6 (7.9%)	2 (1.9%)
No	70 (92.1%)	102 (98.1)

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According to findings of Aryal *et al.* (2016), 49.2 % Nepalese adolescents said they know about nutrition and 44.2% said they know about Vitamin-A. In a study conducted in India, Sharma *et al.* (2019) stated vegetarian adolescents demonstrated lower knowledge and attitude scores compared with those who were non-vegetarians. Yakub *et al.* (2010) in a study in urban Pakistan also derived the same conclusion. However, researches in the west suggests vegetarian demonstrate higher nutritional knowledge than non-vegetarians (Shickle *et al.*, 1989).

4.10 Prevalence and distribution of malnutrition

Out of total population, 28.95% of the vegetarians were stunted with 2.63% severely stunted, while 38.47% of non-vegetarians were stunted with 10.58% severely stunted. The majority of vegetarians, 71.05% of the group, had normal height, compared to 61.53% of non-vegetarians. In terms of thinness, 13.17% of vegetarians were affected, with 13.16% and 2.63% of the group classified as overweight and obese, respectively. The remaining 71.04% of vegetarians had normal weight. For non-vegetarians, 17.32% were affected by thinness, while 6.73% were overweight, and none were found to be obese. The vast majority of non-vegetarians, 75.95% of the group, had normal weight. Prevalence of malnutrition among adolescents is displayed in figure 4.5.
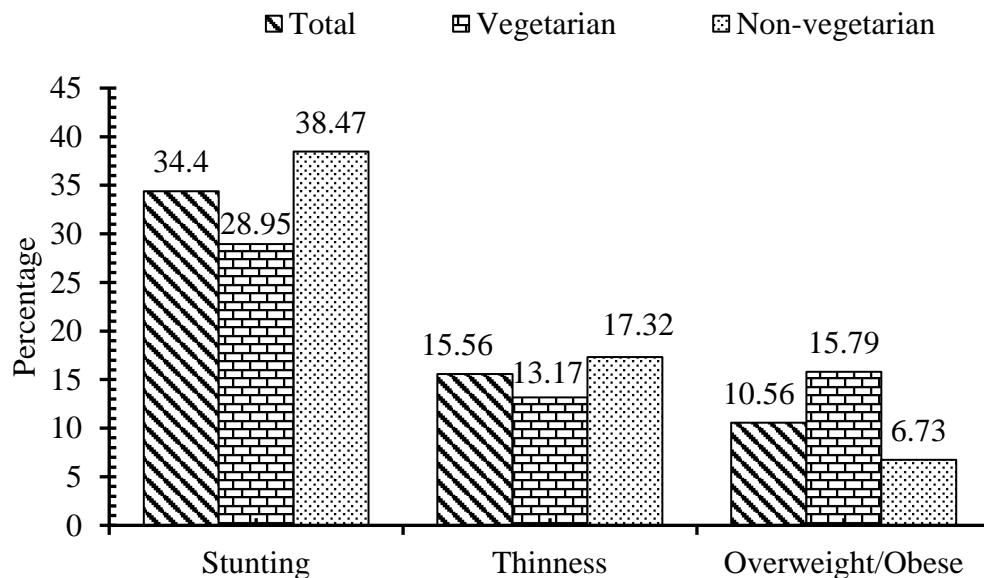

Figure 4.1: Prevalence of malnutrition in adolescents

Findings of this study showed stunting, thinness and overweight/obesity in the study area was higher than the findings of Van Tuijil *et al.* (2020) where stunting among adolescents in Nepal was 29.9%, thinness was 10.2% and overweight/obesity was 5.76%. In comparison between vegetarian and non-vegetarian nutrition status, finding of the study contradicts with the finding of Weder *et al.* (2019), where stunting was more prevalent in vegetarians than omnivores. This may be because vegetarians participating in this study were affluent than non-vegetarians.

In another study Sabate *et al.* (1991) mentioned Adventist vegetarian adolescents were slightly taller than their omnivore counterparts of similar age. Meanwhile, underweight and wasting was more prevalent in non-vegetarians and overweight and obesity was more prevalent in vegetarians, findings are in line with this study. Similar findings were made by Nawab *et al.* (2014) where vegetarians were found to be prone to obesity than non-vegetarian adolescents.

Figure 4.2 shows the percentage distribution of stunting in vegetarian and non-vegetarian adolescents across age groups. In comparison, age-wise, the percentage prevalence of stunting was found to be highest among non-vegetarians aged 13 to 15 years. And lowest among vegetarians aged 13 to 15 and 16-18 years.

