RISK FACTORS ASSOCIATED WITH OVERWEIGHT AND OBESITY IN REPRODUCTIVE AGED KIRATI FEMALES IN KIRAT COLONY OF BHADRAPUR MUNICIPALITY

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Risk factors associated with Overweight and Obesity among reproductive aged kirati females in kirat colony of Bhadrapur municipality

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 kirati Females in kirat colony of Bhadrapur municipality* presented by Nabina Lawoti 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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Abstract

Obesity is a multifactorial disorder in which excessive body fat deposition arises when energy intake is higher than expenditure. It has become a major global public health challenge not only in developed countries but equally in developing countries like Nepal. The aim of the present work was to find out the risk factors associated with overweight and obesity in reproductive aged kirati females in Kirat Colony of Bhadrapur municipality of Jhapa District. Anthropometric measurements and basic associated factors were collected. SPSS version 20 and Microsoft excel 2010 were used for the analysis. Chi-square technique was used to assess factors associated to overweight and obesity of reproductive aged females.

The analysis of the study revealed that 27.7% were overweight and 19.6% were obese according to International BMI classification, similarly it was found that 33% and 32.1% were overweight and obese according to Asian BMI classification. The mean waist circumference was found to be (87.57 ± 16.54) cm. 25.9% of kirati females were at level I risk and 44.6% were at level II risk. According to WHR ratio 67% of the respondents were abdominally obese. This study also analysed many factors associated with overweight and obesity. According to the WHO BMI cut-off the factors associated were age, parity, medication, protein intake, salt intake. Similarly for waist circumference, age, marital status, drink, medication, protein intake factors were found to be associated. Also there are many factors found to be associated with abdominal obesity (WHR) that are age, marital status, drink, medication. The dietary intake was also analysed where it was found out that 33% of respondents were having low fat diet, 48.2% were having inadequate protein, majority i.e 84.8% were having low carbohydrate diet, 92% were having inadequate energy and for calcium majority of respondents that is 74.1% were having inadequate calcium.

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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
GWG	Gestational Weight Gain
GNP	Gross National Product
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
MUAC	Mid Upper Arm Circumference
NCI	National Cancer Institute
NCD	Non-Communicable Disease
NDHS	Nepal Demographic and Health Survey
NHANES	National Health and Nutrition Examination 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
UNDP	United Nation Development Project
WC	Waist Circumference
WHR	Waist hip ratio
WHO	World Health Organization

Part I

Introduction

1.1 General introduction

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. Body mass index is recommended by the World Health Organization to classify obesity (WHO, 2016). Obesity is a global epidemic, which is risk factor for cardiovascular disease and metabolic abnormalities. Obesity is due to energy balance, the intake of calories is more than expenditure of energy. It is a state in which there is generalized accumulation of excess adipose tissue in the body leading to more than 20% of the desirable weight whereas overweight is a condition where the body weight is 10-20% greater than the mean standard weight for age height and sex (Srilakshmi, 2014). It is measured by body mass index, waist circumference, waist circumference waist-hip ratio (WHR), body fat (BF) distribution and abdominal fat mass, each having its own merits and limitation (Amin *et al.*, 2015b).It is a major contributor to the global burden of chronic disease, disability and premature death (A. Sharma, 2009).

Overweight and obesity is the growing global health problems (Shah, 2010).In 2016, more than 1.9 billion adults, 18 years and older were overweight out of which over 650 million were obese. Although South Asians have had low prevalence rates of obesity when compared with many Western countries, their vulnerability to obesity-related diseases with rising comorbidities is higher than in developed countries (Simkhada *et al.*). The evidence with regard to the relationship of obesity with medical comorbidities was assessed and priority research issues were identified. The evidence is overwhelming on the association of obesity to number of medical complication. This includes: insulin resistance, glucose tolerance, diabetes mellitus, hypertension, dyslipidemia, sleep apnea, arthritis, hyperuricemia, gall bladder disease and certain types of cancer. The relationship between central obesity and the above condition is positive for most of them (FX, 1999). The fundamental cause of overweight and obesity is an energy imbalance between calories consumed and calorie expended. Mainly due to high intake of energy-dense foods that are high in fat and also due to increase in physical inactivity, increase in sedentary lifestyle also due to change in the modes of transportation and increasing urbanization.

Nepal falls in low human development category ranking 144 among 188 countries in the world, but still has progressed from 157th in 2013 which shows both increase in income and educational level of Nepalese people **(**UNDP, 2015). Historically, most populations suffering from obesity resided in high-income, industrialized countries (Caballero, 2007). However, in the recent times, the most dramatic increases in the prevalence of overweight or obesity are seen in low-income countries (Prentice, 2005) Similarly, a study conducted in US found that obesity is associated with early puberty, aberrant menstrual patterns, decreased contraceptive efficacy, ovulatory disorders and increase the miscarriage rate (Lash and Amstrong, 2009).

