RISK FACTORS ASSOCIATED WITH OVERWEIGHT AND OBESITY AMONG REPRODUCTIVE AGED FEMALES RESIDING IN DHARAN SUB-METROPOLITAN CITY

by

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Risk Factors Associated with Overweight and Obesity Among Reproductive Aged Females Residing in Dharan Sub-Metropolitan City

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

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Approval Letter

This *dissertation* entitled *Risk Factors Associated with Overweight and Obesity Among Reproductive Aged Females Residing in Dharan Sub-Metropolitan City* presented by Prabina Bhattarai has been accepted as the partial fulfillment of the requirements for the degree of Bachelor of Science in Nutrition and Dietetics.

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(Prabina Bhattarai)

Abstract

Overweight and obesity has threatened the modern world not only in developed countries but equally in developing countries like Nepal. This study therefore aimed to assess the risk factors associated with overweight and obesity among reproductive aged women residing in Dharan sub-metropolitan city. A cross-sectional descriptive study was done on 206 reproductive aged females (15-49 years) using a structured questionnaire. Weight, height, waist circumference and hip circumference were measured to determine indicators related to overweight and obesity. The anthropometric measurements were then analysed using WHO and IDF criteria. Microsoft excel and SPSS version 20 were used to analyze data. Chi square test was used to analyze the factors associated with BMI, WC and WHR cut-offs.

It was found that 48% (n=99) of women were overweight and obese. Similarly on the basis of WHR, 89.8% (n=185) women were abdominally obese and on the basis of WC, 75.2% (n=155) women were abdominally obese. This study found that age (p=0.000), marital status (p=0.004), size of family (p=0.027), parity (p=0.019), alcoholic drink (p=0.031), protein intake (p=0.002) were found to be significantly associated with overweight and obesity. Only parity (p=0.017) was found to be significantly associated with abdominal obesity according to WHR classification while age (p=0.000), marital status (p=0.000), parity (p=0.000), watching TV while eating habit (p=0.049), eating outside once a day (p=0.012) and protein intake (p=0.002) were found to have significant association with abdominal obesity classified according to WC classification. This study showed a high prevalence of overweight and obesity in reproductive aged females residing in Dharan. Hence, concerned agencies should launch appropriate programs to combat the factors.

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List of Abbreviations

Abbreviation	Full form
BMI	Body Mass Index
CBS	Central Bureau of Statistics
CHNS	China Health and Nutrition Survey
CD	Communicable Disease
CVD	Cardio Vascular Disease
CT	Computed Tomography
DALYS	Disability Adjusted Life Years
FFM	Fat Free Mass
HMS	Harvard Medical School
HSPH	Harvard T.H. Chan School of Public Health
IDEA	International Day for Evaluation of Abdominal Obesity
IDF	International Diabetic Federation
IPAQ	International Physical Activity Questionnaire
IUNA	Irish Universities Nutrition Alliance
MET	Metabolic Equivalents
MOH	Ministry of Health
MOHP	Ministry of Health and Population
MRI	Magnetic Resonance Imaging

Abbreviations	Full form
MUAC	Mid Upper Arm Circumference
NCI	National Cancer Institute
NDHS	Nepal Demographic and Health Survey
NSF	National Sleep Foundation
NHMRC	National Health and Medical Research Council
NSP	Non-Starchy Polysaccharides
PMG	Premiere Medical Group
RMR	Resting Metabolic Rate
SES	Socio Economic Status
SPSS	Statistical Package for Social Science
STEPS	Step Wise Approach to Surveillance
WC	Waist Circumference
WHO	World Health Organization

Part I

Introduction

1.1 Background

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health (WHO, 2016). A crude population measure of obesity is the body mass index (BMI) (WHO, 2016). A person with a BMI of 30 or more is generally considered obese. A person with a BMI equal to or more than 25 is considered as overweight (Srilakshmi, 2014b). Waist to hip ratio (WHR) and waist circumference (WC) are the indicators to indicate central obesity (IDF, 2006; WHO, 2008b).

The World Health Organisation (WHO) has declared overweight as one of the top ten health risks in the world and one of the top five in developed nations (WHO, 2013a). It has been estimated that obesity is the fifth major cause for the death worldwide. Globally, at least 2.8million adults die each year as a result of being overweight or obese. In addition, 44% of the diabetes burden, 23% of the ischaemic heart disease burden and between 7% and 41% of certain cancer burdens are attributable to overweight and obesity (WHO, 2013a).There are an overwhelming bad effects of overweight and obesity. These include: insulin resistance, glucose intolerance, diabetes mellitus, hypertension, dyslipidaemia, sleep apnea, arthritis, hyper uricemia, gall bladder disease and certain types of cancer. The independent association of obesity seems also clearly established for coronary artery disease, heart failure, cardiac arrhythmia, stroke and menstrual irregularities (FX, 1999).

Overweight and obesity is the growing global health problems (Shah, 2010). In 2014, more than 1.9 billion adults, 18 years and older, were overweight out of which over 600 million were obese (WHO, 2016). The figure for obesity was greater in future burden of obesity and diabetes will affect developing countries like Nepal (Prentice, 2006). In South East Asia there is double prevalence of female obesity in comparison to male obesity (WHO, 2016). In Nepal trends of overweight and obesity is found to be increasing with 7.1% overweight and 2.4% obesity in 2007 to 17.3% overweight and 4.8% obesity in 2013 (MOHP, 2008b, 2014). Similarly, mean waist to hip ratio was found to be 0.55 in 2007 study while 2013 STEPS survey shows its figure to 0.9. The current prevalence of overweight and obesity is more among female as compared to male in Nepal (MOHP,

2013). The International Day for Evaluation of Abdominal Obesity (IDEA) study has reported that South Asians have the highest prevalence of abdominal obesity (Balkau *et al.*, 2007). Lack of physical activity combined with unhealthy diet, behavioural factors, health factors have led to the global epidemic of overweight and obesity (WHO, 2016). Along with these factors parity level and contraceptive use significantly affects overweight and obesity in reproductive aged women (Geyer, 2013; UN, 2012).

Nepal falls in low human development category ranking 145 among 187 countries in the world, but still has progressed from 157th in 2013 which shows the increase in both income and educational level of Nepalese people (UNDP, 2015). The total population of Nepal is 26.6 million among which 17% population resides in urban area (CBS, 2014b). The annual rate of urbanization was found to take place at 3.2% in 2014 (WB, 2014). In recent studies it has been found that from 1990 to 2014 urban population has grown from 8.9% of total population to 18.2% of total population (WB, 2014). Sunsari district too has urbanized from 17.5% in 1981 to 19.8% in 2001 and finally 34.3% in 2014 (CBS, 2003, 2014b). Looking at Dharan, it is the 8th largest urban city in terms of population size. In terms of population density it comes to the rank of 30 and also the same position in terms of population size (CBS, 2014b). Urbanization has led to more change in lifestyle, accessibility to high fat, high sugar led food, more sedentary lifestyle promoting overweight and obesity (Subesi *et al.*, 2017).

1.2 Statement of the problem and justification

Overweight and obesity is becoming one of the major public health problems in developing countries (Bhurosy and Jeewon, 2014). Overweight and obesity is amazingly increasing in Nepal among reproductive aged females (MOHP, 2006, 2011). Nepal is experiencing nutrition transition in recent decades which has resulted in consumption of high fat and high sugar foods. Similarly, the mean time spent by female on physical activity has decreased from 291.7 minutes to 263.9 minute (MOHP, 2008b, 2013b). Smoking which is a risk factor of obesity is highest in Nepalese females among South East Asian countries. Likewise, 30% of the Nepalese women are found to be engaged in harmful drinking practices (WB, 2011). There is a dramatic decrease in the consumption of fruits and vegetables in Nepal which decreased from 4 numbers of servings per day in 2007 to 1.8 in 2013 (MOHP, 2008a, 2013a). Community-based epidemiological studies in Nepal suggest

a prevalence of depression ranging from 28% to 41% with rates considerably greater among women (Kohrt and Worthman, 2009) .

Obesity is a physiological risk factor for non- communicable diseases (NCDs) (MOHP, 2013c). Nepal is now passing through an epidemiological transition with non-communicable diseases accounting for more than 44% of deaths and 80% of outpatient contacts. Nepal has higher age standardized death rates and disability adjusted life years (DALYs) from NCDs than communicable diseases (CDs) (Neupane and Kallestrup, 2013). Apart from being risk factor for non-communicable diseases, obesity among women of reproductive age affects them by adversing reproductive outcomes. Infertility rates are found to be higher among obese women and once a woman is pregnant, both maternal and fetal risks are increased by high maternal BMI. Obese women are not only associated with pregnancy associated morbidity and mortality, the offspring are equally at an increased risk of obesity and other chronic metabolic diseases. Thus, women of child bearing age are uniquely a risk population (Zera *et al.*, 2011).

In developing countries overweight and obesity is neglected because of the most attention on famine and under nutrition or malnutrition of children (Mbochi, 2010). In Nepal too there are few researches related to obesity, and very few important interventions are planned and implemented to combat it at the national, regional and local level (Vaidya *et al.*, 2010a). If prevention is not applied earlier, the problem will surely escalate and leaves a huge burden to the health care system in Nepal (Gurung, 2013). Hence, it is the utmost responsibility of the policymakers and other concerned sectors to prevent negative consequences especially in women.

So, looking at the urbanization rate in Dharan and the observed high prevalence of risk factors in women it becomes necessary to assess the nutritional status of women to find out over nutritional status. Likewise, the high probability of development of obesity through the retention of gestational weight combined with low physical activity in women call for the high attention of health workers as they are risk of NCDs (Mbochi, 2010; Vaidya *et al.*, 2010a). So, assessment of overweight and obesity in female is the must. Especially, in Dharan, where alcohol consumption (17%) and smoking is high in females, the nutritional assessment becomes necessary to take preventive action (Shakya, 2013).

1.3 Conceptual framework

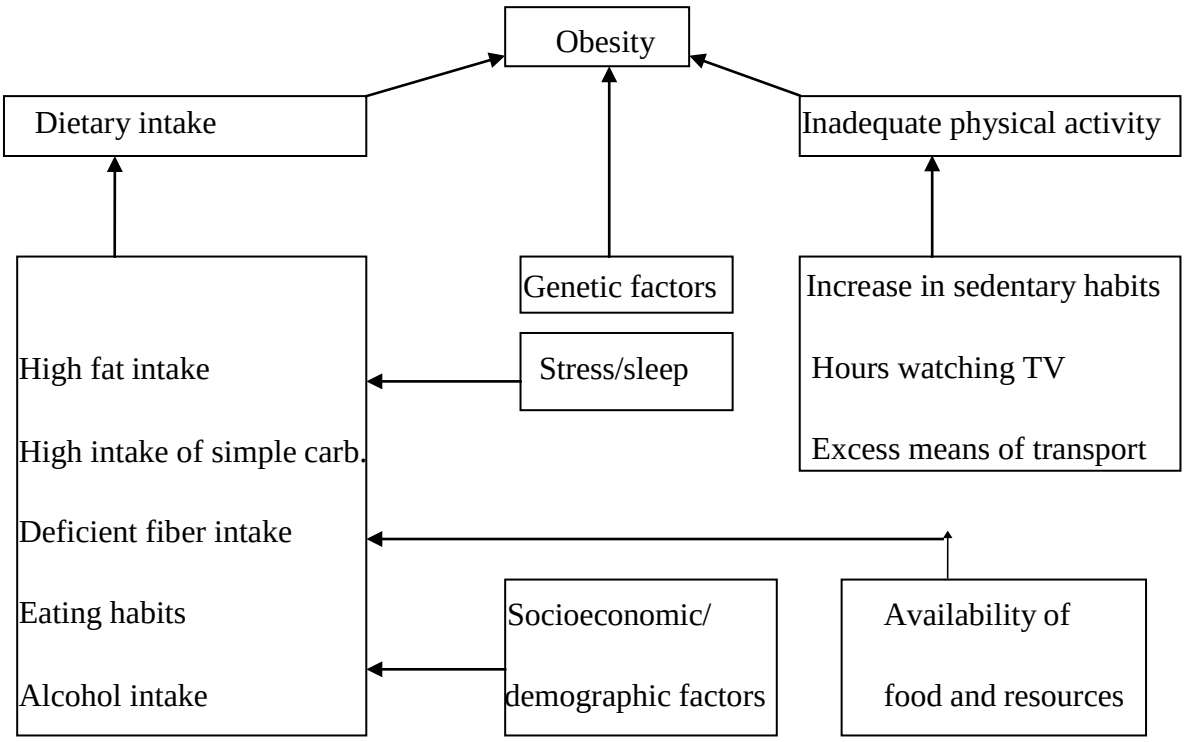

Figure 1.1 Conceptual framework for overweight and obesity

(Gonzalez, 2013; Sartorious *et al.*, 2015)

1.4 Objective of the study

Objectives of this study were:

1.4.1 General objective

To assess the risk factors associated with overweight and obesity among reproductive aged females residing in Dharan sub-metropolitan city.

