ASSESSMENT OF NUTRITIONAL STATUS AND ASSOCIATED RISK FACTORS AMONG ADULTS RESIDING IN SUKUMBASI BASTI, DHARAN

by

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Assessment of Nutritional Status and Associated Risk Factors Among Adults Residing in Sukumbasi Basti, Dharan

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

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Approval Letter

This ***dissertation*** entitled ***Assessment of Nutritional Status and Associated Risk Factors among adults residing in Sukumbasi Basti, Dharan*** presented by **Keshab Shrestha** has been accepted as the partial fulfilment of the requirements for the **B.Sc. degree in Nutrition and Dietetics.**

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(Keshab Shrestha)

Abstract

A cross-sectional study was carried out to assess the nutritional status and risk factors associated with it among adults residing in Sukumbasi basti, Dharan. Total 188 people between 18-70 years of age were assessed by applying simple random sampling method. Anthropometric measurements like BMI, WHR, waist circumference, height and weight were measured whereas stethoscope and sphygmomanometer were used to measure blood pressure. Data were collected and analyzed using SPSS version 22 and Microsoft package 16 (Excel and word). Chi-square test was used to establish the factors associated with nutritional status.

From the study, it was revealed that 4.3% were underweight, 29.3% were normal, 13.3% were overweight and 53.2% were obese. The mean BMI was found to be 25.56±4.93 kg/ m^2 and WC was 89.6±13.4cm with 0.90±0.079 WHR. Age, gender, physical activity, type of diet, marital status, drinking alcohol, hypertension and white meat were strongly associated while wheat and red meat showed close association with the nutritional status of people residing in Sukumbasi basti of Dharan sub-metropolitan city. Age, gender, marital status, physical activity, education were found to have strong association with abdominal obesity due to waist circumference while factors like age, gender, marital status, education and drinking alcohol were found to be associated with abdominal obesity (WHR). The study showed that prevalence of overweight and obesity among adults residing in Sukumbasi basti of Dharan are increasing rapidly than being underweight. Thus, effective public health intervention approaches emphasizing improved primary health care using multi-sectoral approach is essential.

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List of abbreviations

Abbreviations	Full form
OW	Overweight
OB	Obesity
WHO	World health organization
DHS	Demographic health survey
DBM	Double burden of malnutrition
SES	Socio-economic status
LMIC	Low and middle income countries
NCD	Non-communicable diseases
SBP	Systolic blood pressure
DBP	Diastolic blood pressure
NDHS	Nepal demographic and health survey
BMI	Body mass index
LBW	Low birth weight
MET	Metabolic equivalents
HC	Hip circumference
WC	Waist circumference
WHR	Waist to hip ratio
ICMR	Indian council of medical research
IPAQ	International physical activity questionnaire
GLV	Green leafy vegetables
RDA	Recommended dietary allowances
CI	Confidence interval
SPSS	Statistical package for the social sciences

Part I

Introduction

1.1 Background

Nutrition is defined as the science of food, the nutrients and other substances therein, their action, interaction and balance in relation to health and disease, and the processes by which the organism ingests, absorbs, transports, utilizes and excretes food substances (NLM and NAL, 1998). Optimal, balanced nutrition is a major determinant of health. It was only in the second half of the eighteenth century that nutrition started to experience its first renaissance with the observation by scientists that intake of certain foods, later called nutrients, influenced the function of the body, protect against disease, restore health and determine people's response to changes in the environment. Knowing about nutrients are important in order to understand nutrition. There are more than 50 known nutrients including amino acids and fatty acids. Nutrients acts as substrates and cofactors in all of the metabolic reactions in cell necessary for the growth and maintenance of structure and function (Gibney *et al.*, 2013).

Adequate nutrition of any individual is determined by two factors. The first is the adequate availability of food in terms of quantity as well as quality, which depends on socioeconomic status, food practices, cultural traditions, and allocation of the food. The second factor is the ability to digest, absorb, and utilize the food. This ability can be hampered by infection and by metabolic disorders (Haider and Bhatia, 2006). Poverty is considered the prime factor determining food consumption; however, some researchers suggest that cultural factors play a stronger role than socioeconomic conditions in determining allocation of food and nutritional adequacy. Even where food resources are adequate, the mean caloric intake of individual family members can fall below requirements (Haider and Bhatia, 2006). Nutrition, nourishment, or aliment, is the supply of materials - food - required by organisms and cells to stay alive Improvement of nutritional status has been seen as some of the most powerful and cost-effective investment for the overall socioeconomic development by enhancing the optimal physical growth and cognitive development especially of women and children (Department of health services, 2013, 2014).

Intake of a diet sufficient to meet or exceed the needs of the individual will keep the composition and function of the otherwise healthy individuals within the normal range. This equilibrium is disturbed by three processes: decreased intake, increased requirements, and altered utilization. When this disequilibrium occurs, then loss of body tissue ensues. However, lack of nutrients produces a series of metabolic changes in relation to energy and protein metabolism within hours or days of reducing nutrient intake, long before demonstrable anthropometric changes. As well these functional changes predict complications better than other anthropometric parameters showing that a reduction in muscle power is a better predictor of complications than weight loss or arm muscle circumference. Thus, malnutrition and its adverse consequences depend upon altered intake, functional changes, and finally anthropometric effects (Jeejeebhoy *et al.*, 1990).

Malnutrition is one of the most important public health problems of developing countries where resources are very limited like country Nepal. Nutrition is believed to be very essential for socio economic development of the country and is an essential component of millennium development goals. The common cause of malnutrition is lack of access to the nutritious food (Chataut & Khanal, 2016). Nutrition related disorders can be caused by an insufficient intake of food or of certain nutrients, by an inability of the body to absorb and use nutrients, or by overconsumption of certain foods (WHO, 2016b). The dietary intake also ultimately affects the nutritional status because establishing healthy eating habits promotes young people's health, growth and intellectual development across the life course (WHO, 2016a).

The NAGA team first reviewed the primary determinants of undernutrition in Nepal. These included inadequate food availability, access and affordability, poor food- and care-related behaviors including hygiene and sanitation, inadequate food quality/nutrient density, and high prevalence of infections that reduce food absorption and utilization (Team, 2009).

1.2 Statement of Problem and Justification

Adult malnutrition is much more widespread than is commonly recognized. Adult malnutrition has received much less attention than that of the child. This focus appears at least in part unjustified, and many public health workers report that parents often sacrifice their own feeding in times of serious food shortage (acute or chronic) in favor of young children in the family. The latter may also benefit from unusually prolonged breast-feeding. Moreover, if the ability of the adult bread winner to function is compromised because of

malnutrition, the children of the household are clearly at high risk of becoming malnourished themselves (Bailey and Ferro-Luzzi, 1995).

Globally, in 2015, it was estimated that 9% of the world's adult population were underweight and 30–40% were overweight or obese. In 2016, 39% of adults aged 18 years and over (39% of men and 40% of women) were overweight. Overall, about 13% of the world's adult population (11% of men and 15% of women) were obese in 2016 (WHO, 2018). The worldwide prevalence of obesity nearly tripled between 1975 and 2016. Both underweight and overweight affect the functioning as well as structure of body organs, increasing the risk of mortality. 1.02 billion people in the developing world are undernourished. They consume less than the minimum amount of calories essential for sound health and growth. Undernourishment negatively affects people's health, productivity, sense of hope and overall well-being. Malnutrition, in all its different forms, affects all countries of the world. Many countries face a double burden of malnutrition (DBM), where both undernutrition and overweight/obesity exist in the same population, household, or even individual (Chooi *et al.*, 2019). While in high-income countries, overweight/obesity is usually more prevalent among populations with a low socio-economic status (SES), the opposite has been observed for low-income countries. The results from a recent analysis including 126 low- and middle-income countries (LMIC) showed that the increase in the global DBM was driven by the countries with a low gross domestic product, as these tended to have a greater increase in overweight/obesity and a slow decrease in the prevalence of undernutrition. This increase in the double burden of malnutrition was particularly observed in Asia (Khanal *et al.*, 2013).

Three national surveys (Demographic Health Survey) Nepal 2016, Micronutrient Survey 2016 and the STEPS survey 2019), estimated that overall 14.5–17% of the Nepalese adult women were underweight, while 22–25% were overweight/obesity. Among men, 17% were underweight and 17–23.4% were overweight/obesity. The increase in overweight/obesity is an important driver for the increase in the DBM in Nepal (Popkin *et al.*, 2020). The city of Dharan has an area of 192 km2 area and is situated in the Sunsari District of eastern Nepal, approximately 600 km southeast of the capital Kathmandu. Dharan is one of three major urban centers in eastern Nepal, with the latest 2011 census reporting the population at 137,705 (CBS, 2012). Dharan is situated at the foothills of the Siwalik range (Aksha *et al.*, 2020). A survey done in Dharan in 2018 found that 5.4% were underweight, 44.7% were normal weight, 33.3% were overweight and 16.4% were obese (Bhandari, 2018).

People living in Sukumbasi basti of Dharan are known as slum-dwellers of Dharan. Many of the people in Sukumbasi basti, Dharan are employed as daily wage labor. Most of the family consist of one member as the source of income for the family. This causes inadequate income leading to poor lifestyle, causing to compromise or use coping strategy with daily basic needs. This ultimately hampers the nutritional status of the people (child, adult, elderly) causing many nutrition related problems in the community. As the community lies near to water source, most of the people use the banks of the river for dumping purpose as well as for bathing and cleaning clothes. Therefore, contaminated water also causes the health-related problem to mostly kids those who often play in the river. Moreover, not many study or researches are done on malnutrition in Dharan especially targeting people living in Sukumbasi area as a result, not many projects or education programs are conducted or initiated in these areas. Therefore, this study assists to assess the nutritional status of adults living in Sukumbasi basti, Dharan so that in future it helps to bring well-designed educational interventions to increase health awareness in people especially prioritizing people from poor background.

1.3 Objective of the study

1.3.1 General objective

To assess nutritional status and associated risk factors among adults residing in Sukumbasi basti, Dharan.

1.3.2 Specific objectives

1) To assess the nutritional status of adults aged 18-70 years through anthropometric assessment living in Sukumbasi basti, Dharan.

2) To assess the dietary intake and dietary habits of adults living in Sukumbasi basti, Dharan.

3) To assess the relationship with nutritional status and socio-economic and dietary factors among Sukumbasi Basti of Dharan.

1.4 Research questions

i. What is the nutritional status of adult aged 18-70 years residing in Sukumbasi basti, Dharan?

ii. What are the risk factors associated with nutritional status of adult aged 18-70 years residing in Sukumbasi basti, Dharan?

1.5 Significance of the study

1) This study will be helpful to find out the magnitude and distribution of malnutrition, overweight and obesity among the people living in Sukumbasi basti, Dharan.

2) This study may act as guidelines for policy makers for making plans on Sukumbasi basti.

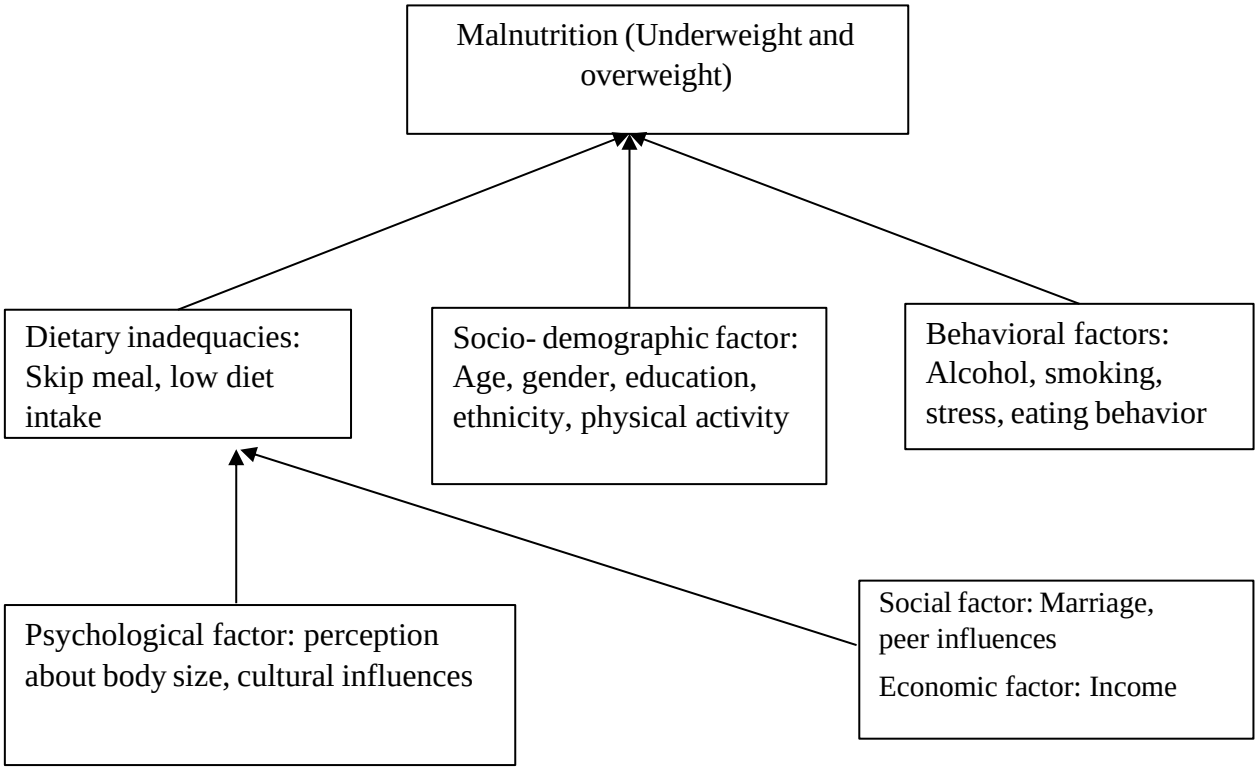
3) It can suggest the corrective measure in order to uplift people malnutrition considering the gender, caste, family economic basis, and dietary behaviour and nutrient intake.