MoHP *et al.* (2018), found the total prevalence of stunting among boys of age 10-14 and 15-19 to be 35.6% and 26.4% while in girls it was 34.0 % and 29.4% respectively. Due to slight difference in the study objectives, the age-based classification in this study is different. Hence, direct comparison is not possible. None the less, stunting prevalence seemed to be low in comparison to national data.
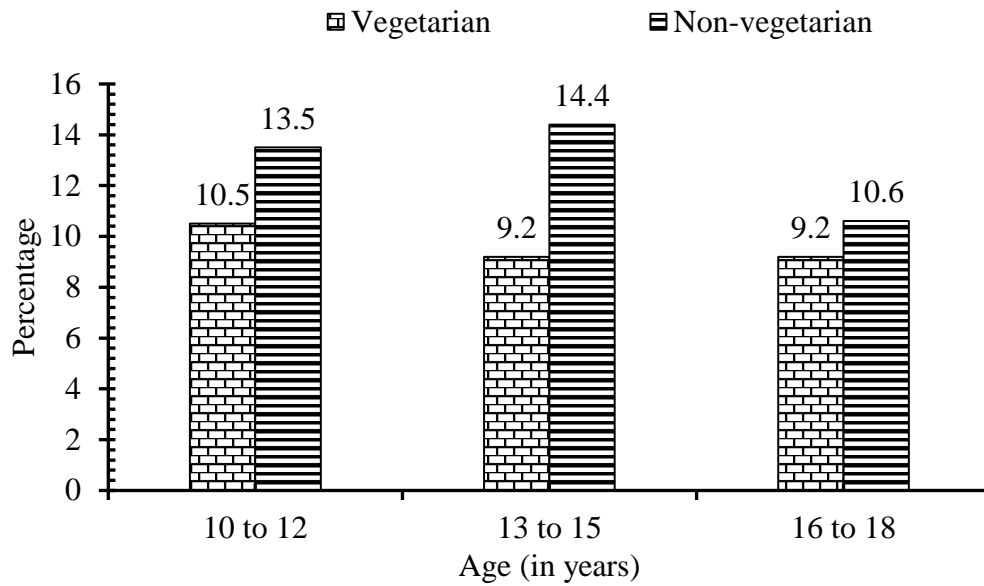
Figure 4.2: Distribution of stunting in adolescents across age groups

Thinness was most prevalent in non-vegetarians aged 13 to 15 followed by vegetarians of same age group while prevalence of overweight/obesity was highest among vegetarians aged 10 to 12 years of age followed by vegetarians aged 13 to 15 years of age. Distribution of thinness and overweight/obesity in adolescents across age groups is displayed in figure 4.3.
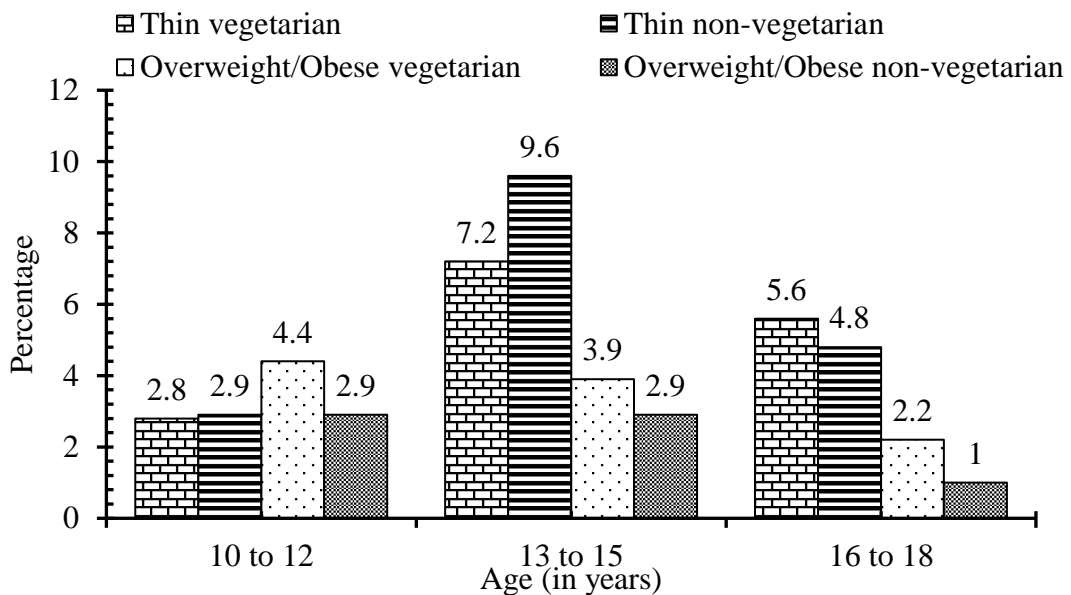
Figure 4.3: Distribution of thinness and overweight/obesity in adolescents across age groups