1.2 Statement of the problem

The rapid emergence of overweight and obesity in developing countries has been recognized as a major public health problem in most regions of the world, overweight now exceeds underweight among women of reproductive age. South Asia has traditionally been characterized as harbouring some of the highest rates of underweight in women worldwide and there has been limited research to investigate how the nutritional status of women has changed during the recent period of economic development. The prevalence of underweight has remained high in Bangladesh, Nepal, and India, whereas the prevalence of overweight-obesity in women of reproductive age has risen between 1996 and 2006 (Balarajan and Villamor, 2009). 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). People who are obese consume fewer essential nutrients, according to a study published online in the Journal of the American College of Nutrition (comittee, 2015). 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, 2008, 2013).

Obesity is a physiological risk factor for non- communicable diseases (NCDs) (MOHP, 2013). 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 standardised 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 adverting reproductive outcomes. Infertility rates are found to be higher among obese women and once a woman is pregnant, both maternal and foetal 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.*, 2010) . If prevention is not applied earlier, the problem will surely rise 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.

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.*, 2010). So, assessment of overweight and obesity in female is the must.

1.3 Conceptual Framework

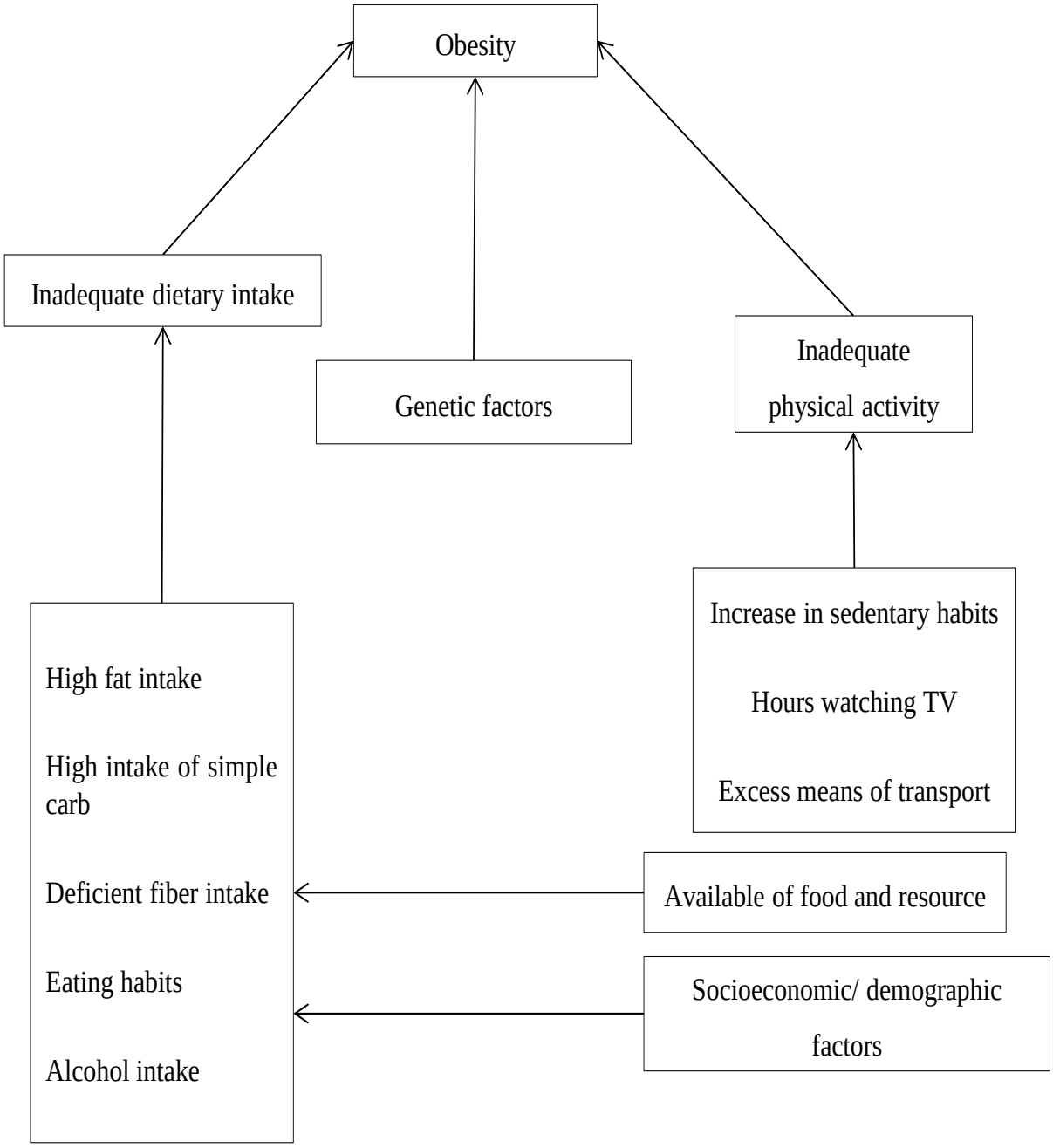


Fig. 1.1 Conceptual framework for overweight and obesity

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

1.4 Objective of the study

1.4.1 General objective

To assess the risk factors associated with overweight and obesity among reproductive aged Kirati females residing in Kirat colony of Bhadrapur municipality.