1.4.2 Specific objectives

i To carryout anthropometric measurements of 15-49 years females.

ii To find out socio-economic status, dietary intake, physical activity level, behavioral factors and health factors.

iii To identify some associated risk factors of prevalent over nutritional status of women residing in Dharan.

1.5 Research questions

i What is the prevalence of overweight and obesity in reproductive aged females in Dharan?

ii What are the risk factors associated with overweight and obesity in reproductive aged females in Dharan?

1.6 Significance of the study

The study will contribute to academic knowledge in the field of foods, nutrition and health. The study results may be useful in highlighting the problem of overweight and obesity and the main contributing factors among women in Dharan in the different socioeconomic groups. As health problems associated with obesity and overweight are increasing in number, these findings will be useful in informing the health sector and the public health planners in the mobilization and allocation of resources for the control and prevention of NCDs. The result of this study could form the basis for the formulation of guidelines and messages which could be used for counseling of women in Dharan and similar circumstances in the country. As prevention is best way to achieve economic growth in country like Nepal, these findings will surely be effective in increasing awareness on overweight and obesity as a problem.

1.7 Limitation

Overweight and obesity could be assessed by different methods namely direct and indirect methods. We could only assess obesity by BMI, WC, and WHR instead of body fat percentage due to limited resources. Likewise, salt intake through different packaged foods was not calculated, instead total dietary salt intake through cooked food was calculated. Similarly, in food frequency questionnaire amount of food consumed was not considered.

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Part II

Literature Review

2.1 Overweight and obesity

Overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health. A crude population measure of obesity is the body mass index (BMI), a person's weight (in kilograms) divided by the square of his or her height (in metres). BMI is a measure of generalized obesity whereas central obesity can be measured on the basis of waist circumference (WC) and waist to hip ratio (WHR). A person with a BMI of 30 or more is generally considered obese. A person with a BMI equal to or more than 25 is considered overweight (WHO, 2016). According to WHO waist to hip ratio above 0.85 is considered as central obesity whereas waist circumference (WC) above 80 cm is considered as being centrally or abdominally obese (Brussels, 2006; WHO, 2011).

When energy intake equals energy expenditure, the body is in energy balance and body energy is stable. When energy intake exceeds energy expenditure, a state of positive energy balance occurs and the consequence is an increase in body mass, of which 60 to 80 percent is usually body fat. Conversely, when energy expenditure exceeds energy intake, a state of negative energy balance ensues and the consequence is a loss of body mass (again with 60 to 80 percent from body fat) (Hill *et al.*, 2012).

Insulin and leptin affects the regulation of body weight. Obesity gene is expressed in the fat cells and codes for the protein leptin. This hormone promotes negative energy balance by suppressing appetite and increasing the energy expenditure. People having genetic defects in leptin show signs of poor appetite control and eat more and may gain weight. In obesity there is sufficient leptin production but there is insensitivity of the adipose tissues to leptin. Leptin plays an important role in the long term regulation of energy balance. On the other hand insulin also inhibits food intake. Likewise insulin provides an indirect role in body weight regulation through the stimulation of leptin. Both insulin and leptin are transferred into the CNS, where they may interact with a number of hypothalamic neuropeptides known to affect food intake and body weight (Srilakshmi, 2014b).

2.2 Theories on obesity

Different theories on obesity have been put forward. They are as follows:

i. Fat cell theory

There are number of fat cells determined early in life which once have formed, have a tendency to form full of fat. Total number of fat cells was set early in life which indicates that adult-onset obesity is causes by an increase in the size of fat cells. The number of fat cells can increase as a result of positive energy balance or can decrease due to weight loss. People having large number of fat cells have more difficulty in maintaining body weight than those with fewer fat cells (Srilakshmi, 2014b).

ii. Set point theory

Each person has an ideal biological weight or set point. Once body weight reaches this point, a whole set of signals is produced that influences the person's food intake to maintain this weight (Srilakshmi, 2014b).

iii. Thrifty genotype theory

The central premise of this theory is that through natural selection we evolved to be efficient at food storage and utilization. The people who had bodies that were better at fuel storage or utilization were more likely to survive during the famine portion of the cycle. Thus over many generations, we have developed genetically to be exceptionally efficient at the intake and utilization of fuel as these were beneficial adaptations throughout the human life. However, during the last century the transition to an overabundance of food and limited physical activity has created a situation where our previously advantageous thrifty genes now make us susceptible to diabetes and obesity. During periods of famine, adaptations such as larger storage of glycogen or fat might have been advantageous in staving off starvation or hunger related disease. So if a person was more efficient at storing energy during the feasting portion of the cycle, he would be more likely to survive during the famine portion. Similarly, being able to utilize fuel more efficiently, such as a decreased rate of glycogen usage, would similarly prevent death during famine. So, the conclusion is often that obesity or an adaptation to easy weight gain during periods of feasting was an advantage that has subsequently been naturally selected. Critics of the theory point to the fact that weight gain during feast are not substantial. Such critiques are

hollow because they only look at one side of the equation, food storage in the adipose tissue, and ignores another strong influencer, physical activity (Magness, 2010).

2.3 Types of obesity

Obesity can be categorized into different types based on BMI, onset of obesity and fat storage (Srilakshmi, 2014a).

2.3.1 BMI

Obesity can be divided into 3 parts based on the BMI (Srilakshmi, 2014a).

i Grade I

These people have body mass index more than 25 but less than 29.9. Overweight does not affect their health. They lead normal health and life expectancy is above normal. They may reduce on their own (Srilakshmi, 2014a).

ii Grade II

The body mass index is between 30-39.9. They have reduced tolerance to exercise with shortness of breath on exertion and they are unduly fatigued. This is due to the burden of increased weight they carry always and reduced capacity of the circulatory and respiratory systems that are handicapped by masses of internal fat and fatty infiltration of muscle. For metabolic and mechanical reasons these patients are at increased risk of diabetes, atherosclerosis, hypertension, fatty liver, gall bladder diseases, osteoarthritis, hernias and varicose veins (Srilakshmi, 2014a).

iii Grade III

The body mass index is above 40 and these patients are in pathetic conditions .Their day to day activities are restricted due to their enormous mass and more susceptible to diseases mentioned in Grade II. They are susceptible in atherosclerosis, prone to accidents and have serious psychological disturbances (Srilakshmi, 2014a).

2.3.2 Onset of obesity

Based on the onset of obesity, there are 2 types of obesity (Sheth and Shah, 2006a).

i Juvenile onset obesity

It occurs due to hyperplasia. In juvenile onset obesity there is increase in size as well as number of fat cells. It begins in the last 3 months of fetal life, continues in the first 3 years of life and at adolescence. Moreover, it is observed that children who are overweight are more likely to become overweight adults (Sheth and Shah, 2006a).

ii Adult onset obesity

It occurs from hypertrophy of fat cells alone. The greater the number of fat cells greater the hunger. A pharmacology intervention coupled with other management strategies will work better in treating such cases (Sheth and Shah, 2006a).

2.3.3 Fat storage

Body fat distribution can be used to establish overweight and obesity. Body fat is distributed differently in men and women. The quantity and location of fat in the body can predict health risks. Based on the fat storage in the body, there are two types of obesity (Sheth and Shah,2000b).

i Android obesity

The obesity in which the fat is accumulated in upper part of body is known as android obesity, sometimes it is referred as apple obesity or upper body obesity. This type is frequently observed in most male and few females. The characteristics of android obesity involves broad shoulders, strong muscular arms and legs, a narrow pelvis and narrow hips. Waistline does not curve inwards so the trunk has a somewhat straight up and down appearance. The android person are usually energetic and can work for long hours and such people have anabolic metabolism, that results in fat accumulation in upper part of the body. Such males have increased production of male hormones (Sheth and Shah, 2006a).

ii Gynoid obesity

This is the typical female pattern where excess fat stores accumulate in the periphery, specifically hips, thigh and bottom. Individuals with a gynoid fat distribution are at a greater risk of mechanical problems (Sheth and Shah, 2006a).

2.4 Risk factors associated with overweight and obesity

Overweight and obesity are influenced by a number of factors including hereditary tendencies, environmental and behavioral factors, ageing and pregnancies. There are

many factors influencing weight gain and loss process beside diet and physical activity. However, they are the main component and modifiable in energy balance (WHO, 2000).

2.4.1 Socioeconomic factors

Studies have repeatedly shown that high socio-economic status is negatively correlated with overweight and obesity in developed countries, particularly among women but positively correlated with it in populations of developing countries (Bhurosy 2014). Differences in diet quality in different socioeconomic status arise due to more frequent consumption of fresh and better quality produce such as fresh fruits, vegetables, and fish among higher socioeconomic status (SES) individuals since fresh produce items are charged higher in grocery and convenience stores. In particular, the poorer segments are often left to choose for energy-dense diets, rich in cheap vegetable oils, and trans-fats (Bhurosy 2014). Likewise, in developing countries, the lower obesity rates observed in the populations of lower socio-economic status are associated with a situation where people are limited in their ability to obtain enough food, yet still engage in moderate to heavy manual work and have little access to public transport. Hence thin adults are considered poor, and overweight and obesity are a sign of affluence in developing countries (Popkin. *et al.*, 2003).

2.4.2 Age

Studies have shown that women in twenties have higher metabolic rate which do not predispose them to overweight and obesity. But as age increases women gradually lose protein mass and in their thirties they start to gain weight. After that in forties women gradually start to lose levels of hormones like estrogen, progesterone which predisposes them to gain weight. Beside that in this age sarcopenia causes them to lose protein mass which naturally declines the metabolic rate (Fetters, 2015). Pregnancy and menopause are significant factors in the development of obesity in women, suggesting that fluctuations in reproductive hormone concentrations uniquely predispose women to excess weight gain (Schlenker and Long, 2007).

2.4.3 Marital status

Marital status has been known to influence bodyweight particularly of women. Marital status has been shown to be associated with BMI and most cross sectional studies have found that married people are more often overweight and obese than those living alone

(Tzotzas *et al.*, 2010). The prevalence of overweight was found to be two-fold higher in married men and women than never-married men and women, even when age, educational level, leisure time physical activity, smoking habits, and place of residence were controlled It has been found that people after marriage perform less physical activity, change their dietary pattern, have least focus on being attractive, have more social support. On the other hand, unmarried subjects may intentionally manage their weight in an effort to look more attractive to potential marital partner (Janghorbani *et al.*, 2008).

2.4.4 Parity

Parity is another unique factor that is seen to contribute overweight and obesity in women. Parity is known to contribute to obesity due to postpartum weight retention. Several published studies have reported positive associations between parity and being obese (Martinez *et al.*, 2013). It is unclear whether becoming overweight after pregnancy is primarily due to high gestational weight gain, altered lifestyle habits during the postpartum period, or combination of influences. Overall evidences have supported the conclusion that substantial weight gain associated with childbearing is an important risk factor for the development of overweight and obesity in women during midlife (Gunderson *et al.*, 2008). A study conducted in urban India showed that women having parity level of greater than or equal to three are more overweight or obese as compared to women having one to two or nil parity level (Gouda and Prusty, 2014b).

2.4.5 Physical activity

Any body movement that burns calories, whether it's for work or play, daily chores, or the daily commute can be referred as physical activity. Studies have shown that exercise brings about many regulatory processes like stimulating the effect of key enzymes, increasing cell sensitivity to numerous hormones, facilitating substrate transport through membranes, influencing cell receptors in a tissue-specific manner which improves metabolic rate of body. With the lack of physical activity human body needs to compensate for the lack of exercise stimulation to maintain energy and macronutrient balance which ultimatley leads to fat gain in body (Chaput *et al.*, 2011). A study conducted in Indian women showed that women who were more physically active were less overweight and obese (Jayamani *et al.*, 2013). Similarly another study too supported the fact that higher physical activity is associated with lesser odds of being obese (Little *et al.*, 2016). The intensity of physical activity is measured in metabolic equivalents or METs. One MET is defined as the calories

burned while an indvidual sits quietly for one minute. For average adult, this is about one calorie per every 2.2 pounds of body weight per hour. Moderate intensity physical activity burns three to six METs while vigorous intensity activity burn more than six METs (HSPH, 2017).