MoHP *et al.* (2018), found the total prevalence of thinness to be high among younger adolescents. While, no such huge difference was observed in overweight/obesity prevalence with prevalence rate of 4.8% and 4.7% (younger vs older adolescent boys) and 4.3% and 4.3% (younger vs older adolescent girls) respectively.

4.11 Statistical significance of anthropometric measurement and dietary intake

Table 4.15 shows, the gender-wise comparison of anthropometry among adolescents. There was significant difference in height among male and female respondents. While, no difference was observed in age, weight, BMIZ and HWZ among total boys and girls.

According to MoHP *et al.* (2018), BMIZ of adolescent boys in Nepal was -1.10±1.22 and same of adolescent girls was -0.82±1.06, while HWZ for boys and girls respectively were -1.56±1.12 and -1.63±0.99 respectively.

**Table 4.15** Gender-wise comparison of anthropometry among adolescents

Variables	Boys (n=85)	Girls (n=95)	
	Mean±sd	Mean±sd	p-value
Age	14±2.40	13.48±2.38	0.150
Anthropometry			
Height	150.5±14.47	144.92±10.04	0.003*
Weight	42.512±13.53	39.05±9.99	0.378
BMIZ	-0.71±1.51	-0.5±1.18	0.303
HWZ	-1.57±1.17	-1.52±1.05	0.789

'*' indicates the value with significant difference

The findings illustrated in the table 4.16 shows there was significant difference in height, weight, BMIZ, HWZ, energy intake and carbohydrate intake between vegetarian and non-vegetarian boys. Vegetarians and non-vegetarian girls were not significantly different in any measured anthropometric and dietary intake data.

The findings of this study differed with the study by Meirelles *et al.* (2001), in which there was significant difference in intakes of protein (p<0.0001), fats (p<0.0001), niacin (p<0.001) and iron (p<0.01) among vegetarian and non-vegetarian girls.

Table 4.16 Gender-wise comparison of anthropometry and dietary intake among vegetarian and non-vegetarian adolescents

Variables	Boys			Girls		
	Vegetarian (n=38)	Non-vegetarian (n=47)		Vegetarian (n=38)	Non-vegetarian (n=57)	
	Mean±sd	Mean±sd	p-value	Mean±sd	Mean±sd	p-value
Age	14.29±2.42	13.76±2.38	0.32	13.40±2.49	13.54±2.32	0.77
Anthropometry						
Height	154.92±13.55	146.94±14.34	0.01*	145.84±11.01	144.32±9.40	0.49
Weight	47.60±13.39	38.4±12.31	0.002*	40.39±11.66	38.17±8.69	0.32
BMIZ	-0.22±1.47	-1.11±1.44	0.007*	-0.41±1.26	-0.56±1.12	0.57
HWZ	-1.21±1.22	-1.86±1.05	0.01*	-1.31±1.10	-1.66±0.99	0.10
Dietary intake						
Energy(Kcal)	1944.5±456.2	1711.65±389.2	0.015*	1531.5±412.8	1655±411	0.16
CHO(g)	338.08±90.88	281.84±65.37	0.002*	256.16±77	269.43±75.7	0.41
Protein(g)	55.85±15.12	52.06±19.12	0.31	45.68±13.76	45.77±14.3	0.98
Fats(g)	38.52±18.12	40.76±13.11	0.524	33.5±18.8	40.37±19.6	0.09
Iron(g)	16±8.09	13.80±6.62	0.587	14.49±5.49	16.02±8.77	0.09

4.12 Factors associated with malnutrition

4.12.1 Factors associated with stunting

Factors seen to be statistically related to stunting in vegetarians and non-vegetarians are shown in table 4.17 and 4.18 respectively. Factors like place of eating (p=0.011), adequacy of physical activity (p=0.007) and adequacy of protein(p=0.023) intake were found to be related with stunting in vegetarians.