4) The study will also provide information on the factors associated with malnutrition, overweight/obesity and effects of nutrient intake and dietary behaviour on nutritional status.

5) It also includes assessment of dietary intake and dietary habits of adolescents which would be useful for implementing programs to modify dietary habits of general population in that community if needed.

6) It also provides information to governmental and nongovernmental organizations to conduct different programs for uplifting the nutrition status and dietary behaviour of the people living in the poor community.

1.6 Conceptual Framework of study



Modified from: (UNICEF, 2020)

Figure 1.1 Conceptual framework of study

1.7 Limitations of the study

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

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

3) This study was conducted in the single area, so it may not be representative of whole Sukumbasi basti of Dharan.

Part II

Literature review

2.1 Nutritional status

Nutritional status refers to the condition of health of the individual as influenced by the utilization of the nutrients. It can be determined only by the correlation of information obtained through a careful medical and dietary history, through physical examination and appropriate laboratory investigation (Srilakshmi, 2014). Nutritional status is the condition of the body resulting from the intake absorption and utilization of food (FAO, 1984).The evaluation of the nutritional status is a broad topic, and to be of clinical importance, the ideal method should be able to predict whether the individual would have increased morbidity and mortality in the absence of nutritional support (Jeejeebhoy, 1998). Nutritional status is required for the formulation of recommendations for nutrient intake (Elmadfa and Meyer, 2014).

Nutritional status has an important influence on the immune system and its function is very sensitive to nutritional changes. Both under- and overnutrition are known to alter immunocompetence (Samartín and Chandra, 2001). Nutrition is concerned primarily with the parts played by nutrients in body growth, development and maintenance. Adequate nutrition helps to attain normal physical growth and is a fundamental right for every human being (Joshi, 2012).

2.2 Malnutrition

Malnutrition refers to all deviations from adequate and optimal nutritional status, including energy undernutrition and over-nutrition. Malnutrition arises from deficiencies of specific nutrients or from diets based on inappropriate combinations or proportions of foods; for example, goiter, scurvy, anemia and xerophthalmia are forms of malnutrition caused by inadequate iodine, vitamin C, iron and vitamin A, respectively. Malnutrition can also result from excess nutrient losses or utilization (Shetty, 2003).

Malnutrition is a widespread problem, affecting the global population at some life stage. This public health epidemic targets everyone, but the most vulnerable groups are poverty-stricken people, young children, adolescents, older people, those who are with illness and have a compromised immune system, as well as lactating and pregnant women. Malnutrition

includes both undernutrition (wasting, stunting, underweight, and mineral- and vitamin-related malnutrition) and overnutrition (overweight, obesity, and diet-related noncommunicable diseases). In combating malnutrition, healthcare costs increase, productivity is reduced, and economic growth is staggered, thus perpetuating the cycle of ill health and poverty. The best-targeted age for addressing malnutrition is the first 1000 days of life as this window period is ideal for intervention implementation and tracking for the improvement of child growth and development (Dukhi, 2020).

Malnutrition among the elderly has become a serious problem as their population increases in Japan. To approach the risk of malnutrition in the healthy, community-dwelling elderly is important for early prevention of malnutrition. The nutritional status and mutable associated factors with poor nutritional status specific to the healthy elderly were examined comprehensively (Iizaka *et al.*, 2008).

In modern age malnutrition continues to be a serious public health problem and has for a long time been recognized because of poverty since most of the world's malnourished children live in the developing nations of Asia, Africa and Latin America where those mostly affected are from low-income families. The children from households with a low or very low socioeconomic status had 2.5 times the risk of being underweight relative to children who came from households with middle to upper socioeconomic status (Babar *et al.*, 2010).

Poor health has repercussions not only for women but also their families. Women with poor health and nutrition are more likely to give birth to low weight infants. They are also less likely to be able to provide food and adequate care for their children. Finally, a women's health affects the household economic well-being, and as a woman with poor health will be less productive in the labor force. While malnutrition is prevalent among all segments of the population, poor nutrition among women begins infancy and continues throughout their lifetime (Rao *et al.*, 2010).

2.2.1 Causes and symptoms of malnutrition

Causes of malnutrition include: Lack of specific nutrients in diet. Even the lack of one vitamin can lead to malnutrition. An unbalanced diet. Certain medical problems, such as malabsorption syndromes and cancers.

Symptoms may include fatigue, dizziness, weight gain and weight loss or, no symptoms. To diagnose the cause of the problem, doctor may do blood tests and a nutritional assessment. Treatment may include replacing the missing nutrients and treating the underlying cause (Rodriguez *et al.*, 2015).

2.3 Types of malnutrition

There are two types of malnutrition mostly common in adults:

1) Undernutrition: Undernutrition occurs when people do not eat (or absorb) enough nutrients to cover their needs for energy and growth, or to maintain a healthy immune system. Micronutrient deficiencies are a sub-category of undernutrition and occur when the body lacks one or more micronutrients (e.g. iron, iodine, zinc, vitamin A or folate) (Burgess, 2008). Undernutrition is caused primarily by an inadequate intake of dietary energy, regardless of whether any other specific nutrient is a limiting factor (Shetty, 2003). Undernutrition is subdivided into two categories that include micronutrient malnutrition and growth failure. To differentiate between acute or chronic malnutrition, the nutritional status of an individual is assessed by using anthropometry (Torun, 1999).

2) Over-nutrition: Over-nutrition is commonly defined as chronic consumption of a diet consisting of 60% fat and 20% fructose. Over nutrition includes overweight, obesity and diet-related non-communicable diseases (NCDs) such as diabetes mellitus, heart disease, some forms of cancer and stroke (Mandavia *et al.*, 2012).

2.4 Prevalence of malnutrition around the world

Malnutrition is an important global issue currently, as it affects all people despite the geography, socio-economic status, sex and gender, overlapping households, communities and countries. Anyone can experience malnutrition but the most vulnerable groups affected are children, adolescents, women, as well as people who are immune-compromised, or facing the challenges of poverty. Globally, in 2015, it was estimated that 9% of the world's adult population were underweight and 30–40% were overweight or obese. Women had a slightly higher prevalence of overweight and obesity. Although there has been a marginal decline in the prevalence of underweight (1), the rise in the proportion of people being overweight or obese is currently being described as a global pandemic. There has been a 50–80% increase in overweight and obesity in the past 30 years. According to the World Health

Organization (WHO), 462 million adults are underweight, while 1.9 billion adults are overweight and/or obese. In children under 5 years of age, 155 million are stunted, 52 million are wasted, 17 million are severely wasted and 41 million are overweight and/or obese (Dukhi, 2020).

In the last five decades overweight and obesity appears to be reaching epidemic levels in both developing and developed countries. Eclipsing infectious disease and under-nutrition as a significant mortality and ill-health contributor, overweight and obesity have presented as the most prevalent global nutritional problem over the last two decades. Globally an estimated 1 billion adults are overweight, with 300 million of them being obese. An estimated 155 million obese children contribute to this epidemic. Obese children tend to become obese adults (Hossain *et al.*, 2007).

2.5 Prevalence of malnutrition in Nepal

Studies undertaken in Nepal have shown that although the prevalence of undernutrition in the population has generally decreased over the last decades, it has remained high among women of reproductive age. During this period the prevalence of overweight/obesity has increased substantially. Three national surveys Demographic Health Survey (DHS) Nepal 2016, Micronutrient Survey 2016 and the STEPS survey 2019), estimated that overall 14.5–17% of the Nepalese adult women were underweight, while 22–25% were overweight/obesity. Among men, 17% were underweight and 17–23.4% were overweight/obesity. The increase in overweight/obesity is an important driver for the increase in the double burden of malnutrition in Nepal. In the Nepal DHS 2016, there was no difference in the prevalence of overweight and obesity between ecological zones or between rural vs. urban populations.

2.6 Factors affecting nutritional status

Some factors that could affect the nutritional status of the people of Sukumbasi basti are mentioned below.

2.6.1 Age

Aging refers to a multidimensional process in humans, the process of physical, psychological, and social changes. As a population, older adults are more prone to age-related diseases, functional impairment, and physical inability that may interfere with the

maintenance of a good nutritional status (Amarya *et al.*, 2015). Improvement in nutrition are known to bring tangible benefits to older people and many age-related diseases and conditions can be prevented, modulated or ameliorated by good nutrition. However, practical and realistic approaches are required to optimize diet and food intake in older adults (Clegg and Williams, 2018)

2.6.2 Gender

Females are at a disadvantage at both the ends of the malnutrition spectrum, i.e., female older adults face a higher risk of being both underweight and overweight as compared to their male counterparts. In most populations, the prevalence of obesity among women is higher than men, although, the rates vary between countries. Additionally, there are various household, biological and behavioral factors that contribute to sex differentials in obesity prevalence. Food consumption, physical activity and mobility are gendered and these differences not only govern individual behavior but also influence institutions that affect daily life and reinforce gender differences. In many cultures, being a female is more intricately linked to food production and consumption and a certain notion of body image is associated to them. One major factor behind the same is women's reproductive role (Singh and Chattopadhyay, 2023).

2.6.3 Socio-economic factors

Income is an important predictor of dietary adequacy. Lower income levels are generally associated with lower levels of energy intake in all three household's types, although this finding might be partly accounted for by differential under reporting in the lowest income groups, as well as differences in age, gender and ethnic group distributions (Nelson *et al.*, 2002). Low income is associated with poor nutrition at all stages of life, from lower rates of breast-feeding to higher intakes of saturated fatty acids and lower intakes of antioxidant nutrients. Moreover, there is increasing evidence that poor nutrition in childhood is associated with both short-term and long-term adverse consequences such as poorer immune status, higher caries rates and poorer cognitive function and learning ability (Nelson, 2000). Higher education level is generally regarded as higher socio-economic status which leads to well-off living standard. Individuals with higher educational status are recorded with higher prevalence of obesity than those with lower education (Pereko *et al.*, 2013).

2.6.4 Marital status

Married individuals often have higher body weights than unmarried individuals, but it is unclear how marital roles affect body weight-related perceptions, desires, and behaviors. Controlling for demographics and current weight, married or cohabiting women and divorced or separated women more often perceived themselves as overweight and desired to weigh less than women who had never married. Marital status was unrelated to men's weight perception and desired weight change. Marital status was also generally unrelated to weight management approach, except that divorced or separated women were more likely to have intentionally lost weight within the past year compared to never married women. Additionally, never married men were more likely to be attempting to prevent weight gain than married or cohabiting men and widowed men. Overall, married and formerly married women more often perceived themselves as overweight and desired a lower weight. Men's marital status was generally unassociated with weight-related perceptions, desires, and behaviors. Women's but not men's marital roles appear to influence their perceived and desired weight, suggesting that weight management interventions should be sensitive to both marital status and gender differences (Klos and Sobal, 2013).

2.6.5 Physical activity

Total energy expenditure of an individual is reduced with the reduction in physical activity, and this is an important factor contributing to a reduced energy requirement in the elderly. Physical activity contributes to good physical and psychological health at all ages,30 and inactivity associated with minor illness in the elderly often leads to loss of muscle tone and mass, and, thereafter, former physical activity levels may never be regained (Amarya *et al.*, 2015).

Short IPAQ (International Physical Activity Questionnaire) was used for classifying physical activity of study participants. Physical activity part was used to collect data on type, frequency, duration and intensity of physical activity during work, transportation and leisure time in a typical week. The purpose of the questionnaires is to provide common instruments that can be used to obtain internationally comparable data on health-related physical activity.