2.4.6 Dietary intake and overweight and obesity

i Energy dense foods

Large shifts of diet and physical activity have occurred in the last two or three decades of twentieth century. Modern societies seem to be converging on a diet high in saturated fats, sugar, refined foods, and low in fibre referred to as western diet and on lifestyles characterised by lower levels of activity. The diets of developing world are rapidly shifting particularly with respect to fat, calorie sweeteners and animal source foods. In 2000, 306 kilocalories were consumed per person per day, about a third more than the calorie consumed in 1962 countries (Popkin. *et al.*, 2003). Nepal's increasing trend towards urbanization presents large health challenges, whose consequences are at an early stage (Vaidya and Krettek, 2014).

In Nepal, the average proportion of energy from fat has significantly increased from 13% in 1970 to 17% in 2010. Plant fat and sugar are the main contributors to the increased energy intake trends over the 40 years, followed by meat, fish, milk and eggs. Nepalese dietary patterns have changed over the past forty years, especially with increased energy from plant fat, sugar and animal products coinciding with increased levels of obesity and overweight, especially in urban areas (McGuire and Beerman, 2012). Changing dietary habits can shift a society's disease pattern from infectious, communicable diseases' dominance towards a status of double-disease burden with increasing prevalence of obesity and non communicable diseases (NCDs) (Vaidya and Krettek, 2014).

ii Fruits and vegetables

Fruits and vegetables are important components of a healthy diet, and their sufficient daily consumption helps to prevent weight gain. High fiber content of fruits and vegetables promote weight loss. High fiber content food increases satiety levels that will prevent overeating. Beside this soluble fibre present in them will form viscous solution that will prevent absorption of fat and cholesterol. A minimum of 400g to 500 gm of fruits and vegetables per day (excluding potatoes and other starchy tubers) is recommended for

controlling weigh gain and CVD (WHO, 2017a). In Nepal, low consumption of fruits and vegetables was found which has directly attributed to non-communicable diseases in Nepal (Shahi *et al.*, 2013a).

iii Milk and Milk products

Calcium is one of the most abundant mineral present in milk (Gopalan and Sastri, 2004). Many studies have shown that calcium-rich diet could help to control body weight. Dietary calcium is known to increase lipolysis and persevere thermogenesis, thereby accelerating weight loss (Regina *et al.*, 2012).

iv Salt intake

It has been recommended that adults should consume less than 5 gram of salt per day (WHO, 2013b). A study conducted in Andhra pradesh in India showed a positive association between salt intake and BMI (Johnson *et al.*, 2017). High salt intake leads to water retention in body which subsequently leads to weight gain. Beside this high salt intake is known to increase adeponectin levels in body which subsequently increases fat in body (Kamari *et al.*, 2010).

v Alcohol

A recent review suggests that in the short term, small amounts of alcohol consumed prior to meals cause a clear and consistent increase in food. Heavy drinking has also been reported to lead to overeating (Yeomans, 2010). Studies have shown that high alcohol consumption leads to a suppression of lipid oxidation and thus the enhancement of a positive fat balance. These non-oxidised fat preferentially deposits in the abdominal area (Suter, 2005). In Nepal, one study found that increased alcohol consumption is significantly associated with obesity and overweight (Vaidya *et al.*, 2010b). However, high alcohol consumption could lead to lose weight by depleting NAD+, thus preventing conversion of pyruvate acid to acetyl- CoA (McGuire and Beerman, 2012).

2.4.7 Behavioural factors

i Watching T.V. while eating

There is an increasing evidence of association between television viewing and adiposity in adults. A cross sectional analysis study done in Australian adults found the association between television viewing and waist circumference. It was explained that increase in

waist circumference is due to food and beverage consumption during TV viewing but was not explained by decrease in leisure time physical activity (Cleland *et al.*, 2008). A study done among adolescents in Nepal found that watching TV is a risk factor for developing overweight (Piryani *et al.*, 2015). Studies have shown that while watching T.V people are distracted and pay less attention to what they have eaten ultimately making meal or snack less memorable and consuming larger amount of food (Asante, 2013).

ii Stress

Various studies have implicated the relation between stress and overweight and obesity in adults. However, it is suggested that stress may contribute to changes in dietary behaviors that lead to weight change, with various effects related to baseline body mass index, or cortisol reactivity in response to stress (Block *et al.*, 2008). Different hormones are known to be activated due to the stress which directly affects eating pattern and leads to weight gain (Scott *et al.*, 2012). One of the study done in medical students in India showed a positive correlation between BMI and stress (Gupta *et al.*, 2009). The mechanism behind the weight gain during stress is known to be high secretion of cortisol. A study found that women with high WHR secreted more cortisol as compared to others. Cortisol mobilizes triglycerides from storage and relocate them to visceral fat cells. It also aids adipocyte's development into mature fat cells. Cortisol too suppresses insulin which in turn starved off cells to glucose leading to overeating (Aronson, 2009; Moyer *et al.*, 1994).

iii Sleep

In general, people who get too little sleep tend to weigh more than those who get enough sleep (Patel and Hu, 2008). A study conducted in Assamese adults showed that people with a shorter sleep duration were prone to have more BMI (Bania and Barua, 2013). Similarly a cross sectional and longitudinal study conducted in US people of 32-49 years showed that people sleeping less than 7 hours in a day had in an average higher BMI as compared to others (Ganqwisch *et al.*, 2005). The national sleep foundation of United States has recommended that adult of age 18-64 years should sleep for 7-9 hours a day (NSF(US), 2015).

Various mechanisms have been put forward to explain the association between sleep and weight gain. However a study conducted in sleep deprivation has found that sleep loss

can cause an increase in the ratio of ghrelin to leptin, enhancing appetite and specifically, increasing cravings for carbohydrate rich foods (Kondracki, 2012).

iv Eating outside once a day

It has been found that eating outside on a frequent basis is associated with overweight and obesity (Bezerra *et al.*, 2012). Eating outside may lead to overconsumption and increase the risk of obesity in part because of larger portion sizes, high energy dense foods, and increased variety and preferred taste of the foods (Anderson and Rafferty, 2011).

v Breakfast skipping

Various studies have found the inverse relation between breakfast consumption and being overweight and obesity. A study conducted in overweight and obese women found that high calorie breakfast with reduced intake at dinner is beneficial and might be a useful alternative for the management of obesity and metabolic syndrome (Jakubowicz *et al.*, 2013). The mechanism behind relation between breakfast and body weight is that breakfast increase satiety level, hence preventing overeating. Beside that larger breakfast is known to reduce blood cortisol level which lowers appetite ultimately reducing daily caloric intake (Castro, 2004).

2.4.8 Genetic factor

Genetic inheritance influences 50-70 percentage a person's chance of becoming fat more than any other factor. A genetic base regulates species differences in body fat and sexual differences within a species. Within a family, the chance of being obese is 80 percent if both parents are obese and 50 percent if one parent is obese. A mutation in the human gene coding for the B3 receptor in adipose tissue, involved in lipolysis and thermogenesis markedly increase the risk of obesity. Many genes play a role in energy homeostasis (UCP1, UCP2, UCP3), food intake regulation (MC3R, MC4R, CCKAR), appetite (NPYRS), and ultimately obesity (ASIP, CPE, LEO, LEPR, TUB, POMC), in mammals (Srilakshmi, 2014a).

2.5 Comorbidities of overweight and obesity

There are an overwhelming evidence on the association of obesity to number of medical conditions. These include: insulin resistance, glucose intolerance, diabetes mellitus, hypertension, dyslipidemia, sleep apnea, arthritis, hyperuricemia, gall bladder diseases, and

certain types of cancer. The independent association of obesity seems also clearly established for coronary artery diseases, heart failures, cardiac arrhythmias, stroke, and menstrual irregularities (FX, 1999).

High blood pressure is about six times more common in people who are obese than in those who are lean. According to the American heart association, 22 pounds of excess weight boosts systolic blood pressure by an average of 3 millimeters of mercury (mm Hg) and diastolic blood pressure by an average of 2.3 mm Hg, which translates to a 24% increase in stroke risk (Gutmann, 2015). A study to examine connection between weight and heart disease found that being overweight boosted the risk of heart disease by 32% while obesity increased the risk by 81% (HMS, 2012). Compared with people of normal weight, overweight people face a 22% higher risk of stroke while for obese risk rises to 64% (PMG, 2017). Overweight and obesity are so closely linked to diabetes that experts have coined the term "diabesity" to describe the phenomenon. In obesity, there is insulin resistance especially in muscle and there is hyperinsulinemia because of impaired insulin uptake by receptors in target tissue (Srilakshmi, 2014a). About 90% of people with type 2 diabetes are overweight or obese (NIDDKD, 2012).

Different study have showed a link between excess body weight and many different cancers. Some of the findings said that among people ages 50 and older, overweight and obesity may account for 14% of all cancer deaths in men and 20% of all cancer deaths in women (Anand *et al.*, 2008). In women, deaths from cancer of the breast, uterus, or ovary were elevated with higher BMIs (NCI, 2017). A study conducted in England found that the risk of death increased along with body size, ranging from 44% higher for those who were mildly obese to 250% higher for those with of 40 to 50 (Slayback, 2014). Specifically looking at reproductive aged women, gestational diabetes and gestational hypertension could complicate their health issue due to excess weight. Similarly, reproductive age women who are obese are at increased risk of infertility, miscarriage, and other adverse pregnancy outcomes. Along with this, risk of fetal anomalies like cleft palate, neural tube defects, and congenital heart disease could too increase in offspring of such women (Zera *et al.*, 2011).

2.6 Measurement of overweight and obesity

There are various methods to measure overweight and obesity. These ranges from the useful, simple anthropometric measurements such as weight and height from which the

BMI is derived; waist circumference, waist and hip ratio and skin fold thickness to the more sophisticated measures. These include: Hydro densitometry, Magnetic Resonance Imaging (MRI), Computerized Tomography (CT), Dual Energy X-ray Absorptiometry (DEXA), Bioelectric Impedance analysis (BIA) and Air Displacement Plethysmography (Srilakshmi, 2014b).

2.6.1 Body mass index

Body mass index (BMI) is a simple index of weight-for-height that is commonly used to classify overweight and obesity in adult. It is defined as a person's weight in kilograms divided by the square of his height in meters (kg/m^2) (WHO, 2016). There are different cut offs point for BMI according to the geographical area. The classification adopted by WHO is given below.

Table 2.1 Classification of adults according to BMI

Classification	**BMI (kg/m^2)**	**Risk of comorbidities**
Underweight	<18.5	Low
Normal	18.5-24.9	Average
Overweight	25-29.9	
Pre obese	25-29.9	Increased
Obese I	30-34.9	Moderate
Obese II	35-39.9	Severe
Obese III	≥40	Very severe

(WHO, 2017d)

However due to high body fat content in Asians, the cut-offs are slightly less than that of WHO classification as shown in Table2.2.

Table 2.2 Classification of Asian BMI cut-offs

BMI (Kg/m²)	Categories
<18.5	Underweight
18.5-23	Increasing but acceptable risk
23-27.5	Increased risk
≥ 27.5	High risk

(WHO, 2016)

BMI provides the most useful population-level measure of overweight and obesity as it is the same for both sexes and for all ages of adults. However, it should be considered a rough guide because it may not correspond to the same degree of fatness in different individuals (WHO, 2016). It is because it doesn't distinguish fat mass from lean mass. It means BMI could be underestimated in old aged people while can be overestimated in muscle builders. Another limitation is that BMI doesn't give any idea about fat distribution. It is found that there is 70% variation in visceral fat between individuals having same BMI. However, it is widely used index for the measurement of generalized obesity (NHMRC, 2004).

2.6.2 Fat Percentage

For more accurate measurement of overweight and obesity total amount of body fat should be taken. The upper limit of fat percentage to be considered as obesity is 25% for males and 30% for females. Dual Energy X-ray Absorptiometry is one of the most widely accepted methods of measuring body composition (Srilakshmi, 2014b). Beside it, skin fold thickness using various skin-fold calipers like the Harpender and the Lange Calipers is used to measure body composition. They are inexpensive and can yield a good estimate if measured correctly. This technique has a limitation that if performed by untrained people the skin folds may not be obtained easily and accurately (Sheth and Shah, 2006b). According to age the adjusted body fat percentage of women can be categorized as follows.