Table 4.17 Factors associated with stunting in vegetarians (n=76)

Factors	Stunted	Normal	$\chi 2 - $value	P-value
Place of eating at home				
Kitchen/Dining room	19(25%)	30(39.47%)	6.477	0.011
In front of TV/Mobile/Bedroom	3(3.95%)	24(31.58%)		
Adequacy of physical activity				
Adequate	6(7.89%)	33(43.42%)	7.164	0.007
Inadequate	16(21.05%)	21(27.63%)		
Adequacy of protein intake				
Adequate	19(25%)	32(42.11%)	5.202	0.023
Inadequate	3(3.95%)	22(28.95%)		

'f' symbol denotes values of Fisher exact test or fisher-freeman-halton extension

Factors like ethnicity(p=0.041), religion (p=0.040), occupation of father (p=0.012) , number of siblings(p=0.015), consumption of milk and milk product(p=0.008), consumption of green leafy vegetables(p=0.012_f) and consumption of meat, fish and eggs(p=0.040) were found to be related with stunting in non-vegetarians.

Van Tuijil *et al.* (2020) in a study found out association of paternal occupation and education, household income, number of earning household members, geographical place of residence, caste/ethnicity and nutritional knowledge with stunting in Nepalese adolescents.

Table 4.18 Factors associated with stunting in non-vegetarians (n=104)

Factors	Stunted	Normal	ˉχ 2 – value	P-value
Ethnicity				
Khas-Arya	7(6.73%)	25(24.03%)	6.389	0.041
Janajati/Dalit	12(11.54%)	10(9.62%)		
Aadibasi	21(20.19%)	29(27.89%)		
Religion				
Hinduism	27(25.96%)	54(51.92%)	4.070	0.040
Others	13(12.5%)	10(9.62%)		
Occupation of father				
Agriculture	4(3.85%)	8(7.69%)	8.785	0.012
Service/foreign employment/business	4(3.85%)	22(21.15%)		
Labour/others	32(30.77%)	34(32.69%)		
Number of Siblings				
Zero	0(0)	2(1.92%)	10.5	0.015
One	10(9.62%)	3(2.89%)		
Two	16(15.39%)	35(33.65%)		
Three or more	14(13.46%)	24(23.09%)		
Consumption of milk and its products				
Regularly	9(8.65%)	31(29.81%)	9.747	0.008
Frequently	10(9.62%)	5(4.81%)		
Rarely	21(20.19%)	28(26.92%)		
Consumption of green leafy vegetables				
Regularly	19(18.27%)	46(44.23%)	7.621_f	0.012_f
Frequently	19(18.27%)	18(17.31%)		
Rarely	2(1.92%)	0(0%)		
Consumption of meat, fish, egg				
Frequently	31(37.5%)	37(35.58%)	4.215	0.040
Rarely	9(8.65%)	27(25.96%)		

'$_f$' symbol denotes values of Fisher's exact test or fisher-freeman-halton extension

4.12.2 Factors associated with thinness and overweight/obesity

Thinness and overweight/obesity were found to be related with gender(p=0.030), occupation of father(p=0.029$_f$), food source(p= 0.008), sleeping hours(p=0.048$_f$) and adequacy of calories(p=0.009$_f$) in vegetarian adolescents which is shown in table 4.19.

Table 4.19 Factors associated with thinness and overweight/obesity in vegetarians (n=76).

Factors	Thin	Normal	Obesity	$\chi 2$ – value	P-value
Gender					
Male	7(9.21%)	23(30.26%)	8(10.53%)	6.986	0.030
Female	3(3.95%)	33(43.42%)	2(2.63%)		
Occupation of father					
Agriculture	5(6.58%)	25(32.90%)	2(2.63%)	9.862$_f$	0.029$_f$
Service/foreign employment/ business	2(2.63%)	28(36.84%)	8(10.53%)		
Labour/others	3(3.95%)	3(3.95%)	0(0)		
Food source					
Own production	4(5.26%)	5(6.58%)	0(0)	9.967$_f$	0.019$_f$
Purchased from market	0(0)	5(6.58%)	3(3.95%)		
Both	6(7.90%)	46(60.53%)	7(9.21%)		
Sleeping hours					
Less than 8 hours	1(1.32%)	3(3.95%)	3(3.95%)	5.358$_f$	0.048$_f$
More than 8 hours	9(11.84%)	53(69.74%)	7(9.21%)		
Adequacy of calories					
Adequate	3(3.95%)	4(5.26%)	4(5.26%)	9.058$_f$	0.009$_f$
Inadequate	7(11.84%)	52(68.42%)	6(7.89%)		