Physical activity was categorized as low, moderate and high according to the score of each individual calculated following the short IPAQ questionnaire. For this total MET-minutes/week was calculated and physical activity level was determined as shown below:

Table 2.1: MET values computation

MET values	Formula for computation
Walking MET minutes/week	3.3 × walking minutes × walking days
Moderate MET minutes/week	4 × moderate intensity activity minutes × moderate days
Vigorous MET minutes/week	8 × vigorous intensity activity minutes × vigorous days
Total MET minutes/week	Walking + Moderate + Vigorous MET minutes/week scores

(IPAQ,2004)

Total MET-minutes/week = Walk (METs×min×days) + Moderate (METs×min×days) + vigorous (METs×min×days).

Where, MET factors for walk, moderate activity and vigorous activity are 3.3, 4 and 8 respectively.

IPAQ categorical score is as follows:

a) Low : No physical activity is performed or physical activity with MET values less than 600 MET per week activity (IPAQ, 2002).

b) Moderate: Physical activity with MET value 600 or greater than 600 per week or 3 or more day of vigorous activity of at least 20 minutes per day activity (IPAQ, 2002).

c) Vigorous: Vigorous-intensity activity on at least 3 days and accumulating at least 1500 or 7 or more days more days of any combination of walking, moderate or vigorous intensity activities accumulating at least 3000 MET-minutes/week activity (IPAQ, 2002).

2.6.6 Sleep

Affecting approximately 20% of general population, short sleep duration and poor sleep quality is imposing a growing burden on public health. With the steadily declined time devoted to sleep in working-aged adults for decades, accumulating evidence indicates that poor sleep quality is associated with a variety of cardiometabolic diseases. Previous studies

have suggested the significant relationship between sleep disturbance and insulin resistance, in which short sleep duration and poor sleep quality contributed to increasing risk for metabolic syndrome, impaired glucose tolerance and type 2 diabetes mellitus. Epidemiologic studies have also provided evidence that insufficient sleep can cause obesity and weight gain. Thus, it can be postulated that the developed obesity and related adverse metabolic condition in individuals suffering sleep disturbance may trigger pathophysiologic processes contributory to various cardio metabolic diseases (Park *et al.*, 2018).

2.6.7 Behavioral factors

a) Stress

Stress has been often applied in developing eating disorder models. During chronic stress and the corresponding hyperactivation of the hypothalamus-pituitary-adrenal (HPA) axis, glucocorticoids and insulin increase craving for calorie-rich meals, a phenomenon explained by the "comfort food" hypothesis. Stress and negative affect are increasingly recognized as risk factors for obesity and binge eating disorder. Food overconsumption can be conducive to the excessive body weight and adiposity that define obesity, a condition that is pervasively damaging of health and is now included among the high-burden chronic conditions such as diabetes, hypercholesterolemia, and hypertension (Razzoli *et al.*, 2017).

b) Drinking alcohol

Alcohol influences nutritional status in humans by interacting with normal nutrient metabolism and utilization. The alcoholic's diet and the presence or absence of liver disease influence the risk for malnutrition. Alcohol is a source of calories and therefore can be considered nutrient. However, when chronically ingested in excess as little as 20 grams of alcohol per day for women and 40 grams per day for men. Alcohol negatively affects the metabolism of macronutrients and micronutrients (Marsano, 1993).

c) Skipping breakfast

Breakfast skipping is associated with changes in appetite and decreased satiety, which may lead to subsequent overeating and impaired insulin sensitivity (Onnerfalt *et al*., 2018). (Chowdhury *et al.,* 2016) conducted a randomized controlled trial and demonstrated that in obese adults, daily breakfast leads to more significant physical activity during the morning, whereas morning fasting results in partial dietary compensation (i.e. higher energy intake)

later in the day. Skipping breakfast has become more prevalent among school-age children, adolescents and working adults (Ma *et al.,* 2020). Skipping breakfast was significantly correlated with waist circumference and BMI (Watanabe *et al.,* 2014).

d) Eating in front of TV

The more television people watch, the more likely they are to gain weight or become overweight or obese (Thorp *et al.,* 2011). Different studies revealed that watching television is positively associated with an overall increase in food intake, particularly pizza, fast food, and high-calorie snacks and are inversely associated with intakes of vegetables and fruits (Ahmed *et al.,* 2020). Research among adolescents in Nepal, reports that watching TV for longer time is one of the major risk factors for developing overweight (Piryani *et al.,* 2016).

e) Smoking

Smoking is another factor associated with both lower weight and increased probability of death. According to (Willett *et al.,* 2019) "A second major concern is that confounding factors may distort the association between body weight and mortality. Smoking is particularly important, because smokers tend to weigh less and to have much higher mortality rates than nonsmokers." (Flegal *et al.,* 2007)

2.6.8 Dietary intake

A major cause of malnutrition among poor households is the low diet diversity and the associated low intake of essential micronutrients. Excess weight, obesity and associated NCDs are largely preventable through improvements in lifestyle choices and consumption habits. Certain foods that constitute a healthy diet are not being consumed in sufficient quantities to meet recommended intakes or are being replaced by unhealthy (new) foods in the NT process (Miller *et al.,* 2020).

1) Dietary fat: Low fat and diabetic diets are mainly associated with undernutrition through a lower energy density of food. Epidemiological studies have shown a positive relationship between dietary fat intake and obesity. Dietary fat intake often has been claimed as responsible for the increase in adiposity. Human studies have shown that high-fat diets ($\geq$ 30 % of energy from fat) can easily induce obesity. Epidemiological studies conducted in countries such as China, Canada and the USA have shown that, when the average amount of fat in the diet increases, the incidence of obesity also increased. This has led to a worldwide

effort to decrease the amount of fat in the human diet. Diets rich in fat not only induce obesity in humans but also make animals obese (Lee *et al.*, 2001).

2) Dietary carbohydrate: Consuming a low-carbohydrate (approximately <47% energy) diet is associated with greater likelihood of being overweight or obese among healthy, free-living adults. Lowest risk may be obtained by consuming 47% to 64% energy from carbohydrates (Sclafani, 1987).

3) Dietary protein: Metabolic rate is known to rise above basal levels after eating, especially following protein consumption. Yet, this postprandial rise in metabolism appears to vary among individuals. Metabolic rate may increase up to about 30% after protein consumption, High protein diets, such as the Atkins diet and Zone diet are popular for weight loss in the United States. While high protein diets provide good satiety and are popular with the public, health professionals are generally more cautious about such diets. High protein diets often result in high fat consumption and may also promote increased calcium excretion and longer-term problems such as an increased risk of heart disease, osteoporosis, kidney problems, and increased mortality (Riggs *et al.*, 2007).

4) Milk and milk products: Milk and dairy products are good sources of high-quality protein. Protein is important during weight loss and subsequent weight maintenance due to the high satiating effect which helps to prevent over-consumption of energy and thereby reduces body fat stores. Furthermore, dairy protein is a good source of essential amino acids for muscle protein synthesis and thus helps to maintain the metabolically active muscle mass during weight loss. Meta-analyses support that in adults, dairy products facilitate weight loss and improve body composition, that is, reduce body fat mass and preserve lean body mass during energy restriction and in short-term studies. The effect of an increased dairy consumption on body weight in long-term studies (>1 year) and in energy balance studies is less convincing. This is likely due to the opposing effects of dairy on body composition, that is, reduction of fat mass and preservation of lean body mass (Thorning *et al.*, 2016).

5) Fruits consumption: Fresh fruits and vegetables are the primary dietary source of a wide range of chemicals and nutrients, and have been identified as one of the key dietary factors in the global disease burden. Previous studies have shown that inadequate intake of fruit and vegetable may result in illness, disability, and death. In 2017, 11.4% of all disease deaths worldwide were attributable to insufficient fruits and vegetables consumption (3.9 million deaths, of which 2.4 million and 1.5 million were due to low fruit and vegetable intake, respectively), including oral cancer, esophageal cancer, lung cancer, Type 2 diabetes, and

various cardiovascular and cerebrovascular diseases. On the other hand, studies have shown that increasing fruit and vegetable intake can reduce the risk of many chronic diseases. Increased intake of certain fruits is associated with lower SBP, DBP, and weight gain (Guo *et al.*, 2023).

6) Salt intake: High salt intake is the major cause of raised blood pressure and accordingly leads to cardiovascular diseases. Recently, it has been shown that high salt intake is associated with an increased risk of obesity through sugar-sweetened beverage consumption. Increasing evidence also suggests a direct link. One reason for this association is that high salt intake stimulates thirst and increases fluid intake and thereby increasing sugar- sweetened beverage consumption. It has been shown that 1-g/d increase in salt intake is associated with an increase in sugar-sweetened soft drink consumption of 27 g/d in children and adolescents. The association between salt and obesity may also be partially caused by excessive consumption of processed food that is high in both calorie and salt. However, increasing evidence suggests that there may be a direct link between salt intake and obesity independent of total energy intake (Ma *et al.*, 2015).

2.6.9 Lifestyle diseases

Lifestyle diseases characterize those diseases whose occurrence is primarily based on the daily habits of people and are a result of an inappropriate relationship of people with their environment. The main factors contributing to lifestyle diseases include bad food habits, physical inactivity, wrong body posture, and disturbed biological clock (Sharma, 2016).

Overweight/obesity is also a leading risk factor of NCDs including cardiovascular disease, hypertension, and diabetes. While the prevalence of undernutrition remains high in many low middle income countries, especially in South Asia, trends in BMI suggest an emerging problem of overweight/obesity. Evidence from 126 low middle income countries with data from the 2010s suggests that 38% of these countries were facing a double burden of malnutrition (simultaneous undernutrition and overnutrition) based on a 20% overweight prevalence cutoff. NCDs such hypertension and diabetes also disproportionately affect people living in low middle income countries (Nguyen *et al.*, 2022).

2.7 Nutritional requirement of adults

Nutritional requirements are important to determine accurately and remain same whether nutrition support is provided enterally or parenterally. Appropriate calculations of caloric and protein requirements are important to achieve optimal anabolism and avoid the metabolic complications associated with overfeeding. There are three major nutritional components that must be synthesized into a unified plan for each individual patient: carbohydrates, fat and protein. Carbohydrates and fat serve as energy sources and proteins serve as structural building blocks (Chopra and McVay, 2003). Recommended dietary allowances and nutritional requirements of humans is a growing science that keeps changing, hence medical fraternity needs to be updated. ICMR-NIN are the nodal agencies in India for refining and reformulating dietary needs as per the nutritional transition occurring globally (Deepthi *et al.*, 2023).

Table 2.2: Recommended daily allowances requirement as per ICMR 2020 guidelines

Age group	Category	Energy(kcal)	CHO (gm)	Protein (gm)	Fat (gm)
Male	Sedentary	2110			25
(19-39 yrs)	Moderate	2710	100	42.9	30
	Heavy	3470			40
Female	Sedentary	1660			20
(19-39 yrs)	Moderate	2130	100	36.3	25
	Heavy	2720			30

* After the age of 40 years, requirements should be reduced by 5 percent per each decade until the age of 60 years, and 10 percent for each decade thereafter.

2.8 Indicators of nutritional status

2.8.1 Body mass index (BMI)

The body mass index (BMI) is the metric currently in use for defining anthropometric height/weight characteristics in adults and for classifying (categorizing) them into groups. The common interpretation is that it represents an index of an individual's fatness. It also is

widely used as a risk factor for the development of or the prevalence of several health issues. In addition, it is widely used in determining public health policies. The BMI has been useful in population-based studies by virtue of its wide acceptance in defining specific categories of body mass as a health issue. However, it is increasingly clear that BMI is a rather poor indicator of percent of body fat. Importantly, the BMI also does not capture information on the mass of fat in different body sites. The latter is related not only to untoward health issues but to social issues as well. Lastly, current evidence indicates there is a wide range of BMIs over which mortality risk is modest, and this is age related (Nuttall, 2015).

Table 2.3: Asian-BMI classification

Nutritional status	**BMI (kg/m2)**
Underweight	<18.5
Normal	18.5-22.9
Overweight	23-24.9
Obese I	25-29.9
Obese II	>30

(Mahajan and Batra, 2018)

2.8.2 Waist circumference

Most previous investigations of body weight and mortality have used body mass index (BMI) as the measure of adiposity. Fat distribution, however, may be more important than total body fat. In particular, increased visceral or abdominal fat is positively associated with metabolic disease risk independent of overall adiposity. Waist circumference is strongly related to visceral fat depot and is therefore a measure of abdominal obesity (Koster *et al.*, 2008).

Table 2.4: Classification of waist circumference

Classifications	Waist circumference (cm)	
	Male	Female
Normal	<90	<80
Risk	>90	>80

(Lee *et al.*, 2001)

2.8.3 Waist to hip ratio

In 1999, the WHO definition included a measure of obesity and defined obesity in terms of either BMI or WHR. The EGIR (1999) and ATPIII (2001) definitions also introduced waist circumference as a measurement of adiposity (F. Wang *et al.*, 2009). Waist hip ratio is the most common proxy measure of visceral adipose tissue (VAT). Waist hip ratio may be a better predictor of cardiovascular diseases risk as hip circumference is inversely associated with the development of cardio-metabolic risk factors and CVD (De Koning *et al.*, 2007).