Table 2.3 Age adjusted body fat percentage charts for women

Age	Under fat	Healthy	Overweight	Obese
20-40 yrs	Under 21%	21-33%	33-39%	Over 39%
41-60 yrs	Under 8%	8-19%	19-25%	Over 25%
61-79 yrs	Under 24%	24-36%	36-42%	Over 42%

(Gallagher *et al.*, 2000)

2.6.3 Waist circumference

WC is an indicator of health risk associated with excess fat around the waist. A waist circumference of 102 cm (40 inches) or more in men, or 88 cm (35 inches) or more in women, is associated with health problems such as type 2 diabetes, heart disease and high blood pressure. The measurement of waist circumference gives an idea about the distribution of body fat and is also an indicator of metabolic syndrome. More precisely it is used to measure fat deposition in abdomen. Different researches have shown that fat deposited around waistline increases the risk of mortality because fatty tissue in this area secretes cytokines, hormones and metabolically active compounds that can contribute to the development of chronic diseases, particularly CVD and cancers. Also a close relationship is found between an excess of abdominal tissue, especially intra-abdominal visceral fat and obesity related complications (WHO, 2008a).

In some populations, waist circumference may be a better indicator of risk than BMI e.g. in Asian people. Waist circumference- reflecting mainly subcutaneous abdominal fat storage- has been shown to be positively, although not perfectly, correlated to disease risk in individuals with a BMI of less than 35. However there is a physical difficulty in measuring waist circumference in obese; >35 kg/m² and also there is little predictive power for disease risk for this BMI. Though visceral fat is more directly associated with metabolic risks, due to the difficulty in measuring the former, waist circumference remains the best for practical purpose (NHMRC, 2004).Waist circumference alone measured at the mid-point between the lower border of the rib cage and the iliac crest- may provide a more practical correlate of abdominal fat distribution and associated ill health (WHO,2000). Although waist circumference is a good measure of absolute risk, it is not such a good measure of relative change in body fatness because weight losses are not reflected in waist

circumference losses because fat is lost from parts of the body other than the waist (Kim, 2016). Similarly, other studies have shown that using waist circumference to predict both changes in visceral fat and improvements in cardiovascular risk factors during weight loss has limitations in overweight men and women (NHMRC, 2004). Waist circumference above or equal to 80 cm is known as abdominal obesity (Brussels, 2006).

2.6.4 Waist to hip ratio

The 1997 WHO Expert Consultation on Obesity recognized the importance of abdominal fat mass (referred to as abdominal, central or visceral obesity), which can vary considerably within a narrow range of total body fat and body mass index (BMI). It also highlighted the need for other indicators to complement the measurement of BMI, to identify individuals at increased risk of obesity-related morbidity due to accumulation of abdominal fat (WHO,2000a). Waist–hip ratio (i.e. the waist circumference divided by the hip circumference) was suggested as an additional measure of body fat distribution. The ratio can be measured more precisely than skin folds, and it provides an index of both subcutaneous and intra-abdominal adipose tissue (WHO, 2008a). A 12-year follow-up of middle-aged men, which showed that abdominal obesity was associated with an increased risk of myocardial infarction, stroke and premature death, whereas these diseases were not associated with measures of generalized obesity such as BMI (WHO, 2008a). In women, BMI was associated with increased risk of these diseases; however, waist–hip ratio appeared to be a stronger independent risk factor than BMI (WHO, 2008a). However due to the difficulty to measure hip circumference, waist circumference and BMI is highly appreciated. Abdominal obesity is defined as WHR greater than 0.9 for male and WHR greater than 0.85 for female. The hip circumference is measured at a level parallel to the floor, at the largest circumference of the buttocks (WHO, 2008b).

2.7 Prevalence and trends of overweight and obesity

2.7.1 Global trends of overweight and obesity

Overweight and obesity have escalated rapidly in many parts of the world to epidemic proportions over recent years, reflecting increased consumption of energy dense diets high in fats and sugars, compounded by declining levels of physical activity (Popkin *et al.*, 2012). In 2014, more than 1.9 billion adults, 18 years and older, were overweight and 600 million were obese (WHO, 2014). Obesity has so widely taking over its place in world

that, it is now referred to as an epidemic. The increment in obese individuals can be easily seen by comparing data of 1995 and 2000 when 200 million obese adults were found worldwide which increased to over 300 million in 2000 and now it has reached 600 million (WHO, 2000, 2014). The WHO has stated "the growth in the number of severely overweight adults is expected to be double that of underweight during 1995-2025"(WHO 1998). Nowadays obesity is not only the issue of developed countries and high income people, it has equally affected the lives of developing countries and low-income people. It is estimated that 115 million people suffer from obesity related problems (WHO, 2002b).

The International obesity task force (IOTF) estimates that up to 1.7 billion people may be exposed to weight related health risks, taking into account varied Asian populations with a body mass index (BMI) of 23 or more. It has been found that more than 2.5 million deaths each year are attributed to higher BMI, a figure that is expected to double by 2030 (IOTF, 2003). The problem is even more complicated in poor and developing countries, as they now have to deal with the "double burden of malnutrition". Hunger and inadequate nutrition contribute to early deaths for mothers, infants and young children, and impaired physical and brain development in the young. At the same time, growing rates of overweight and obesity worldwide are linked to a rise in chronic diseases such as cancer, cardiovascular disease and diabetes conditions that are life-threatening and very difficult to treat in places with limited resources and already overburdened health systems (WHO, 2017).

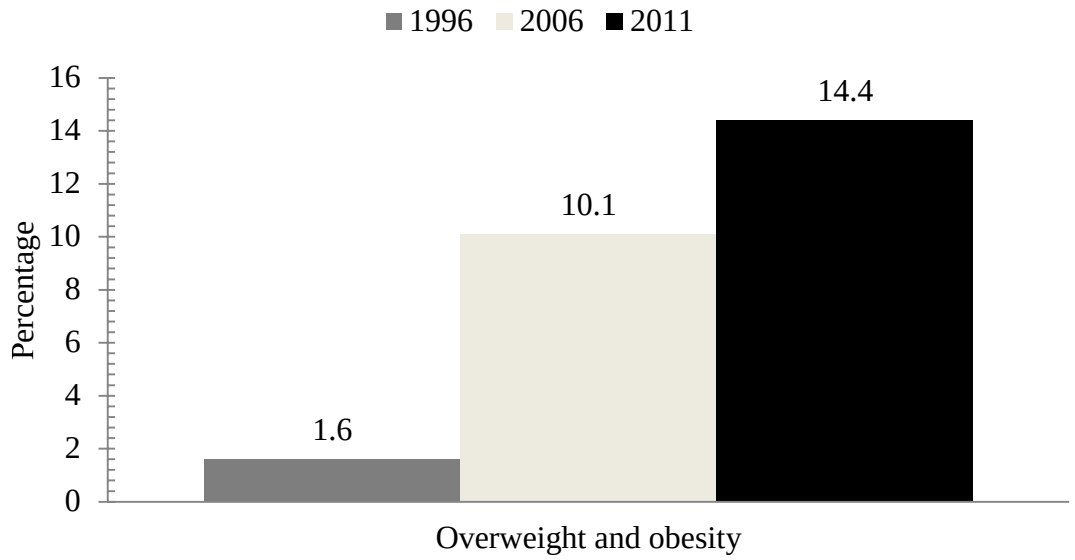
Asian countries are experiencing alarming rates of increase in prevalence of overweight and obesity in recent years, although they have some of the lowest prevalence. The rise in economic development and cultural factors are often cited as drivers to overweight and obesity. Vietnam and India have the lowest rates of obesity in Asia Pacific (1.7 % and 1.9% respectively). Malaysia has the highest obesity prevalence at 14 % in the South East Asia region and possibly in Asia, with Thailand in second position (8.8 %). These figures fall far behind those in the Oceanic countries, with 26.8 % obesity rates in Australia and 28.3 % in New Zealand. The prevalence of obesity in these countries is similar to rates seen in the United Kingdom (26.9 %) and US (33 %). Overweight and obesity rates in the United States have almost stabilized in the last five years, while rates are increasing at a faster pace in the Asian countries. China's overweight and obesity prevalence in adult

rose from 11.3 % to 27.9 % between 1980 and 2013 and in individuals below age 20 from 5.7 % to 18.8 % (Chiong, 2014).

The most recent nationally representative and large regional data demonstrates that without any doubt there is an epidemic of obesity, overweight and abdominal obesity in South Asian countries. The prevalence of overweight and obesity (based on Asian cut-offs: overweight ≥ 23 kg/m^2, obesity ≥ 25 kg/m^2) ranged from 3.5% in rural Bangladesh to over 65% in the Maldives. Countries with the lowest prevalence had the highest upward trend of obesity. According to the proposed WHO cut-off values for Asians, the percentage of Sri Lankan adults in the overweight, obese and centrally obese categories were 25.2%, 9.2% and 26.2%, respectively**.** In a study done in Pakistan, 34% men and 49% women were found to be over-weight/obese (Amin *et al.*, 2015) whereas in North India it was found to be 29.6% and 12.7% respectively (Girdhar *et al.*, 2016).

2.7.2 Overweight and obesity in Nepal

For Nepal, the increase in the combined prevalence of overweight and obesity in female was about six times (1.6% in 1996 versus 10.1% in 2006) between 1996 and 2006 as shown in Figure 2.1. It has now increased to 14.4% in reproductive aged women.



(MOH, 1996; MOHP, 2006, 2011)

Figure 2.1 Trends in overweight and obesity in reproductive aged females (15-49 years)

A STEPS survey conducted in Nepal found that 7.3% and 2.4% of female were overweight and obese respectively in 2007 which increased to 17.3% and 4.8% in 2013 respectively (MOHP, 2013c). A survey conducted in Kathmandu slum women found that almost one in five (19%) were overweight and a third (28%) were at risk of overweight and obese indicating the risk of double burden of malnutrition in Nepal. Likewise, a study done in adult population residing in Kathmandu found a combined prevalence of overweight and obesity in one fifth of the population while one third of the population were overweight (Amatya *et al.*, 2014). A study conducted among adolescents school children in Kaski district showed that almost 8.1% adolescents were overweight or obese with 5.8% being overweight and 2.3% being obese (Acharya *et al.*, 2014). Likewise another study conducted in Lalitpur sub metropolitan city described that almost 12.2% adolescents were overweight. In a study conducted among female in Ramkot VDC of Kathmandu found the prevalence of obesity and overweight to be 1.8% and 24.5% respectively (Shahi *et al.*, 2013b).

Part III

Materials and methods

3.1 Study setting

The study was conducted at Dharan sub-metropolitan city of Sunsari district, Koshi zone, Nepal. Dharan is located at Sunsari district of Koshi Zone in eastern Nepal. It is surrounded by hills at three directions with Charkose forest enclosing it from the south and lie about 17 km north of Itahari (Baba, 2012)**.**

3.2 Study population: Source population of the study was women of 15 to 49 years of age residing in Dharan sub metropolitan city.

3.3 Selection criteria

i Inclusion criteria: Women residing in Dharan of age between 15 to 49 years of age were included in the study.

ii Exclusion criteria

a Females who were below 15 years and above age 49.

b Females who were seriously ill, mentally unfit, pregnant and lactating women.

c Females residing in hospitals, prisons, nursing homes.

d Females who were not available at household during the time of study.

e Females who were residing temporarily in Dharan.

3.4 Research Design

A cross-sectional study of reproductive aged females residing in Dharan was done where prevalence of overweight and obesity and their associated risk factors were assessed. It consisted of:

i Anthropometric measurements

ii Survey with the help of questionnaire

3.5 Sampling technique

All wards were chosen for sample selection. Number of households from each ward was calculated on the basis of probability proportionate sampling technique. Alternate households were chosen for sample selection. Only one female from each households were chosen for study.

3.6 Sample size

Sample size was determined by literature review and by statistical calculation. The sample size was calculated to represent entire women aged 15-49 years residing in Dharan .In order to achieve this statistical inference, the sample size was determined by using a single proportional formula assuming the combined prevalence rate of overweight and obesity to be 24% in the survey area, 95% confidence interval (CI), 6% margin of error (d) and 5% non-response rate is added to the total calculated sample size. The WHO STEPS NCD survey conducted in Nepal in 2013 was taken as the reference proportion.