'$_f$' symbol denotes values of Fisher-Freeman-Halton exact test

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Factors related with thinness and overweight/obesity in non-vegetarians were type of family($p=0.006_f$), occupation of father($p=0.034_f$), family income($p=0.020_f$), consumption of green leafy vegetables($p=0.002_f$) and consumption of other vegetables ($p=0.000_f$). Table 4.20 shows the factors associated with thinness and overweight/obesity in non-vegetarians.

Table 4.20 Factors associated with thinness and overweight/obesity in non-vegetarians (n=104).

Factors	Thin	Normal	Obesity	$\bar{\chi}2$ – value	P-value
Type of family					
Nuclear	9(8.65%)	54(51.92%)	3(2.89%)	12.917_f	0.006_f
Extended	2(1.92%)	18(17.31%)	4(3.85%)		
Joint	7(6.73%)	7(6.73%)	0(0)		
Occupation of father					
Agriculture	3 (2.89%)	7(6.73%)	2(1.92%)	9.329_f	0.03_f
Service/foreign employment/ business	1(0.96%)	22(21.15%)	3(2.89%)		
Labour/others	14(13.46%)	50(48.08%)	2(1.92%)		
Family Income					
Below 30,000	17(16.35%)	63(60.57%)	3(2.89%)	7.273_f	0.020_f
Above 30,000	1(0.96%)	16(15.38%)	4(3.85%)		
Consumption of green leafy vegetables					
Regularly	5(4.81%)	53(50.96%)	7(6.73%)	15.066_f	0.002_f
Frequently	12(11.54%)	25(24.04%)	0(0%)		
Rarely	1(0.96%)	1(0.96%)	0(0%)		
Consumption of other vegetables					
Frequently	5(4.81%)	63(60.58%)	5(4.81%)	17.266_f	0.000_f
Rarely	13(12.5%)	16(15.39%)	2(1.92%)		

'f' symbol denotes values of Fisher-Freeman-Halton exact test

Van Tuijil *et al.* (2020) also found out associated factors with thinness and overweight/obesity in adolescents in Nepal to be paternal occupation, education, household income, geographical region, caste/ ethnicity and nutrition knowledge were associated with thinness. Bhattarai and Bhusal (2019) in a study in Dang district, Nepal stated significant association of religion, gender, family type, school type, earning status of family, daily intake of green leafy vegetables and school sports with the underweight and overweight/obesity in adolescents.

PART- V

Conclusions and recommendations

5.1 Conclusions

In the study, nutritional status of vegetarian and non-vegetarian adolescents was assessed and compared. The conclusions that can be drawn from the study are:

a) Prevalence of stunting and thinness was high among non-vegetarians with 38.47% and 17.32% of them stunted and thin respectively and overweight/obesity was high among vegetarians with the prevalence of 15.79%.

b) Most of the adolescents, be it vegetarian or non-vegetarian had insufficient intakes of calories and fats. Protein intake in most of the vegetarian and non-vegetarian adolescents were adequate.

c) There was no significant difference in anthropometric and dietary intake between vegetarian and non-vegetarian girls while vegetarian and non-vegetarian boys differed significantly in BMIZ and HWZ.

d) Energy and carbohydrate intake of non-vegetarian boys and vegetarian boys significantly differed.

e) Place of eating, adequacy of physical activity and adequacy of protein intake was found to be associated with stunting in vegetarian adolescents. Ethnicity, religion, occupation of father, number of siblings, and consumption of green leafy vegetables, milk and milk products and meat, fish, eggs were found to be associated with stunting in non-vegetarian adolescents.

f) Gender, occupation of father, food source, sleeping hours and adequacy of calories were associated with thinness or obesity in vegetarian adolescents. Type of family, occupation of father, family income, consumption of green leafy and other vegetables was related with thinness or obesity in non-vegetarian adolescents.

5.2 Recommendations

a) Inadequate calorie, fat, and iron intake in overall population and inadequate protein intakes among the girls aged 16-18 years of age highlights the need for community-based nutrition program and interventions.

b) Further study can be done to see other unexplained factors that were not included in the present study.