Table 2.5: Classification of WHR ratio

Classifications	WHR cut-offs	
	Male	Female
Normal	<0.90	<0.85
Risk	>0.90	>0.85

(Qiao and Nyamdorj, 2010)

Part III

Materials and Methods

3.1 Research design

A cross sectional survey was conducted from 13th September to 20th September 2023 in Sukumbasi Basti of Dharan to assess the nutritional status as well as risk factors associated with it by using semi structured questionnaires and measurement of anthropometric variables like height, weight, waist and hip circumference.

3.2 Study area

The study was conducted in Sukumbasi basti, Dharan Sub-metropolitan city of Sunsari district, Koshi province. It has total 20 wards. It is the third most populous city in Eastern Nepal after Biratnagar and Itahari. The study was done in Naulo basti, Devi gaun and Gauri gaun which are located at Dharan-11, Dharan-13 and Dharan-16. The total population of Dharan ward number 11 was 17833, ward number 13 was 9733 and ward number 16 was 18033.

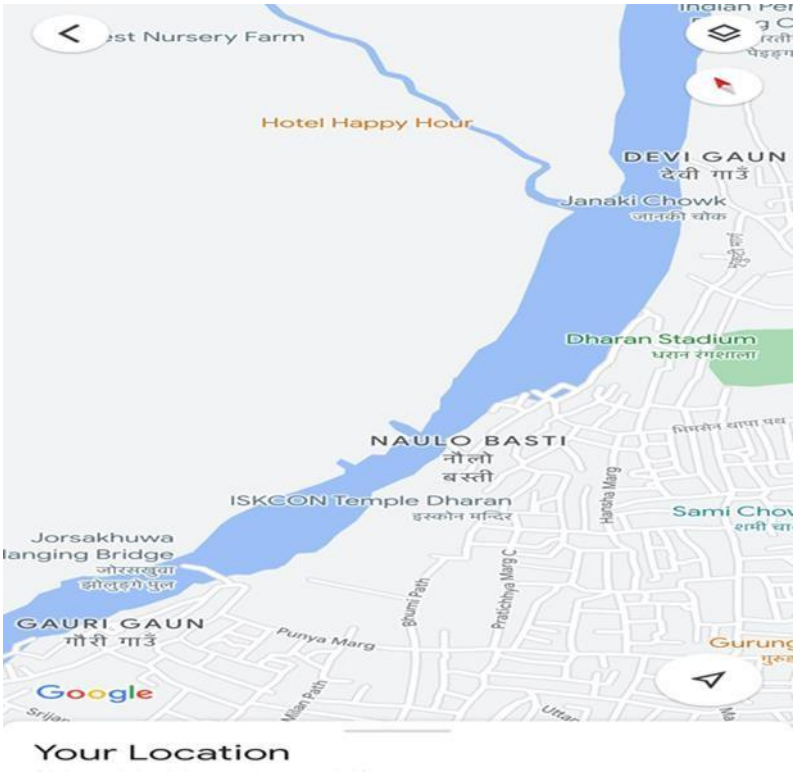


Figure 1.2 Map of study site

3.3 Study variables

3.3.1 Dependent variables

1) Body mass index (BMI): Based on WHO standards of classification for Asians, a BMI of 18.5-22.9 were classified as normal, with BMI of 23.0 to 27.5 kg/m² were classified as overweight; while those with a BMI greater or equal to 27.5 kg/m² were classified as obese (WHO, 2004).

2) Waist circumference: Men and women with waist circumference above 90 cm and 80 cm respectively were identified as being abdominally obese (IDF, 2006).

3) Waist to hip circumference: Men and women with waist to hip ratio greater than 0.90 and 0.85 were considered as abdominally obese respectively (WHO, 2008).

3.3.2 Independent variables

1. Socio-economic and demographic variables: age, sex, ethnicity, religion family size, family type, occupation, monthly income, education and family size.

2. Behavioral characteristics: Watching TV while eating foods, skipping breakfast, smoking, alcohol intake, and sleeping hours

3. Dietary habit: 24 hour dietary recall, food frequency, food habit related variables (vegetarian/non-vegetarian, skipping of meal, fast food consumption etc.)

4. Physical activity: From the IPAQ-short questionnaire, physical activity was classified into different levels as low, moderate and high.

3.4 Target population

People aged 18-70 residing in Sukhumbasi area of Dharan 11, 13 and 16.

3.5 Selection criteria

a) **Inclusion criteria**: The participants with following criteria were included in study:

1. Must be between 18-70 years old.

2. People who are permanent residence of Sukumbasi basti of Dharan 11, 13 and 16.

3. People who willingly signed consent forms

b) **Exclusion criteria:**

1. People who were not available at the time of survey.
2. People who were physically challenged, ill and pregnant.
3. People under below 18 years and above 70 years old.
4. People who do not want to participate in the study.

3.6 Sampling technique

Purposive sampling was applied to select Dharan city. Simple random sampling method was used and three wards Dharan 11, 13 and 16 were chosen. The total population was 45599 out of which 188 people were selected for the survey from sample size calculation. Random households were chosen and from each household, one person was selected in case of more than that lottery method was used for the survey.

3.7 Sample size

The sample size was determined by using a single proportional assuming the prevalence rate was 32%, 95% confidence interval (CI) 7% margin of error (d) and 10% non- response rate was added to the total calculated sample size.

The calculation of infinite sample size will be done by using the statistical formula,

$(n) = Z^2 * p(1-p)/d^2$

Where n = required sample size

Z = confidence interval at 95% (standard value of1.96) P = estimated prevalence of malnutrition among people. d=margin of error at 7% (standard value of 0.05)

i. calculation for the sample size. So, p=0.32

The prevalence rate of eating disorder is 32% 1-p=0.68 The sample will be obtained as below,

$(n) = Z^2 * p(1-p)/d^2$ = (1.96) ^2*0.32(0.68)/ (0.07) ^2 =170.059

Now1 the new sample size is further calculated below: - Let us assume the non -response rate is 10% Now the required size is =170.59+17.05 =187.64 =188

Hence, sample size for conducting this survey is 188.

3.8 Research instruments

Instruments used for the research work were:

a) Stadiometer: A well calibrated stadiometer, measuring up to 200 cm with least count of 0.1 cm, to assess the height of participants (Fryar *et al.*, 2021).

b) Digital weighing balance: A digital weighing balance (Micro life WS50), measuring up to 180 kg with least count of 0.1 kg (Fryar *et al.*, 2021).

c) Questionnaire: Well designed and pretested set of questionnaires to collect information on demographic variables, socio-economic condition along with food frequency table and 24-hour dietary recall sheet to study the food consumption pattern and nutrient intake of the targeted participants (Cade *et al.*, 2004).

d) Standardized utensils: Glass, bowls and photos of different foods (Mack *et al.*, 2019).

e) Blood pressure measuring devices: Stethoscope and Sphygmomanometer were used for blood pressure measurement (Tholl *et al.*, 2004).

3.9 Pre-testing

The prepared sets of questionnaire and anthropometric instruments were pre-tested among 5 people. Pre-testing was conducted in order to maintain accuracy and clarity of questionnaire, to check the consistency in interpretation of questions by respondents and to identify ambiguous item. After pre – testing all the ambiguous, misleading and wrongly interpreted questions will be omitted and questionnaire will be revised in accordance with the findings of pre-testing and suggestions.

3.10Validity and reliability of the research

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

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

3.11 Data collection techniques

Socio-demographic data was collected using semi-structured questionnaire and anthropometric measurement. Interview was done with the people to fill the questionnaire. Height and weight were measured by using stadiometer and digital weighing balance.

1) Weight: A digital weighing scale was used to measure weight. The scale was placed on flat surface. Shoes, socks and any other excess clothes were removed before measuring weight (WHO, 2017).

2) Height: For measuring the height of participants, stadiometer was used. Footwear, hat, hair ties and any other excess clothes were removed and participants were told to stand on the flat board and heels against the back board with their feet together and knees straight (WHO, 2017).

3) Waist and hip circumference: A measuring tape was used to measure waist and hip. : It was measured at the mid-point between the lower border of the rib cage and the iliac crest. Waist circumference was measured using a non-stretchable tape halfway between the lower border of ribs and the iliac crest on a horizontal plane, while ensuring that the tape was level around the body and parallel to the floor. Two measurements to the nearest 0.1cm were taken and the mean recorded (Eneje, 2023).

4) Blood pressure: Doctor Morepen sphygmomanometer was used to measure the blood pressure of the participants. The measurements were done in left arm two times separately and the subject was made to sit in a chair at a resting position for at least 5 minutes before measuring blood pressure. There was at least 5-10 minutes of gap before taking second measurement (Rajbanshi, 2019).

5) Physical activity: IPAQ (International Physical Activity Questionnaire) were asked to the participants to know their physical activity. Information on physical activity of the

participants included its type, intensity, duration and frequency in a week for the purpose of work, transportation and recreational activities (IPAQ, 2004).

6) Dietary intake: Food frequency questionnaire and 24 hour dietary recall were used to assess the dietary intake of the participants. Measuring cups, spoons and bowls were used to know the amount of food consumed by participants previous day. For FFQ, a list of food items and beverages were given to participants and asked if they had consumed this foods in 7 days and if yes then how many times a day (Thapa, 2019).

3.12 Data Analysis

After collecting and arranging the data, it was coded into the database using SPSS version 22 and Microsoft Excel 2016. Mean was used to describe the dietary intake of participants. ICMR was also used to find the RDA of calories, carbohydrates, protein and fat for every participant. Chi-square test were done to know the association between dependent and independent variables.

3.13 Ethical considerations

Before starting survey, permission to conduct study was received from Nutrition and dietetics department, Central Campus of Technology. From all the participants, an informed written and verbal consent was obtained. Collected data of participants was made sure to be kept private.

Part IV

Results and Discussions

To assess the nutritional status of adults residing in Sukumbasi Basti of Dharan, a cross-sectional study was done. A total number of 188 people participated in this study and the obtained results are well explained in the following topics:

4.1 Demographic and Socio-economic characteristics

On the basis of age, gender, ethnicity, family size, education and monthly income etc., the results are distributed on following sub-headings.

4.1.1 Age wise distribution

Majority of the participants were from the age group 31-40 years 51 (27.1%) while only 6 (3.2%) participants were from above 60 years of age. Age distribution of the study population is shown in table 4.1.

Table 4.1 Distribution of study population according to age (n=188)

Variables	**Frequency (n)**			**Percentage (%)**
	Male	**Female**	**Total**	
Age group				
>18-20	7 (8.8%)	2 (1.9%)	9	4.8
21-30	19 (23.8%)	29 (26.9%)	48	25.5
31-40	16 (20%)	35 (32.4%)	51	27.1
41-50	20 (25%)	23 (21.3%)	43	22.9
51-60	13 (16.3%)	18 (16.7%)	31	16.5
<70	5 (6.3%)	1 (0.9%)	6	3.2

4.1.2 Gender wise distribution

The study showed that there were more females participants accounting for 108 (57.4%) than males with only 80 (42.6%). This was because most of the male members were abroad for employment and most of the females were housewives. The distribution of gender of participants is shown in Table no. 4.2

Table 4.2 Distribution of study population according to gender (n=188)

Variables	**Frequency (n)**	**Percentage (%)**
Gender		
Female Male	108	57.4
	80	42.6

4.1.3 Religion and ethnicity wise

According to the table, 58.5% (110) participants were Hindus, 17.6% (33) were Buddhist and 15.4% (29) were Christian. Only 8.5% (16) were from other religion. A major percent of participants was Janjati 76.1% 143 while, only 3.2% (6) were Chhetri. 13.8% (26) were dalits and 6.9% (13) were Brahmin. The distribution of religion and ethnicity of participants is shown in Table no. 4.3

Table 4.3 Distribution of study population according to religion and ethnicity (n=188)

Variables	Frequency (n)			Percentage (%)
	Male	Female	Total	
Religion				
Hindu	46 (57.5%)	64 (59.3%)	110	58.5
Christian	12 (20%)	17 (15.7%)	29	15.4
Buddhist	16 (15%)	17 (15.7%)	33	17.6
Others	6 (7.5%)	10 (9.3%)	16	8.5
Ethnicity				
Janjati	65 (81.3%)	78 (72.2%)	143	76.1
Brahmin	4 (5%)	9 (8.3%)	13	6.9
Chhetri	4 (5%)	2 (1.9%)	6	3.2
Dalit	7 (8.8%)	19 (17.6%)	26	13.8

4.1.4 Family type

It was found that most of the participants lived in nuclear family i.e. 154 (81.9%) whereas 34 (19.1%) participants lived in joint family. Also, a major percent of participants 58.5% (110) lived in a house having family members less than 5 and 41.5% (78) participants lived in a house having family members less than 5. The distribution of family type and family size of participants is shown in Table no. 4.4

Table 4.4 Distribution of study population according to family size and type (n=188)

Variable	Frequency(n)			Percentage (%)
	Male	Female	Total	
Family type				
Nuclear	66 (82.5)	88 (81.5%)	154	81.9
Joint	14 (17.5%)	20 (18.5%)	34	19.1
Family size				
<5	50 (62.5%)	60 (55.6%)	110	58.5
≥5	30 (37.5%)	48 (44.4%)	78	41.5

4.1.5 Marital status

From the table, it was found that a large number of participants 163 (86.7%) were married and only 25 (13.3%) were single. The distribution of marital status of participants is shown in Table no. 4.5

Table 4.5 Distribution of study population according to marital status (n=188)

Variables	Frequency (n)			Percentage (%)
	Male	Female	Total	
Marital status				
Single	19 (23.8%)	6 (5.6%)	25	13.3
Married	61 (76.3%)	102 (94.4%)	163	86.7

4.1.6 Socioeconomic factors

Monthly income category was based on analysis of monthly expenses by (Sharma, 2016). Out of 188 participants, 51.6% (97) participants were literate and then secondary education with 21.3% (40). A minority of participants had received higher secondary and above, accounting for 11.2% (21) and 16% (30) of proportion were illiterate. Large number of participants had monthly income less than 15 thousand, accounting for 70.2% (132) and small number of participants, i.e. 29.8% (56, had monthly income more than 15 thousand.