N= sample size, p= estimated proportion of an attribute present in the population, z= confidence interval at 95% (standard value of z is 1.96)

Sample size (N) = $Z^2 \times p\ (1-p)/d^2$

Now, N=$1.96^2 \times 0.24 \times (1-0.24)/ (0.06)^2$ =195

Sample size for known population,

N÷ (1+ (N-1) ÷total population)

=195÷ (1+ (195-1) ÷32693)

=194

Considering non-response rate as 5%, the adjusted sample size is calculated to be 204.

3.7 Study variables

3.7.1 Dependent variables

The dependent variables under this study were defined as:

i Body mass index

Women with a BMI of 25.0 to 29.9 kg/m² were classified as overweight; while those with a BMI greater or equal to 30.0 kg/m² were classified as obese based on WHO standards of classification (WHO, 2016).

ii Waist circumference in cm

Women with waist circumference above 80 cm were identified as being abdominally obese (IDF, 2006).

iii Waist to Hip ratio

Women with waist to hip ratio greater than 0.85 were considered as abdominally obese (WHO, 2011).

3.7.2 Independent variables

Independent variables included in this study were as follows:

i Socio-economic and demographic variables: Age, caste, religion, marital status, income, occupation, education, parity, family size.

ii 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:

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:

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

ii 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).

iii 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).

Adequacy of physical activity for each individual was also determined according to WHO recommendation. WHO has recommended that adults aged 18–64 should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity activity (WHO, 2017b).

i Dietary intake**:** With the help of information obtained from dietary assessment nutrients like fat, energy, calorie, carbohydrates were calculated. Nutrients like fat, protein, calcium as well as total calorie were calculated and classified according to WHO recommendations. It is recommended that 15-30 % of total calories should be included from fat (WHO, 2017d). Similarly, it is recommended that 55-75% of total calories should be included from carbohydrate (Mann *et al.*, 2007). Protein intake should be 0.83gm/kg (WHO, 2002a). Recommendation for total calories is based on the energy requirement of an individual. Total energy requirement is calculated as follows:

Recommended energy for less than 18 years=(13.384×weight+692.6)×PA factor

18 to 30 years=(14.818×weight+486.6)×PA factor

31 to 60 years=(8.126×weight+845×PA factor) (FAO, 2011)

Table 3.1 Physical activity factor to calculate total energy

Physical activity level	Factors
Low	1.53
Moderate	1.76
Heavy	2.25

(FAO, 2011)

Beside these it is recommended to consume 600mg of calcium per day. Fruits and vegetables are recommended to consume minimally 400 to 500 gram/day excluding tubers like potato, cassava etc (WHO, 2017a).

ii Health related characteristics: Menstrual disorders, use of contraceptives.

iii Behavioral characteristics: Watching TV while eating, sleep, stress, eating food outside once a day, smoking, alcohol intake.

3.9 Pre-testing

Pretesting was done in ten females for the feasibility and practicability of the tool. The questionnaire was developed in English and reviewed by supervisor and co-guide of this study. The prepared sets of questionnaire and anthropometric instruments were pre-tested among few females who were under sampling plan. Pre-testing of the questionnaire was performed to gather information about understanding ability, time consumed by each question, acceptability and to check the interpretation of the variables. After pre- testing all the ambiguous, misleading and wrongly interpreted questions were omitted and questionnaires were revised in accordance with the findings of pre-testing.

3.10 Validity and reliability

Validity of instrument was ascertained by comparing the data provided by our weighing balance with standard weights. Likewise validity of stadiometre was ascertained by comparing the measurement from our stadiometre and UNICEF stadiometre. Measuring tape was calibrated against standard stadiometre. For 24 hours recall, different foods were standardized in utensils for data collection. The instruments were checked and reset daily to validate the data. The questionnaire was validated by reviewing different literature

designed to assess the dietary habit, physical activity and other behavioural factors of reproductive aged women. The questionnaire was also pre-tested prior to data collection to ascertain content validity. The test re-test method was used to test consistency in producing the same results.

3.11 Data Collection Techniques

Data collection was spread over two phases, namely, initial contact with the participant, completing the semi structured questionnaire and taking anthropometric measurements. The socio-demographic and economic variables part involved asking the respondents about their age, marital status and parity, income, education and occupation. Information on other variables and data on anthropometric measurements were obtained by following methods.

i Physical activity: 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. Data on physical activity were collected using the short form of "International Physical Activity Questionnaire (IPAQ)". The purpose of the questionnaires is to provide common instruments that can be used to obtain internationally comparable data on health-related physical activity (IPAQ, 2002).

ii Dietary intake: Data was collected using a food frequency questionnaire and the 24-hour recall method. The food frequency questionnaire was used to obtain information on the type of foods consumed by the respondents in the preceding days and the frequency of consumption of those foods. Various foods from different food groups were read out to the respondent, who in return was required to state the number of times she had consumed the food in the preceding days. The 24-Hour recall involved asking the participants to report on all the foods and drinks consumed in the previous 24 hours (the previous day), in direct chronological order from the first foods in the morning to the last foods before going to bed. Probing allowed us to obtain information on forgotten foods. A range of local household utensils: glasses, spoons, cups and plates were used for estimating the amount of foods and beverages actually consumed by the respondents. The gram equivalents of those foods were calculated which was used to calculate amounts of nutrients consumed.

iii Anthropometric measurements : Anthropometric measurements were conducted by measuring height with the help of stadiometre, weight with the help of weighing balance and waist and hip with the help of non-stretchable measuring tape.

a. Waist circumference: 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. The tape was tightened around the body without depressing the skin (CDC, 2007). Two measurements to the nearest 0.1cm were taken and the mean recorded.

b. Hip circumference: It was measured around the highest point of hip. Hip circumference was measured using a non-stretchable tape (CDC, 2007). Two measurements to the nearest 0.1cm were taken and the mean was recorded.

c. Weight: Weight was measured to the nearest 100 grams (0.1kg) using a weighing scale with the capacity of 180 kg , after calibrating it to zero, and after removal of shoes and excess clothing. Both weight and height were taken twice. In order to ensure quality data, the weighing scale was calibrated before measuring of weight every day and after every five measurements during the data collection time (CDC, 2007).

d. Height: Height was measured using stadiometre with the capacity of 197 cm and to the nearest 0.1cm. The subject was told to stand (without shoes) on a horizontal platform with his heels together and with the Frankfurter plain horizontal. The subject draws himself to full height without raising the shoulders with arms and hands relaxed and with the feet flat on the ground (CDC, 2007).

3.12 Data analysis

The questionnaire were checked and rechecked at the end of each day. After the data are manually edited and coded, they are entered into a database immediately. Microsoft Excel 2010 and SPSS version 20 were used to analyze data. Descriptive analysis was used to describe percentage and distribution of respondents by socio demographic variables, physical activity, dietary patterns, medical characteristics and behavioral characteristics. Likewise, qualitative data were transcribed and coded by assigning labels to various categories. Verified test parameters were used to establish the relationships between the variables and indicators of overweight and obesity in women.

3.13 Logistic and ethical considerations

Permission to conduct study was received from Nutrition and dietetics department, Central Campus of Technology. Ethical approval was obtained from National Health and Research Council (NHRC). An informed written and verbal consent was obtained from all the participants. The objectives of the research were explained in simple language. Privacy and confidentiality of collected data was ensured.

Part IV

Result and discussion

The cross sectional study to assess the prevalence of overweight and obesity as indicated by BMI, WC and WHR was conducted in 206 reproductive aged women (15-49 years) of Dharan sub-metropolitan city and results obtained are explained in the following headings:

4.2 Demographic and Socio-economic characteristics

The information's on demographic and socio-economic characteristics are shown below:

4.2.1 Age distribution of the study population

There were relatively more women in the youngest age-group (<30years) and they made up more than half, 52.4% (108) of the total sample. The age group with the least number of participants was 41-49 with figure of 16.5% (34). Age distribution of female population is shown in Table 4.1.

Table 4.1 Distribution of age of surveyed population (n=206)

Age	Frequency	Percent
<30	108	52.4
30-40	64	31.1
41-49	34	16.5
Total	206	100.0

4.2.2 Religion and caste distribution of study population

Almost all of the respondents, 91.3% (188) were Hindu. Minority of them, 0.5% (1) was Muslim followed by Christian, 2.4% (5) and Buddhist, 5.8% (12). On other side, more than half, 55.3% (114) were *Janajati* as Dharan is a major residence area of Kiratis. It was followed by Brahmin, 21.8% (45), Chettri, 14.6% (30) and Dalit, 4.4% (9). Madhesi and others categories comprised of 3.4% (7) and 0.5% (1) respectively. The result of CBS, 2011 survey too had revealed that majority of population of Dharan are *Janajatis.* Religion and caste distribution of reproductive aged female residing in Dharan is shown in Table 4.2.

Table 4.2 Distribution of religion and caste of surveyed population (n=206)

Factors	Frequency	Percentage
Religion		
Hindu	188	91.3
Christian	5	2.4
Buddhist	12	5.8
Muslim	1	0.5
Total	206	100
Caste		
Brahmin	45	21.8
Chhetri	30	14.6
Janajati	114	55.3
Dalit	9	4.4
Madhesi	7	3.4
Others	1	0.5
Total	206	100

4.2.3 Marital status and parity

The majority, 76.2% (157) of the females were married. The percentage of respondents who were either divorced or separated were only 1% (2) as shown in Table 4.3. Parity is one of the important factors of overweight and obesity in female possibly due to hormonal changes, changes in dietary pattern and other behavioral factors. This study found that majority of the respondents, 48.55% (100) had one to two parity because most of them were married. Beside that 31.55% (65) had zero parity which represents most unmarried females and newly married females while remaining 19.9% (41) had parity of $\geq$3 level as shown in Table 4.3.

Table 4.3 Distribution of marital status and parity (n=206)

Variables	Frequency	Percentage
Marital status		
Married	157	76.2
Unmarried	47	22.8
Separated	2	1
Total	206	100
Parity		
0	65	31.55
1-2	100	48.55
≥3	41	19.9
Total	206	100

4.2.4 Socioeconomic factors

The occupation type determines the income and type of physical activity performed during the work. Majority of females, 67.5% (139) were unemployed while remaining, 32.5% (67) were employed in different forms like clerical/shop owner or farmer etc. Only 6.3% (13) were illiterate which is much lower as compared to the finding from NDHS 2011 where 40% reproductive aged females were illiterate. Majority of the respondents had studied up to high school with figure of 30.6% (63). After that majority of them, 35.4% (73) had studied up to intermediate level. This all shows that females are much more educated in Dharan as compared to females form NDHS data. Majority of the respondents, 53.9% (111) have monthly income of greater than thirty thousand rupees while remaining 46.1% (95) had monthly income below thirty thousand rupees. This shows that slightly more than half of them had monthly income more than average monthly income of Nepalese families as determined by Nepal Rastriya Bank (NRB, 2014). Distribution of income, occupation and education are shown in Table 4.4 as follows.

Table 4.4 Distribution of socioeconomic factors (n=206)

Variables	Frequency	Percent
Monthly income(Rs)		
<30000	95	46.1
≥30000	111	53.9
Total	206	100
Occupation		
Employed	67	32.5
Unemployed	139	67.5
Total	206	100
Education		
Illiterate	13	6.3
Primary school	36	17.5
Middle school	21	10.2
High school	63	30.6
Intermediate or higher	73	35.4
Total	206	100

4.2.5 Type of family

This study showed that 88.8% (183) of female used to live in nuclear family while remaining, 11.2% (23) lived in joint family. It is an observed pattern that people nowadays are living in a nuclear pattern due to occupational, educational reason. It was found that 54.9% (113) of female had family members of less than 5 while 45.1% (93) had family members of greater than five as shown in Table 4.6. This result was found consistent with the result obtained from census of Sunsari district where average family size in Dharan was found to be around 4.3 (CBS, 2014a). Distribution of size of family and type of family is shown in Table 4.5.

Table 4.5 Distribution of size of family and type of family (n=206)

Factors	Frequency	Percent
Size of family		
Less than 5	113	54.9
More than 5	93	45.1
Total	206	100
Type of family		
Single	183	88.8
Joint	23	11.2
Total	206	100.0

4.3 Behavioral characteristics

None of the respondents skipped their breakfast. Almost half of them did not watch TV while eating. However, 18.4% (38) used to eat while watching TV on daily basis, 18% (37) used to eat 3 to 4 times a week while 14.6% (30) used to eat twice a week as shown in Table 4.6. This showed that at a certain period in a week female consumed food while eating T.V that could sub-consciously lead to overconsumption. In addition to availability of T.V. in every home, occurrence of nuclear family could be the reason behind watching television and eating simultaneously. It was found that 27.2% (56) of females used to eat outside once a day while remaining females did not eat as shown in Table 4.6. As most of the females were unemployed they might tend to eat at home rather than going outside.