PART- VI

Summary

Adolescence is a phase in life with tremendous physical and mental growth. It has increased nutritional needs which may be affected by food habits influenced by vegetarian and non-vegetarian diets; also, by personal, socio-economic, demographic and dietary characteristics. Vegetarian diet, although a recent trend in the world is integral part of different cultures in South Asia. Adolescence stage is crucial for paving way of good health in later phases of life. Hence, the health and nutritional status in adolescence becomes undoubtedly important.

A community based cross sectional study was carried out to assess nutritional status of vegetarian and non-vegetarian adolescent population of Pranami Nagar, Bhadrapur. A structured questionnaire was used to collect data of 180 subjects. Anthropometric measurements were used to determine BMI z-score. Dietary intake was assessed using 24-hour dietary recall and food frequency questionnaire. Data collected was analyzed using WHO Anthroplus v1.0.4, SPSS 26 and Microsoft Excel. T-test, Chi-square test and fisher's exact test were used for necessary analysis.

The prevalence of stunting, thinness and overweight/obesity in vegetarians was 28.95%, 13.17% and 15.79% respectively and in non-vegetarians it was 38.47%, 17.31% and 6.73% respectively. Age-wise, percentage prevalence of stunting was found to be highest among non-vegetarians aged 13 to 15 years. Significant differences in height, weight, BMI z-score, height for weight z-score, calorie intake and carbohydrate intake were seen among vegetarian and non-vegetarian boys. No significant difference in anthropometric measurements and dietary intakes were seen among girls. In vegetarians, place of eating, adequacy of physical activity and adequacy of protein intake were found associated with stunting and gender, occupation of father, food source, feeling about self, attempt to gain weight, watch own body, source of water, sleeping hour and adequacy of calories were associated with thinness and overweight/obesity. In non-vegetarians, ethnicity, religion, occupation of father, number of siblings, consumption of milk and milk products, green leafy vegetable and meat, fish, egg were associated with stunting, while type of family, occupation of father, family income and consumption of green leafy vegetables and other vegetables were associated with thinness. Properly planned interventions from authorities should certainly enhance the nutritional status of the target population.

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Appendices

Appendix-A   **Consent letter from Bhadrapur municipality**

"पूर्वी क्षेत्रको व्यापारिक द्वार, शान्ति र सम्वृद्धि सहितको नगर "
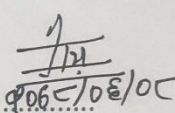
भद्रपुर नगरपालिका

पत्र संख्या

चलानी नं. ३८८

९ नं. वडा कार्यालय
भद्रपुर, झापा
१ नं. प्रदेश , झापा

मितिः-२०७८/०६/०८

श्री विनय राज कोईराला ज्यु
भद्रपुर, १०

बिषयः-सहमति प्रदान गरिएको बारे ।

उपरोक्त सम्बन्धमा भद्रपुर नगरपालिका वडा न.१० बस्ने निवेदक केन्द्रिय प्रविधि क्याम्पस धरानमा स्नातक तह अध्यनरत बिद्यार्थी निजले यस भद्रपुर नगरपालिका वडा न.९ स्थित प्रणामी नगरमा मांसाहारी र शाहाकारी (१० देखी १९बर्ष) उमेर समुहका किशोर किशोरीहरुमा पोषण अवस्था तथा पोषण अवस्था को भिन्नता बिचको अध्ययन गरि तथ्यांक सङ्कलन गरी थेसिस लेखन का लागी यस वडा कार्यालय बाट सहमति प्रदान गरिएको व्यहोरा अनुरोध छ ।

२०७८/०६/०८

राम प्रसाद दाहाल
का.वा. वडा अध्यक्ष

Appendix-B   **Consent form**

Namaste! I, Mr. Binaya Raj Koirala, a graduate student of Nutrition and Dietetics in Central Campus of Technology, Dharan; am going to conduct dissertation work in Bhadrapur municipality for the degree of Bachelor of Science in Nutrition and Dietetics.

The topic for the study is "**COMPARATIVE NUTRITIONAL ASSESSMENT OF VEGETARIAN AND NON-VEGETARIAN ADOLESCENTS OF PRANAMI NAGAR, BHADRAPUR**"

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:

Appendix-C **Survey questionnaire**

A. General information

Code no: Date of interview:

Name of child: _____

Age in years: _____   Date of birth:

Address: Bhadrapur municipality, ward no.10, Pranaminagar tole

Gender: 1) Male   2) Female

Caste/Ethnicity: 1) Brahmin 2) Chhettri 3) Tharu 4) Magar 5) Thakuri

6) Others: _____

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

Are you a vegetarian or non-vegetarian?
1) Vegetarian 2) Non vegetarian

If non vegetarian how often do you eat meat/fish/ egg?