The study showed that 82.4% (151) participants were involved in low physical demanding job like with business, tailor, service, shops and other semi-skilled jobs. A least percent i.e. 17.6% (33) were involved in high physical demanding job like labor and farming. The distribution of socioeconomic factors of participants is shown in Table no. 4.6

Table 4.6: Distribution of study population according to socioeconomic factors (n=188)

Variables	Frequency (n)			Percentage (%)
	Male	Female	Total	
Education				
Illiterate	8 (10%)	22 (20.4%)	30	16
Literate	39 (48.8%)	58 (53.7%)	97	51.6
Secondary school	20 (25%)	20 (18.5%)	40	21.3
Higher level and above	13 (16.2%)	8 (7.4%)	21	11.2
Monthly income				
≤15 thousand	24 (30%)	32 (29.6%)	56	29.8
> 15 thousand	56 (70%)	76 (70.3%)	132	70.2
Occupation				
Low physical	54 (67.5%)	101 (93.6%)	151	82.4
High physical	26 (32.5%)	7 (6.5%)	33	17.6

4.2 Physical activity

Short IPAQ questionnaire was used in order to assess the physical activity level. Subjects were categorized to do low, moderate and vigorous physical activity. Most of the participants were found to do moderate physical activity i.e. 49% (92) whereas only 16.52% (31) did low physical activity and about 34.57% (65) did high physical activity.

Similarly, it was found that 87.8% (165) had adequate physical activity (≥1500mins/week) while only 12.2% (23) performed inadequate physical activity (< 1500mins/week). The distribution of physical activity of participants is shown in Table no. 4.7

Table 4.7: Distribution of study population according to physical activity (n=188)

Variable	**Frequency (n)**			**Percentage (%)**
	Male	**Female**	**Total**	
Physical activity level				
Low	11 (13.75%)	20 (18.51%)	31	16.52
Moderate	37 (46.3%)	55 (50.9%)	92	49
High	32 (39.95%)	33 (30.59%)	65	34.57
Adequacy of physical Activity				
Adequate	71 (88.8%)	94 (87%)	165	87.8
Inadequate	9 (11.3%)	14 (13%)	23	12.2

4.3 Diabetes and Hypertension present

The result showed that large percentage of participants did not have diabetes i.e. 89.4% (168), only 10.6% (20) had diabetes. Similarly, majority of participants 63.3% (69) had hypertension whereas 36.7% (119) did not have hypertension. The distribution of diabetes and hypertension of participants is shown in Table no. 4.8

Table 4.8: Distribution of study population according to diabetes and hypertension present (n=188)

Variable	Frequency (n)			Percentage (%)
	Male	Female	Total	
Diabetes				
Yes	10 (12.5%)	10 (9.3%)	20	10.6
No	70 (87.5%)	98 (90.7%)	168	89.4
Hypertension				
Yes	37 (46.25%)	32 (29.62%)	69	63.3
No	43 (53.75%)	76 (70.37%)	119	36.7

4.4 Behavioral characteristics

According to this table, it was found that maximum number of participants had high stress accounting for 71.3% (134) and only 28.7% (54) of participants had low stress. Meanwhile, 56.4% (106) of participants slept between 7-8 hours while, 28.2% (53) slept more than 8 hours and 15.4% (28.2) slept less than 7 hours. Similarly, 39.36% (74) of participants never watched TV while eating food, 25.53% (48) watched TV once a week while eating, 20.21% (38) twice a week and 14.89% (28) daily.

Nearly, 40% (74) of participants had skipped their breakfast daily whereas 30.32% (57) never skipped breakfast, 18.08% (34) had skipped breakfast twice/thrice a week and 12.23% (23) had skipped their breakfast once a week. A large proportion of participants i.e. 70.2% (132) did not drink alcohol. However, only 29.8% (56) drank alcohol. The distribution of diabetes and hypertension of participants is shown in Table no. 4.9

Table 4.9: Distribution of surveyed population by behavioral characteristics (n=188)

Variable	Frequency (n)			Percentage (%)
	Male	Female	Total	
Stress				
High	21 (26.3%)	33 (30.6%)	54	28.7
Low	59 (73.8%)	75 (69.4%)	134	71.3
Sleeping hours				
<7	15 (18.8%)	14 (13%)	29	15.4
7-8	46 (57.5%)	60 (55.6%)	106	56.4
>8	19 (23.8%)	34 (31.5%)	53	28.2
Smoking				
Yes	27 (33.8%)	13 (12%)	40	21.3
No	53 (66.3%)	95 (88%)	148	78.7
Eating in front of TV				
Daily	8 (10%)	20 (18.51%)	28	14.89
Twice a week	15 (18.75%)	23 (21.28%)	38	20.21
Once a week	27 (33.75%)	21 (19.44%)	48	25.53
Never	30 (37.5%)	44 (40.74%)	74	39.36
Skipping breakfast				
Daily	32 (40%)	42 (38.89%)	74	39.36

Twice/Thrice a Week	15 (18.75%)	19 (17.59%)	34	18.08
Once a week	11 (13.75%)	12 (11.11%)	23	12.23
Never	22 (27.5%)	35 (32.40%)	57	30.32
Drinking				
Alcohol				
Yes	40 (50%)	16 (14.8%)	56	29.8
No	40 (50%)	92 (85.2%)	132	70.2

4.5 Dietary Intate

4.5.1 Dietary characteristics

It was found that majority of participants, 91.5% (172) were having excess salt intake as per recommendation given by WHO and only 8.5% (16) had optimum salt intake. Similarly, almost every participant i.e. 96.8% (182) were non-vegetarian and only 3.2% (6) were vegetarian. The distribution of dietary characteristics of participants is shown in Table no. 4.10

Table 4.10: Distribution of study population according to dietary characteristics (n=188)

Variable	Frequency (n)			Percentage (%)
	Male	Female	Total	
Salt intake/day				
<5gm	4 (5%)	12 (11.1%)	16	8.5
> 5gm	76 (95%)	96 (88.9%)	172	91.5
Type of diet				
Vegetarian	3 (3.8%)	3 (2.8%)	6	3.2
Non vegetarian	77 (96.3%)	105 (97.2%)	182	96.8

4.5.2 Dietary intake in 24-hour dietary recall

The table below illustrates that, 92.6% (174) participants had consumed inadequate calories in their previous day. 5.9% (11) had adequate calorie and only 1.6% (3) had excess calorie. The mean calorie intake of the participants was found to be 1492.46±458.09 kilocalories which was lower than the minimum average adequate requirement of 2220 kilocalories set by ICMR 2020. Calorie intake were mostly inadequate because most people had skipped their meals mostly breakfast and then directly had lunch. Sometimes they would skip snacks also and directly ate dinner.

A large percentage of participants, 90% (169) consumed carbohydrates in excess amount than the recommended amount while, 5.9% (110) and 4.3% (8) consumed in adequate and low amount. The mean carbohydrate intake was found to be 243±184.05 grams. Interestingly, more than half percent of participants i.e. 60.6% (114) had low protein intake, 10.6% (20) had adequate protein and 28.7% (54) had high protein intake. The mean protein intake was found to be 42.94±14.34 grams. It was found that a number of participants did not consume dal which is a good source of protein. It was revealed that majority of participants had high fat intake, accounting for 57.4% (108) whereas 31.4% (59) had low fat

intake and only 11.2% (21) ate foods low in fats. The mean fat intake of participants was found to be 36.73±16 grams. The distribution of dietary intake in 24-hour dietary recall of participants is shown in Table no. 4.11

Table 4.11: Distribution of study population according to dietary intake in 24-hour dietary recall (n=188)

Variable	**Frequency (n)**			**Percentage (%)**
	Male	**Female**	**Total**	
Calorie				
Inadequate	78 (97.5%)	96 (88.9%)	174	92.6
Adequate	2 (2.5%)	9 (8.3%)	11	5.9
Excess	0	3 (2.8%)	3	1.6
Carbohydrates				
Low	3 (3.7%)	5 (4.6%)	8	4.3
Adequate	5 (6.3%)	6 (5.6%)	11	5.9
High	72 (90%)	97 (89.8%)	169	89.9
Protein				
Low	56 (70%)	58 (53.7%)	114	60.6
Adequate	6 (7.5%)	14 (13%)	20	10.6
High	18 (22.5%)	36 (33.33%)	54	28.7
Fat				
Low	3 (38.8%)	28 (25.9%)	59	31.4
Adequate	11 (13.8%)	10 (9.3%)	21	11.2
High	38 (47.5%)	70 (64.8%)	108	57.4

4.5.3 Food frequency questionnaire

The consumption of food items were considered “regular” if consumed daily for at least once, “frequent” when ingested 3-4 times a week, “rare” if consumed once a week or less and “never” if not consumed at all. Since, rice is our staple cereal grain, all participants consumed rice daily. Maize/barley/millet were eaten by 6.9% (13) of participants regularly, 12.8% (24) frequently, 80.3% (151) rarely. Majority of participant i.e. 84.6% (159) ate pulses and legumes regularly while 14.5% (27) of participants ate frequently. Pulses/legumes were eaten rarely by 1% (2). Milk and milk products were consumed by 27.7% (52) of participants regularly then by 22.9% (43) frequently, 29.8% (56) rarely and 19.7% (37) never ate them. Nearly half percent of participants, 48.9% (92) consumed GLV regularly while 46.3% (38) consumed frequently. Participants of total 78.7% (148) ate other vegetables regularly on a daily basis, 20.2% (38) ate frequently while, 1.1% (2) rarely ate other vegetables. Eggs were eaten by 4.8% (9) of participants regularly, 28.42% (53) frequently, 53.7% (101) rarely and 13.3% (25) never ate egg. A majority of participants ate red meat rarely i.e. 54.3% (102) and then frequently 33% (62) while, white meat was eaten by 9.6% (18) regularly and 3.2% (6) never ate white meat. A large participants ate white meat occasionally which was 56.4% (106).