In this study 58.3% (120) of females responded that they did not experience stress while 36.8% (76) experienced stress 2/3 times a week as shown in Table 4.6. Only minority of respondents i.e. 4.9% (10) experienced stress daily. Similarly, this study showed that 59.7% (123) slept for 7-9 hours a day in night, while nearly equal proportion of female slept for <7 hours and >9 hours i.e. 20% (41) and 20.3% (42) respectively as shown in Table 4.6. This implicates that most of them had good sleeping pattern. Distribution of behavioral factors is shown in Table 4.6.

Table 4.6 Distribution of behavioral factors (n=206)

Factors	Frequency	Percentage
Eating while watching TV		
Daily	38	18.4
twice a week	30	14.6
3 to 4 times a week	37	18
Never	101	49
Total	206	100
Stress		
Yes	10	4.9
Two to three times a week	76	36.8
No	120	58.3
Total	206	100
Sleep		
<7	41	20
7-9	123	59.7
>9	42	20.3
Total	206	100
Outside eating		
Once	56	27.2
Never	150	72.8

4.4 Physical activity pattern

Physical activity was assessed by short IPAQ questionnaire and the subjects were categorized into low, moderate, vigorous physical activity according to scoring protocol of IPAQ. Similarly analysis was also done according to WHO recommendation on physical activity and results are shown in Table 4.7. Distribution of physical activity is shown in Table 4.7.

Table 4.7 Distribution of physical activity (n=206)

Variable	Frequency	Percent
Physical activity		
Low	81	39.3
Moderate	110	53.4
Heavy	15	7.3
Total	206	100.0
Physical activity		
Adequate	173	84.0
Inadequate	33	16.0
Total	206	100.0

More than half of the respondents, 53.4% (110) performed moderate physical activity. Least proportion, 7.3% (15) of respondents performed heavy physical activity whereas 39.3% (81) were engaged in low physical activity pattern. As, almost all females are engaged in household work like cleaning, washing, cooking etc, they tend to have moderate physical activity. Some females living in rural part of Dharan performed heavy physical activity in form of agricultural work. Similarly it was found that 84% (173) had adequate physical activity (≥ 1500 mins / week) while only 16% (33) performed inadequate physical activity (<1500 mins/ week). Adequate physical activity for health life was achieved through household work.

4.5 Health related factors

It was found that 78.2% (161) females did not use contraceptives while remaining 21.8% (45) used it. Similarly, 29.6% (61) of females suffered from menstrual disorders while remaining 70.4% (145) did not. This showed that most of the female had good menstrual cycle.

Table 4.8 Distribution of health related factors (n=206)

Factors		Frequency	Percentage
Contraceptives use	Yes	45	21.8
	No	161	78.2
Menstrual disorders	Yes	61	29.6
	No	145	70.4

4.6 Dietary intake

4.6.1 Dietary intake in preceding one day

It was found that 20% (41) of female residing in Dharan consumed high fat diet, 56.3% (116) had normal fat intake while 23.8% (49) of female consumed low fat diet. Majority of females i.e. 80.6% (166) had inadequate calorie intake while 19.4% (40) had adequate calorie intake. Despite of low intake of fat and carbohydrate, there was high prevalence of overweight and obesity in females. It could be present weight status is not majorly determined by present dietary intake. Different confounding factors act together with fat and carbohydrate in weight gain process. In addition to that obese women tend to restrict their food intake especially rich in fat and carbohydrates.

Similarly it was found that 65% (134) of female respondents consumed inadequate protein intake while 35% (72) had adequate intake. It was found that majority of female had low carbohydrate i.e. 69% (142) while only 6.8% (14) had high carbohydrate intake. Calcium intake was found to be inadequate with 66.9% (138) consuming less than 600mg/day. It could be because most of the *janajati* females showed dislike towards dairy products. Distribution of intake of nutrients like fat, calcium etc is shown in Table 4.8.

Table 4.9 Distribution of nutrients intake (n=206)

Nutrients	Frequency	Percentage
Fat		
Low	49	23.8
Normal	116	56.3
High	41	19.9
Total	206	100
Protein		
Adequate	72	35
Inadequate	134	65
Total	206	100
Calorie		
Adequate	40	19.4
Inadequate	166	80.6
Total	206	100
Carbohydrate		
Low	142	69
Normal	50	24.2
High	14	6.8
Total	206	100
Calcium		
Adequate	68	33.1
Inadequate	138	66.9
Total	206	100

Mean intake of fat was found to be (56.26±27) gram which is much high as compared to the females of southern rural Terai of Nepal where mean fat consumption was 26.1±13.8 gram. It could be because meat consumption is high in Dharan while rural area could be deprived of eating meat due to low economic condition. On contrast mean intake of carbohydrate was found to be 263±104 gram which is much lower than that of southern Terai. This could be because females generally diet in Dharan to look attractive by cutting their meal especially rice but consuming other high fat products. Mean intake of calories was found to be a (1749.5±568) kilo calorie which is lower as compared to the females of

Southern Terai where mean calorie consumption was 1930±457 kilocalorie. It could be because most of the females in Dharan are weight conscious but adopt a wrong method to lose weight which simultaneously increases their weight. Cutting calories at a time do not lead to weight loss instead it increases craving for food and overeating may cause weight gain. Similarly, mean intake of protein intake was found to be (46.69±25) gram which is slightly lower than that of females of southern Terai where mean protein consumption was 47.4±12.5 gram (Ohno *et al.*, 1997).

This study also revealed that majority of female had high salt intake (69.4%). It is simply due to lack of knowledge regarding the appropriate amount of salt consumption. There was inadequate consumption of fruits and vegetables (<400gm/day) with 88.8% (183) not consuming recommended amount as shown in Table 4.10. Though majority of them had well income level, due to the ignorance and lack of awareness, females did not consume fruits and vegetables adequately. In addition, most of the married females did not consumed fruits adequately because most of them were found to give priority to children and husband. This study revealed that 32% (66) of female used to drink alcoholic beverages while 68 % (140) did not. This prevalence is much higher compared to the prevalence found in Sunsari district i.e. 16% (Niraula *et al.*, 2013).This could be because Dharan is major city of *janajatis* where alcohol consumption is allowed culturally too. Majority of females were non-vegetarian (90.8%). As most of the females were *janajati*, they generally tend to consume meat and meat products. Similarly, females tend to abstain from meat in their old age, but females in this study are in reproductive age, so majority of them consumed meat and meat products. Distribution of dietary factors are shown in Table 4.10 below.

Table 4.10 Dietary factors distribution

Variables	Frequency	Percentage
Salt intake		
Greater than 5 grams	143	69.4
Less than 5 grams	63	30.6
Total	206	100
Fruits and vegetables		
Adequate	23	11.2
Inadequate	183	88.8
Total	206	100
Drinking alcohol		
Yes	66	32
No	140	68
Total	206	100
Vegetarianism		
Vegetarian	19	9.2
Non vegetarian	187	90.8
Total	206	100

4.6.2 Food frequency questionnaire

This study found that fiber consumption in form of unpolished *dahl* was high with 55.3% (114) subjects consuming it regularly, 11.7% (24) subjects consuming frequently and only 33.1% (68) consuming rarely. Though consumption of unpolished *dahl* is regular, less amount of consumption could make fiber less available to females. Consumption of green leafy vegetables was also found to be high with 44.7% (92) consuming it frequently, 41.3% (85) consuming it on regular basis and only 14.1% (29) consuming it rarely. High consumption of green leafy vegetables could be due to the seasonal effect. Cereal products like whole wheat flour, maize was not consumed as frequently as other food groups providing fiber. Only 10.2% (21) consumed whole wheat flour regularly while 0.49% (1) consumed maize/millets/barley regularly. The frequency of consumption of different foods are given below in Table 4.11.

Table 4.11 Distribution of food/food groups intake

Variables	Frequency of consumption			Percentage		
	Regular	Frequent	Rare	Regular	Frequent	Rare
Fiber						
Whole wheat flour	21	29	156	10.2	14.1	75.7
Maize/Millets/ barley	1	11	194	0.49	5.33	94
Unpolished *dahl*	114	24	68	55.3	11.7	33
Grams and beans	12	93	101	5.8	45.2	49
Green leafy vegetables	85	92	29	41.3	44.7	14
Others vegetables	136	57	3	66	32.5	1.5
Fruits	48	78	80	23.3	37.9	38.8
Milk and milk products	79	52	75	38.3	25.3	36.4
Red meat	2	41	163	0.97	20	79.3
Fast food	105	74	27	51	36	13

Majority of subjects (38.8%) consumed fruits and vegetables rarely while 23.3% (48) consumed it on regular basis. However 23.3% consumed fruits on regular basis which is higher than the consumption pattern found in hill region of Nepal (Bhandari *et al.*, 2016). This study showed that 38.3% (79) subjects consumed dairy products on regular basis while nearly equal number i.e. 36.4% (75) subjects consumed it rarely. Majority of the respondents consumed fast foods regularly with 51% (105) consuming fast foods daily while only 13% (27) female consuming it on rare basis.

4.7 Prevalence of overweight and obesity in female

4.7.1 According to International BMI classification

The result was analysed according to International BMI categorization as given by WHO .This Figure 4.1 illustrates the fact that most of the women of reproductive age in Dharan are overweight or obese.

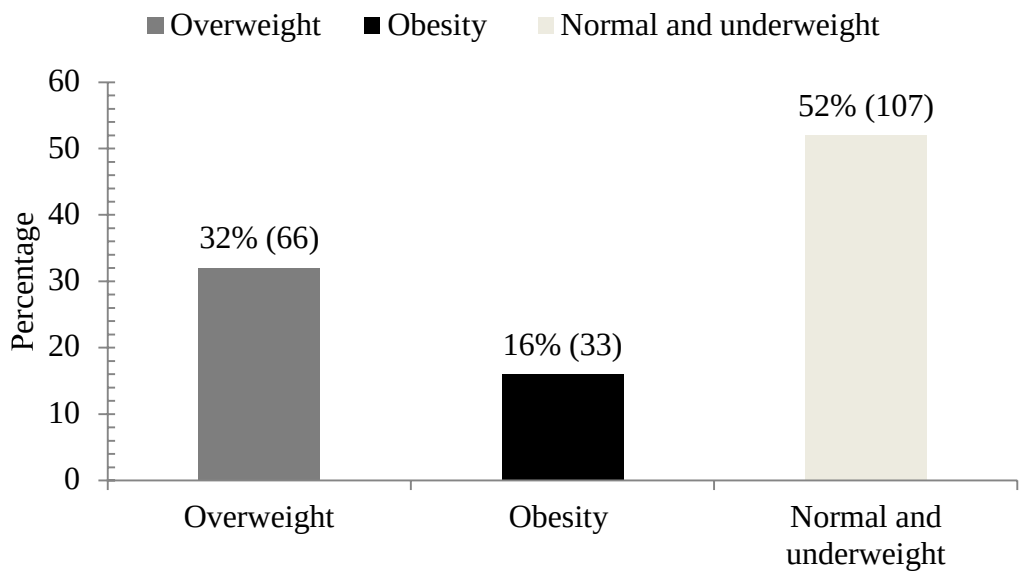


Figure 4.1 Prevalence of overweight and obesity in reproductive aged female residing in Dharan sub metropolitan city

According to WHO BMI classification, 32% (66) were found to be overweight while 16% (33) were obese. Likewise comparing these figures with a survey done in female in Srilanka, 22.8% were overweight while only 6.6% were obese (Jayatissa *et al.*, 2012). The result could be compared with the prevalence of overweight and obesity in male of Dharan which is 32.9% and 7.2% respectively (Vaidya *et al.*, 2006). Likewise the combined prevalence of overweight and obesity i.e.58% is more than double than the national data on urban female where the combined prevalence was only 26% (NDHS, 2011). As overweight and obesity is increasing year by year the high prevalence could be due to the time difference. Beside inadequate consumption of fruits and vegetables and rare consumption of dairy products could be the reason behind the high prevalence of overweight and obesity in female.

4.7.2 According to Asian BMI cut-off

According to Asian BMI cut- off 66.1% (136) of females were overweight or obese while remaining were not. The study found that 11.2% (23) of female were overweight and 52.4% (108) were obese according to Asian BMI cut off as shown in Figure 4.2. This prevalence is much greater than the prevalence found in the study done in female living in Ramkot VDC of Kathmandu district where 24.5% were overweight and only 1.8% were obese (Shahi *et al.*, 2013b).