Marital Status   1) Married 2) Single 3) Widowed

B. Anthropometric information

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

C. Family information

7. Type of family: 1)Nuclear 2) extended 3) Joint

8. Number of family members: _____

9. Number of male members: _____

10. Number of female members: _____

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

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

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

Total: _____ Brothers: _____ Sisters: _____

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

15. Occupation (of father):

1) Agriculture 2) Service 3) Labour 4) Business 5) Foreign employment 6) Others: _____

16. Occupation (of mother):

1) Housewife 2) Agriculture 3) Service 4) Labour 5) Business 6) Foreign employment 7) Others_____

17. Family income:

1) Less than Rs. 30000 monthly 2) Equal to or more than Rs. 30000 monthly

18. Father's Education level:

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

19. Mother's education level:

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

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

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

21. Is the water purified? 1) Yes 2) No

22. Do you have toilet facility in your house? 1) Yes 2) No

23. What is the main source of food for your family? 1) Own production 2) Purchased from market 3) Both 4) Others_____

D. Physical activities

24. On an average, how many hours do you sleep in a day? 1) 5 or less hours 2) 6 hours 3) 7 hours 4) 8 or more hours

25. Do you go to school?   1) Yes 2) No

If Yes

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

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

b) How many hours per day do you spend on doing your homework?

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

c) What do usually do at school breaks?

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

26. Do you normally play games or perform physical activities at home? 1) Yes 2) No

If yes, what type?

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

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

How frequently in a week? _____

27. Do you help your parents in doing domestic activities? 1) Yes 2) No

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

D. Dietary intake and food habits

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

1) Yes 2) No

29. Do you skip any meal? 1) Yes 2) No

If yes, which meal does you skips. 1) Breakfast 2) Lunch 3) Dinner

How often do you skip this meal?

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

30. At home, where do you usually eat? 1) Dining room/Kitchen 2) Bedroom 3) In front of the TV 4) Other places _____

31. If vegetarian, why are you a vegetarian? 1) Religious causes 2) Health consciousness 3) To stop cruelty towards animals 4) Others

　　If non vegetarian how often do you eat meat/fish/egg?

32. In a typical week, how many days do you eat vegetables?

33. How many servings of vegetables do you eat on one of those days?

34. In a typical week, how many days do you eat fruits?

35. How many servings of fruits do you eat on one of those days?

36. Do you consume junk food or processed food?

　　1) Yes 2) No

　　If yes, how often?

　　1)Daily 2) Few days in a week 3) In a fortnight 4) In a month 5) Others

37. Do you drink soft drinks?

　　1)Yes 2) No

　　If yes, how often?

　　1)Daily 2) Few days in a week 3) In a fortnight 4) In a month 5) Others

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

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

39. Do you have daily pocket money? 1) Yes 2) No 3) Sometimes (_____times a week)

40. Do you buy food from school canteen/ shops /vendor? 1) Yes 2) No If yes, what do you usually buy? _____

41. How do you feel about your body? 1) Overweight 2) Right weight 3) Thin

42. Have you ever tried losing weight? 1) Yes 2) No

43. Have you ever tried gaining weight? 1) Yes 2) No

44. Do you watch your figure/weight? 1) Yes 2) No

45. Do you smoke? 1) Yes 2) No

46. Do you drink alcoholic beverages? 1) Yes 2) No

47. Do you know, what is balanced diet? 1) Yes 2) No

48. Can you enlist the rich sources of Vitamin A? 1) Yes 2) No

49. Can you enlist the sources of protein? 1) Yes 2) No

50. Can you enlist the rich sources of iron? 1) Yes 2) No

E. Food frequency table

Food	Regularly	Frequently	Rarely	Never
Cereals				
Pulses and Legumes				
Milk & milk products				
Green leafy vegetables				
Other vegetables				
Fruits				
Egg, Meat, Fishes				
Tea/Coffee				
Fast food				
Soft Drinks				