From the table, it was found that tea and coffee were drank by 63.3% (119) on a daily basis while 6.4% (13), 10.6 % (19) and 19.7% (37) of participants drank frequently, rarely and never drank tea or coffee. Fruits were eaten by 11.2% (21) on a regular basis whilst 25.5% (48), 63.3% (119) ate frequently and rarely. Salads were rarely eaten by participants, 41.5% (77) and only 20.7% (39) regularly ate salads. 11.7% (22), 35.1% (66), 39.9% (75) of participants ate fast foods regularly, frequently and rarely while 13.3% (25) never ate outside foods. 67.6% (127) of participants rarely drank cold drinks whereas 5.9% (11) and 7.4% (14) regularly and frequently drank processed drinks. However, 19.1% (36) never drank cold drinks. The distribution of food frequency questionnaire of participants is shown in Table 4.12

Table 4.12: Distribution of study population according to food frequency questionnaire (n=188)

Variable	Frequency (n)			Percentage (%)
	Male	Female	Total	
Rice				
Regular	80 (100%)	108 (100%)	188	100
Wheat				
Regular	25 (31.3%)	22 (20.4%)	47	25
Frequent	31 (38.8%)	62 (57.4%)	93	49
Rare	24 (30%)	24 (22.2%)	48	25.5
Maize/Barley/Millet				
Regular	7 (8.8%)	6 (5.6%)	13	6.9
Frequent	10 (12.5%)	14 (13%)	24	12.8
Rare	63 (78.8%)	88 (81.5%)	151	80.3
Pulses/Legumes				
Regular	72 (90%)	87 (80.6%)	159	84.5
Frequent	8 (10%)	19 (17.6%)	27	14.5
Rare		2 (1.8%)	2	1
Milk and milk products				
Regular	23 (28.7%)	29 (26.9%)	52	27.7
Frequent	16 (20%)	27 (25%)	43	22.9
Rare	26 (32.5%)	30 (27.8%)	56	29.8

Never	15 (18.8%)	22 (20.4%)	37	19.7
Green leafy vegetables				
Regular	38 (47.5%)	54 (50%)	92	48.9
Frequent	38 (47.5%)	49 (45.4%)	87	46.3
Rare	4 (5%)	5 (4.6%)	9	4.8
Other vegetables				
Regular	63 (78.8%)	85 (78.7%)	148	78.7
Frequent	17 (21.3%)	21 (19.4%)	38	20.2
Rare	0	2 (1.9%)	2	1.1
Eggs				
Regular	2 (2.5%)	7 (6.5%)	9	4.8
Frequent	25 (31.3%)	28 (25.9%)	53	28.2
Rare	43 (53.8%)	58 (53.7%)	101	53.7
Never	10 (12.5%)	15 (13.9%)	25	13.3
Red meat				
Regular	9 (11.3%)	9 (8.3%)	18	9.6
Frequent	25 (31.3%)	37 (34.3%)	62	33
Rare	43 (53.8%)	59 (54.6%)	102	54.3
Never	3 (3.8%)	3 (2.8%)	6	3.2
White meat				
Regular	3 (3.8%)	2 (1.9%)	5	2.7
Frequent	32 (40%)	39 (36.1%)	71	37.8

Rare	42(52.5%)	64 (59.3%)	106	56.4
Never	3 (3.8%)	3 (2.8%)	6	3.2
Tea/Coffee				
Regular	50 (62.5%)	69 (69.3%)	119	63.3
Frequent	9 11.3%)	4 (3.7%)	13	6.4
Rare	6 (7.5%)	13 (12%)	19	10.6
Never	15(18.8%)	22 (20.4%)	37	19.7
Fruits				
Regular	13 (16.3%)	8 (7.4%)	21	11.2
Frequent	16 (20%)	32 (29.6%)	48	25.5
Rare	51 (63.8%)	68 (62.9%)	119	63.3
Salads				
Regular	14 (17.5%)	24 (23.1%)	39	20.7
Frequent	17 (21.3%)	9 (8.3%)	26	13.8
Rare	32 (40%)	45 (41.7%)	77	41.5
Never	17 (21.3%)	29 (26.9%)	46	24.5
Fast foods				
Regular	16 (20%)	6 (5.6%)	22	11.7
Frequent	28 (35%)	38 (35.2%)	66	35.1
Rare	21 (26.3%)	54 (50%)	75	39.9
Never	15 (18.8%)	10 (9.3%)	25	13.3

Cold drinks and juices				
Regular	7 (8.8%)	4 (3.7%)	11	5.9
Frequent	8 (10%)	6 (5.6%)	14	7.4
Rare	45 (56.3%)	82 (75.9%)	127	67.6
Never	20 (25%)	16 (14.8%)	36	19.1

4.6 Prevalence of underweight, normal, overweight and obesity

4.6.1 BMI of participants according to Asian BMI cut off

BMI was analyzed by using WHO for Asian BMI cut-off, it was revealed that more than half of participants were obese i.e. 53.2% (100) while, 13.3% (25) were overweight and 29.3% (55) were normal. Only 4.3% (8) of them were underweight. This result was slightly lower than proportion of underweight of 5.7%, whereas in the case of overweight and obese the percent was slightly higher accounting for, 49.7% among adult population in Dharan in 2018 (Bhandari, 2018). According to the report of NDHS 2016, the Asian-specific BMI cutoffs the prevalence rate of underweight in Nepal was found to be 16.7% while, overweight and obese was found to be 26.4% and 11%.The mean BMI among study population was found to be 25.56±4.93 kg/m^2. The distribution of BMI of participants is shown in figure 1.3

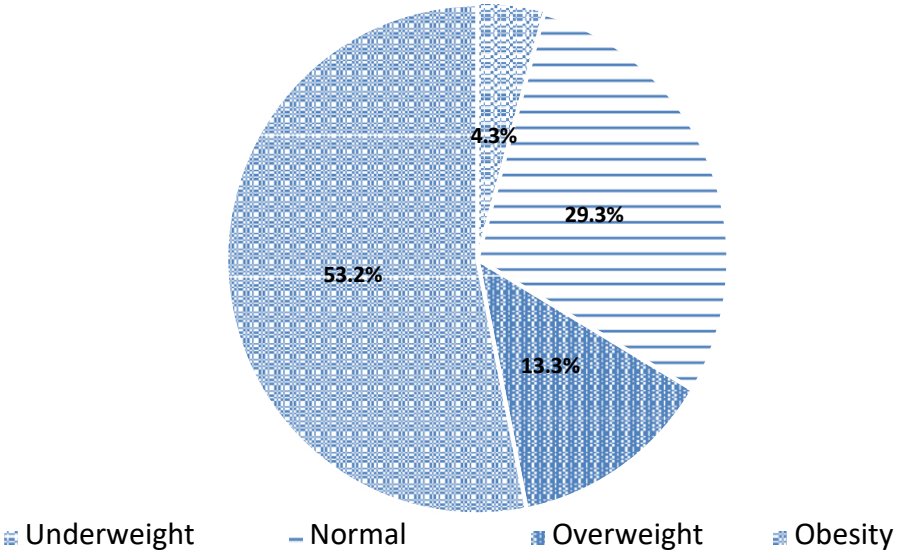


Figure 1.3: Prevalence of nutritional status in 18-70 aged adults residing in Sukumbasi basti, Dharan by Asian BMI cut-offs

4.6.2 BMI according to gender

Out of 80 males, nearly half percent of males i.e. 42.5% (34) were obese while, 8.8% (7) were underweight, 40% (32) were normal and 8.8% (7) were overweight. According to the NDHS report of 2016, 15.1% among males and 17.1% among females were underweight and the prevalence rate of overweight and underweight was found to be 26.4% (27.4% among males and 25.6% among females) and 11.0% (7.7% among males and 13.3% among females), respectively (Al Kibria, 2019). Our results can be compared with the study result found in study done gender differences in factors associated with nutritional status among adults in Dharan where female were more overweight and obese which was 52.40% and high number of male were underweight and normal (Bhandari, 2018). In case of female, a huge percentage of females were obese, accounting for 61.1% (66).Only 1 female participant was found to be underweight. 21.3% (23) had normal weight and 16.7% (18) were overweight. The distribution of BMI of participants according to gender is shown in figure 1.4

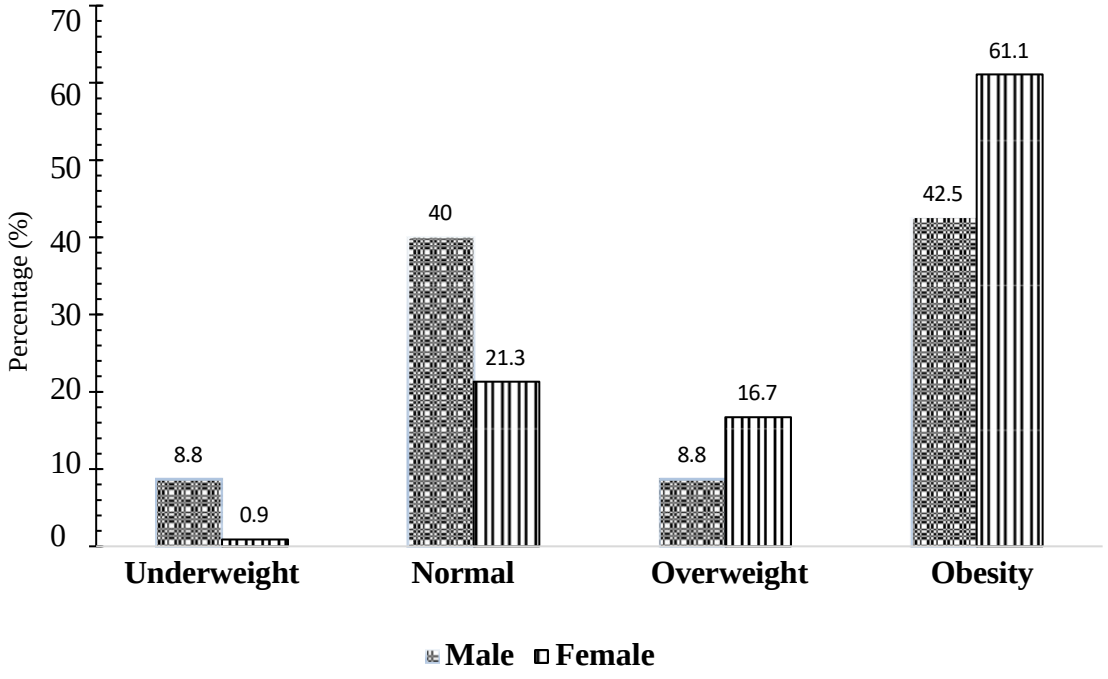


Figure 1.4: Prevalence of nutritional status in 18-70 aged adults residing in Sukumbasi basti, Dharan according to gender

4.6.3 According to waist circumference

From the data analysis, it was found that 41.1% (83) of participants had normal waist circumference while, 55.9% (105) had abdominal obesity. This result was less than

prevalence of abdominal obesity among adult population in Itahari which was 58.50% (60.4% females and 56.8% males) (Khanal, 2022). A study done in Ramdhuni municipality revealed that 59.9% adults residing there were found to be abdominally obese which was slightly higher than our study (Chaudhary, 2020).The mean waist circumference was found to be 89.6±13.4. The prevalence of abdominal obesity according to WC is shown in Figure 1.5

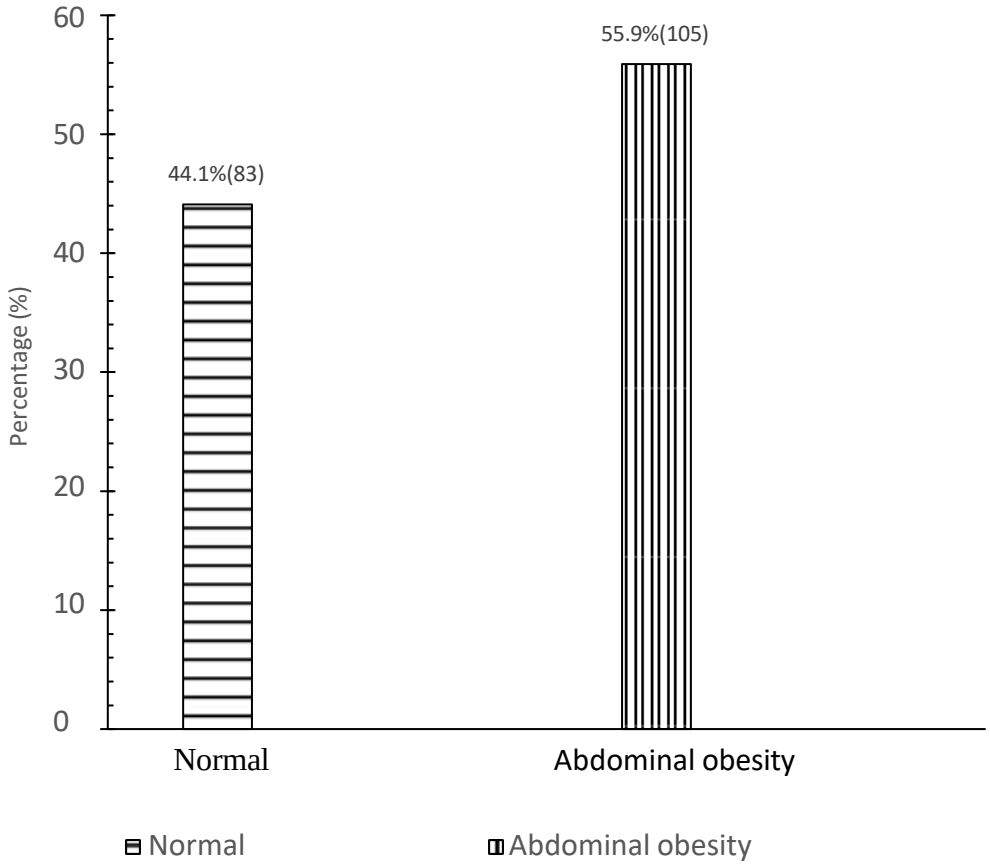


Fig 1.5: Prevalence of Abdominal obesity according to WC

4.6.4 According to waist hip ratio

According to waist-to-hip ratio, the prevalence of abdominal obesity was found to be 57.4% (108) while, the remaining 42.6% (80) had normal WHR ratio (less than 0.85 for females and less than 0.90 for males).). The result was higher than the prevalence of central obesity of 47.56% among adult population of Kathmandu (Silvanus *et al.*, 2018) but lower than 63.6% adults having high WHR according to STEPS survey (Dhimal *et al.*, 2020). Majority of males had normal ratio i.e. 62.5% (50) and only 37.5% (30) had abdominal obesity. In

case of females, large percent had abdominal obesity, accounting for 72.2% (78) whereas 27.8% (30) had normal waist-to-hip ratio. The mean WHR was found to be 0.90±0.079. The prevalence of abdominal obesity according to WHR is shown in Figure 1.6