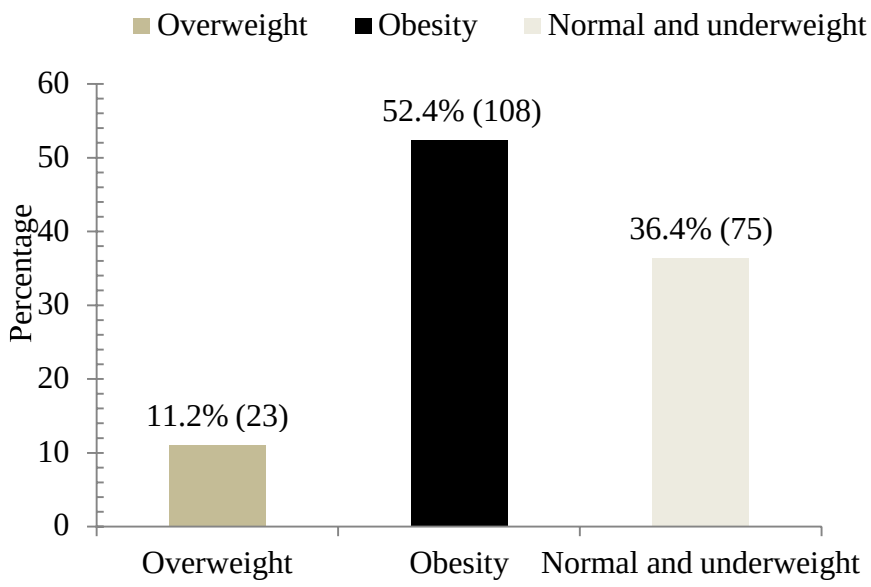


Figure 4.2 Prevalence of overweight and obesity in reproductive aged females residing in Dharan (Asian cut off)

This could be because females in Dharan have more easy access to market and so to fast foods as compared to females living in Ramkot VDC which is a rural part of Nepal. Likewise the prevalence is much higher than the prevalence among urban women residing in Chennai of age 20-49 years where 7.9% were found to be overweight and 19.8% were found to be obese (Anuradha *et al.*, 2011).

Comparing this result to the international prevalence, Srilankan reproductive aged women where 28.7% were overweight and 15.2% were obese which is much lower in comparison to our survey result (Jayatissa *et al.*, 2012). Likewise the prevalence is much higher than the prevalence among urban women residing in Chennai of age 20-49 years

where 7.9% were found to be overweight and 19.8% were found to be obese (Anuradha *et al.*, 2011).

4.7.3 According to waist to hip ratio measurement

The prevalence of abdominal obesity was found to be 89.8% (185). The result as shown in Figure 4.3 could be compared to the study done among nursing students in India where abdominal obesity was found to be 59% i.e. much lower than our finding (Kaur and Walia, 2007). This could be due to the difference in age between nursing students and reproductive aged females of Dharan. The prevalence is much higher than the prevalence i.e. 51.2% found from the study done among males residing in Dharan (Vaidya *et al.*, 2006). As most of the females were married in this study, postpartum weight gain could be the reason behind high prevalence of abdominal obesity as compared to male. Beside this, it could be assumed that abdominal obesity could have increased in this last one decade.

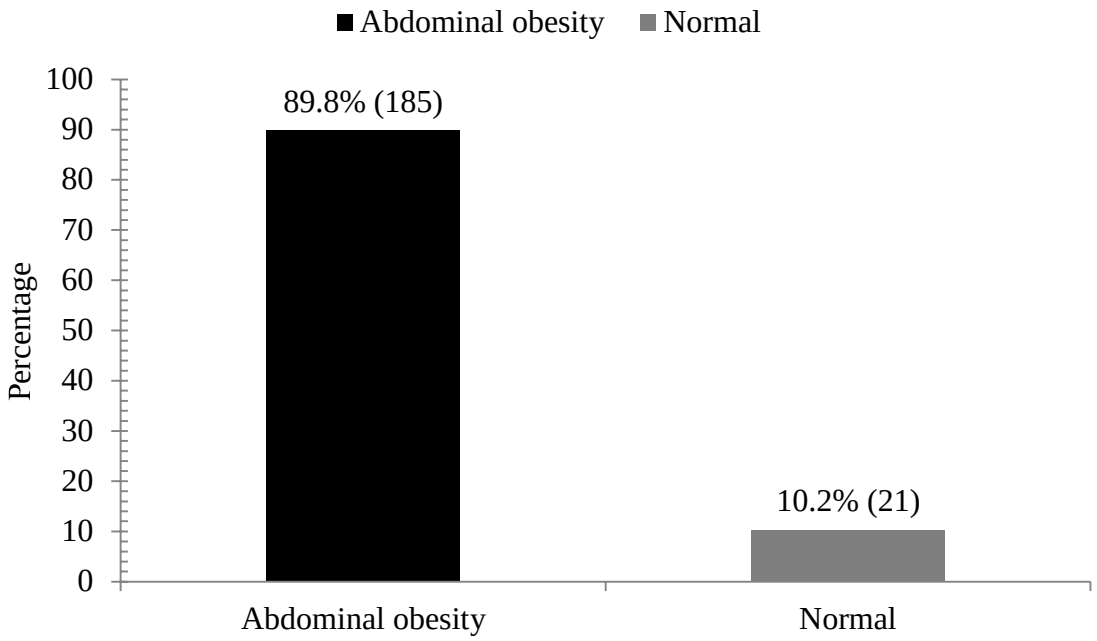


Figure 4.3 Prevalence of abdominal obesity among reproductive aged females residing in Dharan (WHO criteria)

The mean waist to hip ratio was found to be 1.41 which is much higher than NCD risk factors survey 2013 result i.e.0.9 (MoHP, 2013d). As NCD STEPS survey represents whole Nepal, both rural and urban part, it could be due to the lower prevalence in rural part that affected the similarity between these results. Likewise, the result could be compared

with a study done in female in Kavre district where the mean value of waist to hip ratio was 0.889 in non-diabetic female (Shah. and Shah, 2006).

4.7.4 According to waist circumference measurements

The mean waist circumference was found to be 90.14 cm which is far more than the mean WC of NCD steps survey 2013 (76.7 cm) conducted in Nepal (MoHP, 2013d). According to waist circumference measurement 75.2% (155) were found to be abdominally obese while 24.8% (51) were not. This result could be compared to the study done in women visiting TUTH revealed that 82.2% of women were abdominally obese in terms of waist circumference (Shapkota *et al.*, 2015). It could be because women visiting TUTH may have any chronic diseases which are the result of being abdominally obese. So, they have comparatively high waist circumference as compared to general reproductive aged female of Dharan. The figure below shows the prevalence of abdominal obesity in females.

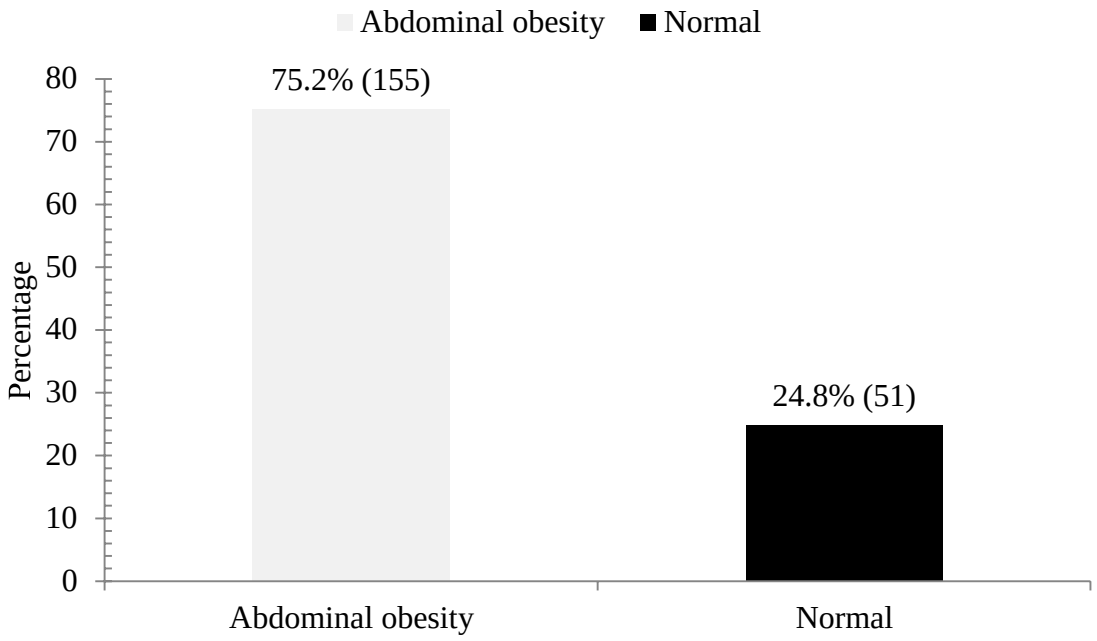


Figure 4.4 Prevalence of abdominal obesity among reproductive aged females residing in Dharan submetropolitan city (IDF)

4.8 Factors associated with overweight and obesity in female

Over nutrition is assessed by BMI using WHO international cut-off, waist circumference and WHR. Chi-square test was used to identify the characteristics that were related to overweight and obesity in women.

4.8.1 Factors associated with BMI (WHO cut off)

Age (p=0.000), Marital status (p=0.004), size of family (p=0.027), parity (p=0.019), drink (p=0.031), protein intake (p=0.002) are found to be significantly associated with BMI categorized according to WHO cut off as shown in Table 4.12. Salt intake (p=0.099) was found to have close relationship with BMI as shown in Table 4.12. The survey conducted in urban India too found that age, marital status and parity significantly affect the BMI of female of reproductive age. It was found that increase in age, marital status and parity level caused increase in BMI in female (Gouda and Prusty, 2014a). It is because with age BMR decreases and body fat increases (Fetters, 2015). However our study showed that weight gain during 40s was slightly less than during 30s. Marital status too affects overweight and obesity because being married causes female to be less conscious on their physical appearance. Similarly, due to the postpartum weight gain in females increase in parity too caused weight gain in females. Parity is known to contribute to obesity due to postpartum weight retention (Martinez *et al.*, 2013). Similarly a study conducted in middle school adolescents in Iran supported the findings that family size is directly related to BMI in female (K.O. *et al.*, 2011). High family size could provide emotional support to family members which may cause them to eat more. Different researches have shown that high protein intake diet helps in losing weight in sustainable basis.

High protein diet helps in better utilization of fat. Beside that high protein diet have high satiety power which prevent people to overeat (Brehm and Dalessio, 2008). Similarly, a study showed a significant association between being obese and drinking alcohol. Females consuming alcohol were less obese as compared to not consuming. It could be due to the fact that the young aged females consumed alcohol and low body weight is attributed to being young . Factors associated with BMI (WHO cut-off) of reproductive aged female are shown in Table 4.12.

Table 4.12 Factors associated with BMI (WHO cut off) among reproductive aged females residing in Dharan sub-metropolitan city

Factors		Overweight/obese	Percentage	Chi-square	P-value
Age	<30	41	37.9	18.556	0.001*
	30-40	44	68.75		
	41-49	20	58.8		
Size	Less than 5	48	42.5	7.254	0.027*
of family	Greater than 5	57	61.3		
Marital	Unmarried/Separated	15	30.6	15.173	0.004*
Status	Married	90	57.3		
Alcoholic	Yes	27	40.9	6.947	0.031*
drink	No	78	55.7		
Protein	Adequate	25	34.7	12.528	0.002*
intake	Inadequate	80	59.7		
Parity	0	22	33.8	18.447	0.019*
	1-2	57	57		
	≥3	25	60.9		
Salt	Greater than 5 gram	75	52.4	4.632	0.099
	Less than 5 gram	30	47.6		

4.8.2 Factors associated with waist circumference

Age (p=0.000), marital status (p=0.000), parity (p=0.0019), TV watching while eating habit (p=0.049), contraceptives use (p=0.018), eating outside (p=0.012), protein intake (p= 0.002) were found to have significant association with waist circumference measurement as shown in Table4.13.