F. 24-hour dietary recall

Timing	Food description	Brand (if possible)	Quantity/Serving size
Breakfast (6-9am)			
Lunch (9-11am)			
Snacks (1-5pm)			
Dinner (9-11pm)			
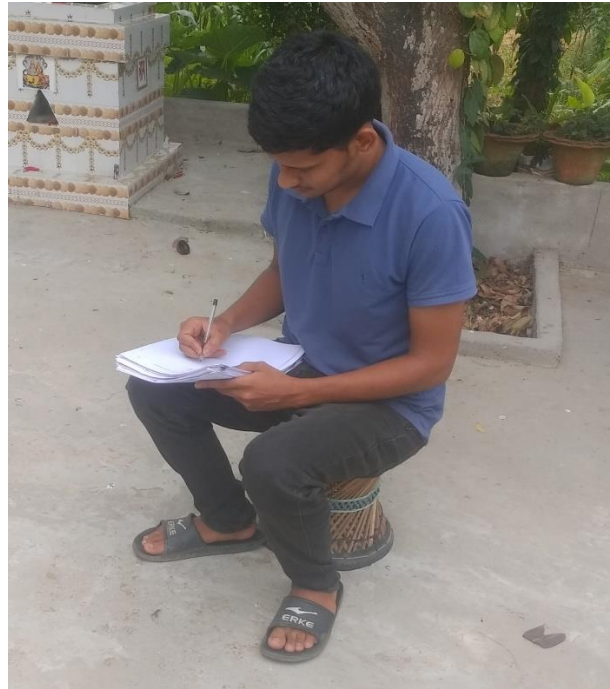
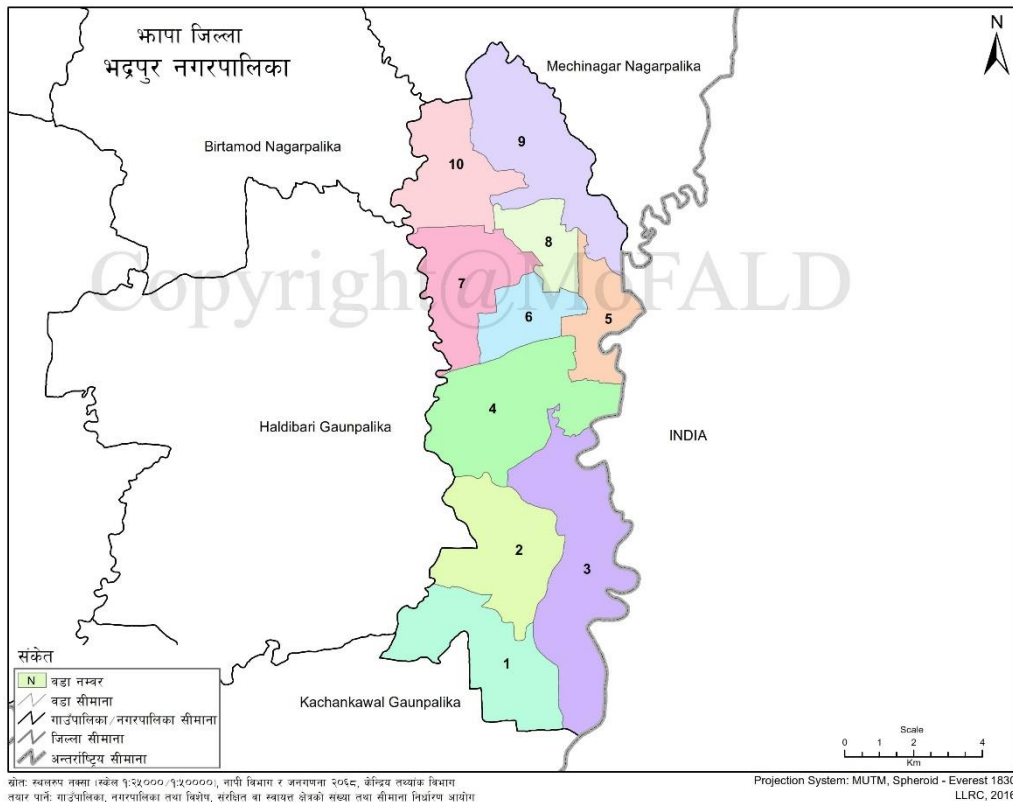a) Measuring height   b)Filling questionnaire

c) Pranami Nagar entrance

Survey site is located in ward number 9 shown in the map of Bhadrapur municipality

Source: MoFAGA (2022)