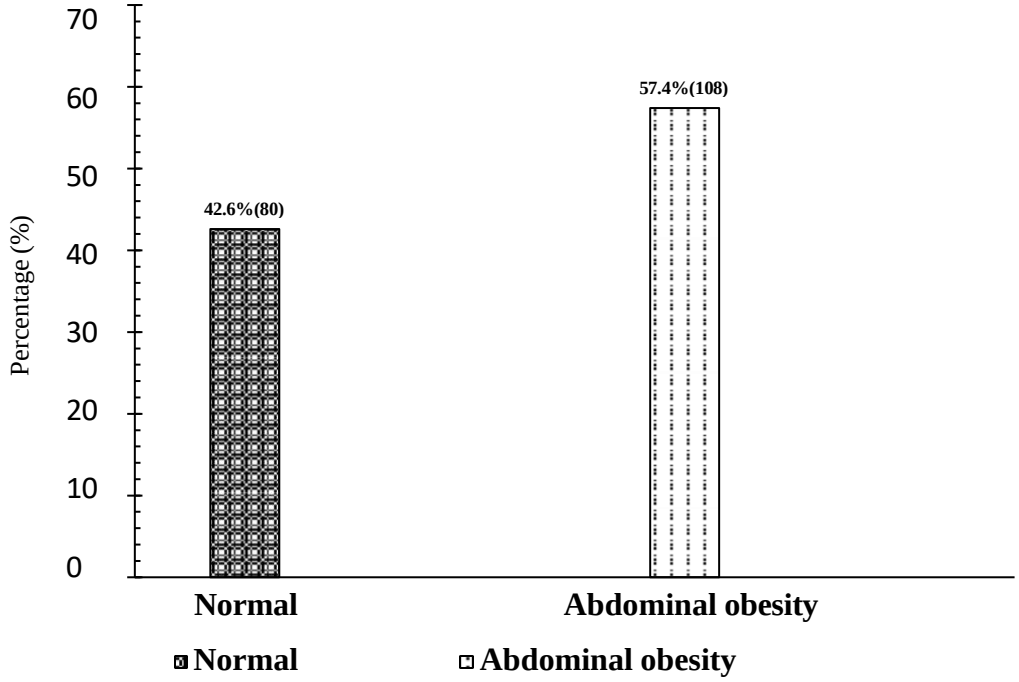


Fig 1.6: Prevalence of Abdominal obesity according to WHR

4.7 Factors associated with nutritional status

4.7.1 Factors associated with BMI

Chi-square analysis was done to identify risk factors associated with nutritional status. It was found that age (P<0.001), gender (P<0.001), physical activity (P=0.010), type of diet (P=0.002), marital status (P<0.001), drinking alcohol (P=0.043), hypertension (P=0.012) and white meat (P=0.024) showed association with BMI while wheat (P=0.005) and red meat (P=0.058) showed closed association with BMI.

The result showed that BMI increases with age which is why most of the people aged between 31-40 years were overweight/obese and adults above 18 and below 20 years of age had normal weight and less prone to overweight. A study done in Bhaktapur in 2015-2017 showed that age was positively associated with BMI in both groups (Schwinger *et al.*, 2020). According to the table, it was revealed that a huge majority of females were overweight and

obese as compared to males. This result is supported by a study done in India where women were found to be more obese as compared to men (Dewan, 2008). Obesity is more prevalent in women than men in most countries, but in some countries and population subgroups, this gap is more pronounced. Women, compared to men, are more likely to be diagnosed with obesity and seek and obtain all types of obesity treatment including behavioral, pharmacological, and bariatric surgery (Cooper *et al.*, 2021).

From the table, it was clear that participants who did moderate and low physical activity were overweight and obese. This result is supported by a study done in China where decrease in physical fitness leads to increase in overweight or obesity in Chinese adults (Tian *et al.*, 2016). Most of the adults residing in this area were found to be non-vegetarian and there is positive association between type of diet and BMI. A similar study was done in North America which showed that all variants of vegetarian diets (vegan, lacto-ovo, and pesco- and semi-vegetarian) were associated with substantially lower BMI and lower risk of type 2 diabetes than non-vegetarian diets (Tonstad *et al.*, 2009). This study proved that marital status and BMI are connected. To show association between these two, a survey was conducted in Korea and the results showed that prevalence of underweight was higher in unmarried men and women or divorced/separated than in married individuals and married participants showed a higher prevalence of obesity and abdominal obesity than those in other marriage categories except for widowed women (J. Lee *et al.*, 2020).

The study showed association between BMI and drinking alcohol. A review by Yeomans, highlights some of the potential explanations for alcohol's influence on weight gain or obesity. First, energy from alcohol appears to be additive to energy from other sources. Beyond adding energy to a meal, alcohol may actually stimulate food intake and supports the study that drinking alcohol promotes weight gain (Yeomans, 2010). Hypertension is more common among the obese than among the nonobese and, conversely, a significant proportion of hypertensive persons in the population are overweight (Chiang *et al.*, 1969). In a formal survey carried out in the adult general population of Uruguay found that association between obesity and hypertension forms part of a broader relationship between body weight and blood pressure (BP) (Diaz, 2002).

Table 4.13: Factors associated with BMI among the Sukumbasi residents of Dharan (n=188)

Variables	Underweight	Normal	Overweight	Chi-square	P-value
Age					
>18-20	3 (33.33%)	4 (44.44%)	2 (22.22%)	42.442	<0.001*
21-30	1 (2.08%)	25 (52.08%)	22 (45.83%)		
31-40	1 (1.69%)	11 (21.56%)	39 (76.47%)		
41-50	2 (4.65%)	10 (23.25%)	31 (72.09%)		
51-60	1 (3.22%)	5 (16.12%)	25 (80.64%)		
<70	0	0	6 (100%)		
Gender					
Male	7 (8.75%)	32 (40%)	41 (51.25%)	16.971	<0.001*
Female	1 (0.96%)	23 (21.30%)	84 (77.81%)		
Physical activity					
High	4 (6.15%)	29 (44.61%)	32 (49.23%)	13.346	0.010*
Moderate	3 (3.27%)	19 (20.65%)	70 (76.08%)		
Low	1 (3.23%)	7 (22.58%)	23 (74.19%)		
Type of diet					
Veg	2 (33.33%)	1 (16.67%)	3 (50%)	12.904	0.002*
Non-veg	6 (3.3%)	54 (29.67%)	122 (67.03%)		
Marital status					
Single	4 (16%)	14 (56%)	7 (28%)	22.821	<0.001*

Married	4 (2.45%)	41 (25.15%)	118 (72.4%)		
Drinking alcohol					
Yes	4 (7.14%)	22 (39.28%)	30 (53.58%)	6.307	0.043*
No	4 (3.03%)	33 (25%)	95 (71.97%)		
Hypertension					
Yes	7 (5.88%)	42 (35.29%)	70 (58.82%)	8.924	0.012*
No	1 (1.44%)	13 (18.84%)	55 (79.71%)		
Carbohydrates					
Low	2 (3.87%)	20 (46.7%)	35 (49.43%)		
Adequate	6 (4.28%)	19 (26.32%)	55 (69.4%)	2.709	0.08
High	2 (3.54%)	16 (29.27%)	33 (67.19%)		
Wheat					
Regular	5 (10.63%)	12 (25.53%)	30 (63.82%)	9.313	0.05
Frequent	2 (2.15%)	24 (258%)	67 (72.04%)		
Rare	1 (2.08%)	19 (39.58%)	28 (58.33%)		
Red meat					
Regular	1 (5.56%)	6 (33.33%)	11 (61.11%)	18.118	0.058
Frequent	2 (3.22%)	12 (19.35%)	48 (77.41%)		
Rare	3 (2.94%)	36 (35.29%)	63 (61.76%)		
Never	2 (33.33%)	1 (16.67%)	3 (50%)		

White meat					
Regular	0	1 (20%)	4 (80%)	14.521	0.024*
Frequent	3 (4.22%)	24 (33.80%)	44 (61.97%)		
Rare	3 (2.83%)	29 (27.35%)	74 (69.81%)		
Never	2 (33.33%)	1 (16.67%)	3 (50%)		

*statistically significant ($p<0.05$)

After fat and fructose, it is now suggested that wheat is a main cause for obesity (Brouns *et al.*, 2013). A study done in the University of Adelaide, Australia that obesity prevalence is positively associated with wheat availability number of studies suggested that wheat consumption contributes to obesity prevalence in several ways including its use in energy dense and refined products (You and Henneberg, 2016). Red meat and white meat are associated with BMI. Meats are high in energy and fat content, and thus may be associated with higher risk of obesity (Y. Wang and Beydoun, 2009). A study conducted in China showed that participants in the moderate or higher level of red meat consumption were more likely to have excess body weight. A cross-sectional study conducted in Iran revealed that higher intakes of white meat and poultry are associated with increased risk of general obesity, while, processed meat consumption was associated with central obesity (Xu *et al.*, 2007).

4.7.2 Factors associated with waist circumference

The table below showed that age ($p<0.001$), gender (($p<0.001$), marital status ($p<0.001$), physical activity ($p=0.036$), education ($p<0.001$), drinking alcohol ($p=0.003$), smoke ($p=0.0035$) were significantly associated with abdominal obesity while fat intake showed close association.

Age was positively associated in the study conducted by health survey in England revealed that prevalence of abdominal obesity was higher in people aged 70-89 years old (Howel, 2012). Gender was also associated with waist circumference. Similar kind of report was presented in Korea where abdominal obesity was found higher in females than males (Choo *et al.*, 2014). The positive relationship between marital status and overweight, obesity, or abdominal obesity can be explained by the fact that people, after marriage have less physical

activity, change their dietary pattern, may be less focused on being attractive, have more social support, or may be exposed to other environmental factors. This result is supported by a study conducted in Iran where marital status was associated with a significantly higher risk of overweight, obesity, and abdominal obesity in both men and women; the associations for women were stronger (Janghorbani *et al.*, 2008).

Table 4.14: Factors associated with abdominal obesity (WC) among the Sukumbasi residents of Dharan (n=188)

Variables	**Normal**	**WC**	**Chi-square**	**P-value**
Age				
>18-20	9 (100%)	0	30.301	<0.001*
21-30	32 (66.67%)	16 (33.33%)		
31-40	15 (29.41%)	36 (70.58%)		
41-50	14 (32.55%)	29 (67.44%)		
51-60	12 (38.7%)	19 (61.3%)		
>60	1 (16.67%)	5 (83.33%)		
Gender				
Male	56 (70%)	24 (30%)	22.66	<0.001*
Female	27 (25%)	81 (75%)		
Marital status				
Single	24 (96%)	1 (4%)	31.439	<0.001*
Married	59 (36.2%)	104 (63.8%)		
Physical activity				

High	37 (56.92%)	28 (43.08%)	6.636	0.036*
Moderate	35 (38.04%)	57 (61.96%)		
Low	11 (35.48%)	20 (64.5%)		
Education				
Illiterate	5 (16.67%)	25 (83.33%)	21.436	<0.001*
Literate	39 (40.2%)	58 (59.8%)		
Secondary	23 (57.5%)	17 (42.5%)		
Higher secondary	16 (76.2%)	5 (23.8%)		
Drinking alcohol				
Yes	34 (60.71%)	22 (39.28%)	8.876	0.003*
No	49 (37.12%)	83 (62.88%)		
Smoke				
Yes	25 (58.13%)	18 (41.86%)	4.426	0.035*
No	58 (40%)	87 (60%)		
Fat				
Low	20 (33.89%)	39 (66.11%)	5.401	0.06
Adequate	13 (61.9%)	8 (38.1%)		
High	50 (46.29%)	58 (53.71%)		

*statistically significant ($p<0.05$)

Despite having many participants doing moderate physical activity, abdominal obesity was found to be high in this group. A research done in participants aged between 45 and 79 years, resident in Norfolk, UK, found that men and women who were inactive were characterized by higher levels of abdominal obesity as quantified by waist circumference, than active individuals (Arsenault *et al.*, 2010). The high energy content of alcohol makes its consumption a potential contributor to the obesity epidemic. A study conducted in Spain found that drinking alcohol was associated with risk of abdominal obesity (Schröder *et al.*, 2007). Cigarette smoking is associated with higher serum levels of cholesterol and lower plasma concentrations of high-density lipoprotein cholesterol which is proved by a

research done in USA (Berlin, 2008). A cross-sectional survey done in Ghana found positive association between abdominal obesity and dietary fat intake (Suara *et al.*, 2020).

4.7.3 Factors associated with WHR

From the table below, it was found that age ($p<0.001$), gender ($p<0.001$), marital status ($p<0.001$), education ($p<0.001$), blood pressure ($p=0.002$) and drinking alcohol ($p=0.008$) were significantly associated with BMI.