Table 4.13 Factors associated with abdominal obesity among reproductive aged females residing in Dharan submetropolitan city

Factors		Abdominal obesity	Percentage	Chi-square	P-value
Age	Less than 30	66	61.1	26.642	0.000*
	30-40	57	89.1		
	40-49	32	94		
Marital status	Unmarried/separated	26	53	15.614	0.000*
	Married	129	82.2		
Parity	0	37	56.9	25.852	0.019*
	1-2	80	80		
	≥3	25	61		
T.V. watching and eating food	Daily	28	73.68	7.879	0.049*
	Twice a week	19	63.33		
	3 to 4 times a week	24	64.9		
	Never	84	83.2		
Eating outside once a day	Once a day	35	62.5	6.704	0.012*
	Never	120	80		
Protein intake	Adequate	45	62.5	9.648	0.002*
	Inadequate	110	82.1		
Contraceptive use	Yes	40	89	5.756	0.018*
	No	115	71		

In a study conducted in South Asian population it was found that with age, waist circumference too increases (Amin *et al.*, 2015). It is because with age BMR decreases and utilization of fat decreases (Fetters, 2015). Likewise some studies supported the fact of gaining abdominal fat in female after marriage. This could be due to change in dietary patterns, less focus on being attractive, have more social support, being less physically active (Coll *et al.*, 2015). Likewise, this study showed that high protein intake was associated with low abdominal obesity. This fact is supported by the cross- sectional study conducted in multi ethnic population of aboriginal, South Asian, Chinese and Europeans

origins. Likewise, a study conducted in obese males and females too supported the fact that high protein diet actually helps in losing weight (Clifton *et al.*, 2009). The satiating capacity of protein rich food and their role in fat utilization of body, proves their actual benefits in losing weight (Brehm and Dalessio, 2008).

Inconsistent to previous studies a contradictory result was found on eating food outside once a day. It showed that female eating outside had less waist circumference as compared to female not eating outside once a day. Another reason could be that females could consume less amount of food outside by replacing the main meal in home which could cut off their calorie intake. Similarly, use of contraceptives lead women to gain weight. There are not many researches done in the field of use of contraceptives and abdominal obesity. But a study conducted among Indian women found that long term use of pills promotes overweight and obesity in female. It is because consumption of pills cause hormonal imbalances in female leading to gain in weight (Agrawal and Agrawal, 2011)..

4.8.3 Factors associated with waist to hip ratio

Only parity (p=0.017) was found to be significantly associated with overweight and obesity in female as shown in Table 4.14. This result was found consistent with the result of the study of reproductive aged female in India (Gouda and Prusty, 2014b). Age (0.062), and marital status (0.072) were found to have near association.

Table 4.14 Factors associated with abdominal obesity (WHO) among reproductive aged females residing in Dharan

Factors		Abdominal obesity	Percentage	Chi-square	P value
Parity	0	52	80	12.043	0.017*
	1-2	94	94		
	≥3	39	95		
Marital status	Married	145	92.4	5.255	0.072
	Unmarried/separated	40	81.6		
Age	<30	92	85.2	5.56	0.062
	30-40	60	93.7		
	40-49	33	97.1		

Part V

Conclusions and Recommendations

5.1 Conclusions

This study has assessed the nutritional status of female of reproductive aged women in terms of overweight and obesity. As no study was conducted to assess the risk factors of overweight and obesity in reproductive aged female, this study needs to be understood clearly. The results of this study indicate that overweight and obesity is an important health issue in female of reproductive age residing in Dharan.

i It was found that more than half (50.48%) of females were overweight and obese (international BMI cut-off) while based on WHR and WC 89.8% and 75.2% were overweight and obese respectively.

ii The main risk factors for overweight and obesity were increasing age (p=0.000), being married (p=0.004), high parity (p=0.019) and low protein intake (p=0.002).

iii The main risk factors for abdominal overweight and obesity (IDF) were increasing age (p=0.000), being married (p=0.000), high parity (p=0.019), not eating outside once a day (p=0.012), low protein intake (p=0.002), contraceptive use (p=0.018). High parity (p=0.017) was only risk factor found to significantly affect abdominal obesity (WHO).

iv There was high prevalence of overweight and obesity in reproductive aged females in Dharan. Hence, concerned agencies should launch appropriate programs to combat the factors associated with overweight and obesity

5.2 Recommendations:

i Similar study could be conducted in same people using body fat as an indicator of overweight and obesity.

ii As enormous number of females were found to be overweight and obese, concerned agency need to formulate appropriate policy to combat this .

iii Physical activity needs to be promoted in females and women-friendly environment needs to be created.

iv As protein intake was found to be inversely associated with overweight and obesity people should be recommended to consume protein rich diet less in fat.

Part VI

Summary

Overweight and obesity is not limited to developed countries but recently have been known to affect the lives of people in developing countries. Through different anthropometric measurements like BMI, WHR, WC, it has been known that overweight and obesity is affecting the world with especial focus on women. Data from Nepal has also shown increasing trends of overweight and obesity among women and increasing disease occurrence.

The cross sectional study was conducted in reproductive aged females residing in Dharan to check out overweight and obesity and their risk factors. This study measured different anthropometric measurements and analysed the data in micro soft excel and SPSS version 20. WHO international classification on BMI was used to determine generalised overweight and obesity. Waist circumference and waist to hip ratio was analysed using IDF and WHO criteria respectively. It was found that 50.48% of women were overweight or obese. Likewise 89.8% of women were abdominally obese using WHO i.e. WHR >0.84 criteria while 75.2% were abdominally obese using IDF criteria i.e. WC>80 cm.

There are various factors namely socio demographic and economic factors, dietary factors, behavioural factors, physical activity, health related factors that affect the indicators of overweight and obesity. However our study, found that age (p=0.000), marital status (p=0.000), size of family (p=0.027), parity (p=0.019), drink (p=0.031), protein intake (p=0.002) are found to be significantly associated with overweight and obesity (WHO cut-off). Only parity (p=0.017) was found to be significantly associated with abdominal obesity (WHO cut-off) in female while age (p=0.000), marital status (p=0.000) , parity (p=0.000), TV watching while eating habit (p=0.049), outside eating (p=0.012), protein intake (p=0.002) were found to have significant association with waist circumference measurement (IDF cut-off).Though food frequency questionnaire did not show any significant association with overweight and obesity, it showed that consumption of whole wheat flour, maize, barley, wheat was too low on regular basis while consumption of energy dense industrial foods and fast foods were extremely high. There was high prevalence of overweight and obesity in reproductive aged females in Dharan. Hence, concerned agencies should launch appropriate programs to combat the factors

associated with overweight and obesity. So that overweight and obesity and consequences could be prevented.

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Appendices

Appendix A Survey questionnaire

Participant's code | | | | | Date of interview (B.S.): | Yr. | Mth. | day |

A. GENERAL INFORMATION

1. Name of female: _____
2. Date of birth (B.S)

Yr.	Mth.	day

3. Age: ☐☐ years
4. Religion:

i. Hindu
ii. Christian
iii. Buddhist
iv. Muslim
v. Others_____

5. Caste/Ethnicity:

i. Brahman
ii. Chhettri
iii. Madhesi
iv. *Janajati*
v. Dalit
vi. Others

6. Address - Dharan Ward no:_____
   Tole:_____

B. Anthropometric information

	Reading a	Reading b	Mean reading
Weight (kg)			
Height (cm)			
Waist circumference (cm)			
Hip circumference (cm)			

C. Family information

7. Number of family members: _____
8. Number of female members:_____
9. Number of male members:_____
10. Type of family:

1. Nuclear 2. Joint

11 Educational level:

i. Illiterate
ii. Primary school
iii. Middle school
iv. High school
v. Intermediate and above

12 Family monthly income level (Rs):

i. .<30,000 ii. ≥30,000

13 Occupation:

i.Unemployed

ii.Employed

14 Marital status :

i. Unmarried / Separated
ii. Married

15 Parity:

D. Dietary factors

16. Do you drink?

i. Yes ii. No

17. What are you?

i. Vegan iii. Lacto ovo vegetarian

ii. Lacto-vegetarian iv. Non-vegetarian

18. How often do you skip breakfast?

i. Daily iii. Twice/thrice a week

ii. Once a week iv. Never

19. How much oil do you use monthly while cooking?_____litres

20. How many salt packets do you use monthly?_____

D. Physical Activity Questionnaire (short IPAQ)

21. 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)?

i. _____Days per week

ii. Don't Know/Not Sure

iii. Refused

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

i. _____Hours per day_____Minutes per day

ii. Don't Know/Not Sure

iii. Refused OR/

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

i. _____ Hours per week _____Minutes per week

ii. Don't Know/Not Sure

iii. Refused

23. 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)?

i. ____Days per week
ii. Don't Know/Not Sure
iii. Refused

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

i. _____Hours per day_____Minutes per day
ii. Don't Know/Not Sure
iii. Refused

OR

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

i. _____ Hours per week_____Minutes per week
ii. Don't Know/Not Sure
iii. Refused

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

i. ____Days per week
ii. Don't Know/Not Sure
iii. Refused

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

i. _____Hours per day_____Minutes per day
ii. Don't Know/Not Sure
iii. Refused

OR

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

i. _____ Hours per week_____Minutes per week

ii. Don't Know/Not Sure

iii. Refused

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

i. _____Hours per weekday_____Minutes per weekday

ii. Don't Know/Not Sure

iii. Refused

OR

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

i. _____Hours on Wednesday _____ Minutes on Wednesday

ii. Don't Know/Not Sure

iii. Refused

F. Other Behavioral factors

28. How often do you eat in front of tv?

i.Daily iii. 3 to 4 times a week

ii. Twice a week iv. Never

29. How often do you have stress?

i. Daily iii. Never

ii. 2-3 times a week

30. Do you wake at night, get out of bed and eat?

i. Always iii. 3 to 4 times a week

ii. Twice a week iv. Never

31. How many hours do you sleep at a night?.....

32.Do you use contraceptives?

i. Yes ii. No

33.Do you have menstrual disorders/irregular menstrual periods/thyroid disorders?

i. Yes ii. No

34. How many times do you eat away from home in a day?

i. Once iii. 3 times

ii. twice iii. > 4 times

G. Food frequency table

Type of food	**Regular (at least once a day)**	**Frequent (3/4 times in a week)**	**Rare (Once in a week or less)**
Rice			
Wheat			
Maize			
Millet			
Barley			
Unpolished *dahl*			
Grams/beans/peas			
GLV			
Other vegetables			
Fruits			
Red meat			
Fast foods			

H. 24 hours dietary recall

Timing	Description of food or drink	Serving	Amount
Breakfast			
Lunch			
Snacks			
Dinner			
Bed time			

Appendix-B Informed consent

Namaste!

I, Miss Prabina Bhattarai, a graduate student of Nutrition and Dietetics in Central Campus of Technology, Dharan; am going to conduct dissertation work in Dharan submetropolitan city for the award of bachelor‟s degree in Nutrition and Dietetics.

The topic for the study is **"RISK FACTORS ASSOCIATED WITH OVERWEIGHT AND OBESITY AMONG REPRODUCTIVE AGED FEMALES RESIDING IN DHARAN SUBMETROPOLITAN CITY**"

Under this study, nutritional status and risk factors associated with it will be surveyed among reproductive aged females residing in Dharan sub metropolitan city. This study will provide information about the overweight and obesity status and risk factors associated with it among reproductive aged females residing in Dharan sub-metropolitan city. During the study height and weight of the participants will be measured and socio demographic and economic factors, behavioral factors, physical activity, dietary factors and health related factors will be assessed.

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

Do you want to get participated in this study?

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

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

Date: Date:

Place: Place:

Appendix C. NHRC approval letter

Government of Nepal

Nepal Health Research Council (NHRC)

Ref. No.: 1372

12 February 2017

Ms. Prabina Bhattarai
Principal Investigator
Central Campus of Technology
Dharan

Ref: **Approval of Research Proposal** entitled **Risk factors associated with overweight and obesity among reproductive aged female residing in Dharan Sub-metropon city**

Dear Ms. Bhattarai

It is my pleasure to inform you that the above-mentioned proposal submitted on 26 January 2017 (**Reg. no. 19/2017**) has been approved by Nepal Health Research Council (NHRC) National Ethical Guidelines for Health Research in Nepal, Standard Operating Procedures Section 'C' point no. 6.3 through Expedited Review Procedures.

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

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

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

As per your research proposal, the total research amount is **NRs. 26000** and accordingly the processing fee amounts to **NRs-1000.00**. It is acknowledged that the above-mentioned processing fee has been received at NHRC.

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

Thanking you,

Dr. Khem Bahadur Karki
Member- Secretary

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

Appendix D- Photo gallery

Map of study site

Measurement of height

Measurement of weight