A survey conducted by WHO in 2008 proved that in both, men and women, waist and waist-to-hip ratio increase with age. A large portion of this increase is driven by gains in body weight, but the increases observed are larger than those that would be predicted from increases in the body mass index alone, and increases in WC are seen with aging in the absence of weight gain (Stevens *et al.*, 2010). Gender is associated with WHR which is supported by a study done among adults Nigerians where females have high WHR as compared to males (Odenigbo *et al.*, 2011). Research done in participants aged between 24 and 74 years, in Hong Kong Chinese population found that waist circumference and waist to hip ratio was lower in both single men and women as they had lower nutrient densities of vitamin D and iron, and lower consumption of vegetables and fish (Woo *et al.*, 1999).

A study done in Finland showed positive relation between gender and WHR ratio such that the WHR increased in all education-level groups, the lowest WHR being among those with the highest education (Lahti-Koski *et al.*, 2000). A cross-sectional study was carried out in Manipal College of Medical Sciences between December 2017 to February 2018 showed that Waist to Hip Ratio have stronger correlation with blood pressure components than Body Mass Index even in normal subjects where SBP was positively correlated with Waist by Hip ratio and DBP was positively correlated with Waist Circumference (Chaudhary, 2020). A cross-sectional study done in France proved that consumption of alcoholic beverages increases waist to hip ratio as it may be a risk factor for obesity in future (Lukasiewicz *et al.*, 2005).

Table 4.15: Factors associated with abdominal obesity (WHR) among the Sukumbasi residents of Dharan (n=188)

Variables	Normal	WHR	Chi-square	P-value
Age				
>18-20	9 (100%)	0	42.883	<0.001*
21-30	35 (72.91%)	13 (27.08%)		
31-40	14 (27.45%)	37 (72.54%)		
41-50	13 (30.23%)	30 (69.76%)		
51-60	8 (25.8%)	23 (74.19%)		
>60	1 (16.67%)	5 (83.33%)		
Gender				
Male	50 (62.5%)	30 (37.5%)	22.66	<0.001*
Female	30 (27.78%)	78 (72.2%)		
Marital status				
Single	23 (92%)	2 (8%)	28.840	<0.001*
Married	57 (34.96%)	106 (65.03%)		
Education				
Illiterate	6 (20%)	24 (80%)	18.352	<0.001*
Literate	37 (38.14%)	60 (61.85%)		
Secondary	21 (52.5%)	19 (47.5%)		

Higher secondary	16 (76.19%)	5 (23.81%)		
Blood pressure				
Normal	61 (51.26%)	58 (48.73%)	10.056	0.002*
High	19 (27.53%)	50 (72.46%)		
Drinking alcohol				
Yes	32 (57.14%)	24 (42.85%)	6.945	0.008*
No	48 (36.37%)	84 (63.63%)		

*statistically significant ($p<0.05$)

Part V

Conclusions and recommendation

5.1 Conclusions

In order to know the prevalence of nutritional status and identify the risk factors associated with it among adults residing in Sukumbasi basti of Dharan sub-metropolitan city, a cross-sectional study was conducted. From the study, following are the conclusions of this study:

1) It was showed that 4.3% were underweight, 29.3% were normal, 13.3% were overweight and 53.2% were obese according to Asian BMI classification.

2) Compared to women, men were found to be underweight and overweight/obesity was found to be higher in females.

3) On the basis of waist circumference, abdominal obesity was found to be higher in females than males. Similarly, abdominal obesity is highest in females than males in accordance to waist to hip ratio.

4) The study showed that age, gender, physical activity, type of diet, marital status, drinking alcohol hypertension and white meat were significantly associated with BMI.

5) Age, gender, marital status, physical activity, education, drinking alcohol and smoke were found to have relation with abdominal obesity due to WC while, age, gender, marital status, education, blood pressure and drinking alcohol were associated with WHR.

5.2 Recommendations

1) Encourage people to do physical activity.

2) Since only dietary habits were observed, dietary history can also be studied.

3) For this study, cross-sectional survey was done. However, longitudinal survey can be done for more detailed study.

4) Different health and food education programs should be conducted in order to tackle underweight and overweight/obesity.

Part VII

Summary

Imbalanced nutritional status adversely affects the health and wellness of individuals. In order to assess the nutritional status and risk factors associated with it among adults residing in Sukumbasi basti of Dharan, a cross- sectional study was carried out. For this purpose, adults of age 18-70 years were selected and Total 3 wards out of 20 wards i.e. Dharan 11, 13 and 16 were chosen applying purposive sampling method. For the survey, total 188 participants were studied. Anthropometric measurements such as BMI, waist circumference and waist to hip ratio were used. IPAQ and semi-structured questionnaire were used to know physical activity and socio-demographic status and similarly 24 hour dietary recall was used to know dietary habits. The data were collected, arranged and analyzed using SPSS version 22 and MS Word and Excel 2016. Chi-square test were used to analyze the factors associated with nutritional status.

It was found that .3% were underweight, 29.3% were normal, 13.3% were overweight and 53.2% were obese. The mean BMI was found to be 25.56±4.93 kg/ m2 and WC was 89.6±13.4cm with 0.90±0.079 WHR. The average daily calories, carbohydrates, protein and fat consumption were found to be 1492.46±458.09 kilocalories, 243±184.05 gm, 42.94±14.34 gm and 36.73±16 gm. Age, gender, physical activity, type of diet, marital status, drinking alcohol, hypertension and white meat were strongly associated while wheat and red meat showed close association with the nutritional status of people residing in Sukumbasi basti of Dharan sub-metropolitan city. Age, gender, marital status, physical activity, education was found to have strong association with abdominal obesity due to waist circumference while factors like age, gender, marital status, education and drinking alcohol were found to be associated with abdominal obesity (WHR). From the result, we can conclude that most of the participants living in this area do not have proper knowledge on balanced diet. Therefore, necessary awareness program should be organized regarding nutritional status.

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Appendixes

Appendix-A

Central Campus of Technology

Informed consent form for study participants

My name is Keshab Shrestha, a student of Nutrition and Dietetics at Central Campus of Technology, Dharan is going to conduct dissertation work in for the award of bachelor's degree in Nutrition and Dietetics. I am going to give you information about this research and invite you to participate in this research.

The topic for the study is "Assessment of nutritional status and associated risk factors among adults residing in Sukumbasi basti, Dharan".

Under this study, nutritional status and its risk factors will be assessed. The study will provide information about nutritional status and risk factors associated with it among adults. During the study height, weight, pressure and hip waist circumference of the participants will be measured. Nutritional status and risk factors associated with it will be assessed using questionnaire. The information obtained from the participants will be kept confidential. This study will make you known about your nutritional status. Some questions may be personal, all information you provide will be important and the privacy of information will be maintained and they will not be misused. Your participation in this study will be voluntary. You may not answer some or all questions if you feel them personal or sensitive. Please sign below if you want to participate in the study.

Signature of participant: ……

Appendix-B

Questionnaire

A) Basic information

1) Form no- 2) Name of the participant-

3) Address-

B) Socio-economic and demographic variables

1) Gender- Male/Female

2) Age-

3) Caste- i) Janjati ii) Brahmin iii) Chhetri iv) Dalit

4) What is your ethnicity?

i) Hindu ii) Buddhist iii) Christianity iv) Islam v) Others

5) Marital status- Single/Married

6) Number of family members-

i) Female members- ii) Male members-

7) Type of family- Joint/Nuclear

8) What is your educational level?

i) Illiterate ii) Literate iii) Secondary level education v) Higher secondary education and above

9) Occupation-

i) Business ii) Labor iii) Farming iv) Abroad v) Unemployed vi) Housewife vii) Other

10) Income of family (Rs.)

i) Less than 15000 ii) More than 15000

ii)

C) <u>Complications</u>

1) Do you have hypertension? Yes/No

2) Do you use medication to control hypertension? Yes/No

3) Do you have diabetes? Yes/ No

A) Behavioral factors questionnaire

i) Do you smoke cigarette?

a) Yes b) No

If yes, then how many cigarettes per day?

a) 1-3 b) 3-9 c) 9 and above

ii) Do you chew tobacco?

a) Yes b) No c) Sometimes

iii) Do you drink alcohol?

a) Yes b) No c) Sometimes If yes or sometimes, then

I) How frequently do you drink alcohol?

a) Everyday b) once a week c) twice a week d) more than twice a week e) Once a month f) Twice a month

iv) How often do you eat in front of TV?

i) Daily ii) Twice a week iii) 3-4 times a week iv) Never

v) Do you drink cold drinks or any type of processed juices?

a) Yes b) No

If yes, then how often you drink these drinks?

a) Everyday b) Once a week c) Twice a week d) More twice than a week

vi) Do you skip any meal?

a) Yes b) No

If yes, then which meal do you skip?

a) Breakfast b) Lunch c) Snacks d) Dinner

vii) How often do you skip meal?

a) Once- twice a week b) Three-four times a week c)Five or more days

vi) Do you have any kind of stress? Yes/No

vii) Do you drink alcohol for relieving stress?

a) Yes b) No

ix) How many hours per day do you sleep on an average? _____Hours.

D) Physical activity questionnaire (IPAQ)

1) During the last 7 days, on how many days did you do vigorous physical activities (heavy lifting, digging, aerobics, or fast bicycling for more than 10 minutes)?

1. _____Days per week
2. Don't Know/Not Sure
3. Refused

2) How much time did you usually spend doing vigorous physical activities on one of those days?

1. _____Hours per day _____Minutes per day
2. Don't Know/Not Sure

3. Refused

OR

How much time in total would you spend over the last 7 days doing vigorous physical activities?”

1. _____Hours per week _____Minutes per week

2. Don't Know/Not Sure

3. Refused

3) During the last 7 days, on how many days did you do moderate physical activities (carrying light loads, bicycling at a regular pace, or double tennis. NO walking)?

1. _____Days per week

2. Don't Know/Not Sure

3. Refused

4) How much time did you usually spend doing moderate physical activities on one of those days?

1. _____Hours per day _____Minutes per day

2. Don't Know/Not Sure

3. Refused

OR

What is the total amount of time you spent over the last 7 days doing moderate physical activities?”

1. _____Hours per week _____Minutes per week

2. Don't Know/Not Sure

3. Refused

5) During the last 7 days, on how many days did you walk for at least 10 minutes at a time?

1. _____Days per week

2. Don't Know/Not Sure

3. Refused

6) How much time did you usually spend walking on one of those days?

1. _____Hours per day _____Minutes per day

2. Don't Know/Not Sure

3. Refused OR

What is the total amount of time you spent walking over the last 7 days?

1. _____ Hours per week _____Minutes per week

2. Don't Know/Not Sure

3. Refused

7) During the last 7 days, how much time did you usually spend sitting on a week day?

1. _____Hours per weekday _____Minutes per weekday

2. Don't Know/Not Sure

3. Refused OR

What is the total amount of time you spent sitting last Wednesday?

1. _____Hours on Wednesday _____ Minutes on Wednesday

Don't Know/Not Sure

2. Refused

E) <u>Dietary/Food Habit Questionnaire</u>

1) Are you: Vegetarian/ Non-vegetarian/Vegan

If Non- vegetarian, then

i. Which meat do you eat the most?

a) Chicken b) Pork c) Mutton d) Buff e) Fish

ii. On an average, how many times per week you eat meat?

a) Everyday b) Once a week c) Twice a week d) More than twice a week e) Once a month f) Twice a month

2) Do you drink milk? Yes/No

i) If yes then do you remove milk cream? Yes/No

3) Do you eat eggs? Yes/No

4) Do you eat fruits? Yes/No

5) How much oil do use daily for cooking? _____Spoon And monthly- ___ liters

6) For cooking which oil do you use?

a) Animal fat b) Vegetable oil c) Combination If vegetable oil then specify: _____ oil

7) How much salt do you use per food for cooking? _____ Spoon and monthly: gm ____

8) Do you consume dairy products? Yes/No

If yes, then specify:

F) Food frequency questionnaire

Types of food	Regular (at least once a day)	Frequent (3/4 times a week)	Rare (once in a week or less)	Never

Rice

Wheat

Maize/Barley/Millet

Pulses/Legumes

Milk and milk products

Red meat

White meat

Egg

GLV

Other vegetables

Tea/Coffee

Fruits

Salad

Fast foods

24 Hours Dietary recall

Time	Food items eaten	Serving	Amount
Breakfast			
Lunch			
Snacks			
Dinner			
Bedtime			

A) Anthropometric measurements

Measurement	Reading 1	Reading 2
Height(cm)		
Weight(kg)		
Waist circumference(cm)		
Hip circumference(cm)		

A) Blood pressure measurements

Blood pressure	Reading 1	Reading 2	Mean
Systolic blood pressure (mmHg)			
Diastolic blood pressure (mmHg)			

APPENDIX -C

Color plates

i) Measuring height

ii) Measuring waist and hips