1.4.2 Specific objectives

- To carryout anthropometric measurements of 15-49 years kirati females to assess overweight and obesity.
- To conduct survey to find out socio-economic status, dietary intake, physical activity level, behavioural factors and health factors with the help of questionnaire.
- To identify the major risk factors associated with overweight and obesity of kirati women residing in Kirat colony of Bhadrapur municipality.

1.5 Research questions

- What is the prevalence of overweight and obesity in reproductive aged kirati females residing in Kirat colony of Bhadrapur municipality?
- What are the socioeconomic status, dietary intake, physical activity level, behavioural factors, and health factors of reproductive aged Kirati women residing in Kirat colony of Bhadrapur municipality?
- What are the major risk factors associated with overweight and obesity in reproductive aged kirati females residing in kirat colony of Bhadrapur municipality?

1.6 Significance of the study

- This survey result will be useful in highlighting the problem of overweight and obesity and also its contributing factors in 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 counselling of women in Kirat Colony and similar circumstances in the country.
- As prevention is best way to achieve health and 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 two 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.

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". The most commonly used measure for overweight and obesity is the Body Mass Index (BMI). It is a simple index to classify overweight and obesity in adults. It is defined as the weight in kilograms divided by the square of the height in meters (kg/m^2) (WHO, 2016). BMI is a measure of generalised obesity whereas central obesity can be measured on the basis of waist circumference and waist to hip ratio (WHR). An adult who has a BMI of 25-29.9 is considered overweight, and an adult who has a BMI over 30 is considered obese. A BMI of 18.5-24.9 is considered normal weight. In general, overweight and obesity indicate a weight greater than what is considered healthy. Obesity is a chronic condition defined by an excess amount of body fat (Balentine). According to WHO waist to hip ratio above 0.85 is considered as central obesity whereas waist circumference above 80 cm is considered as being centrally or abdominally obese (IDF, 2006).

A chronic imbalance between energy intake and energy expenditure leads to obesity. Hyperphagia, a low metabolic rate, low rates of fat oxidation and an impaired sympathetic nervous activity characterize animal models of obesity. Similar metabolic factors have been found to characterize humans who are susceptible to weight gain (Galgani and Ravussin, 2010). Apart from increased intake of energy rich food and decreased physical activity, hormones and gene also play an important role in overweight and obesity.

Several hormones including leptin, insulin, sex hormones and growth hormone have been studied extensively for their role in obesity and increase in body weight. These hormones play a role in appetite, metabolism, body fat distribution and increased storage of excess energy in food as fats. Obese people have levels of these hormones that can increase accumulation of body fat by altering the metabolism of the fats (Mandal). Insulin and leptin affects the regulation of body weight. 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 eats 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 another 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, 2014).

The rapid emergence of overweight and obesity in developing countries has been recognized as a major public health problem. In most regions of the world, overweight now exceeds underweight among women of reproductive aged women (Balarajan and Villamor, 2009). Age specific fertility rates are defined using the number of women in each age group and number of births to women in that age group. Women of reproductive age refers to all women aged 15-49 years.(WHO, 2006)

2.2 Theories on Obesity

There are different theories on obesity. They are

2.2.1 Fat cell theory

The idea behind the theory is that each body is programmed to have a basic set number of cells. Fat cell theory shows that during growth, fat cells increase in number. When energy intake exceeds expenditure, fat cells size increases. When fat cells have reached their maximum size and energy intake continues to exceed energy expenditure, fat cells increase in number again. When there is fat loss, the size of the fat cells shrinks, but not the number. The theory states that the creation of new fat cells is far easier than losing old ones, a fact that plays an important role in adult weight loss (Anon., 2017)

2.2.2 Set point theory

According to the set-point theory, there is a control system built into every person dictating how much fat he or she should carry – a kind of thermostat for body fat. Some individuals have a high setting, others have a low one. According to this theory, body fat percentage

and body weight are matters of internal controls that are set differently in different people (Riess and Miller, 2002).

2.2.3 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 was 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, 2014).

2.3.1 Based on BMI

2.3.1.1 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.

2.3.1.2 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 handicaapped by masses of internal fat ad 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.

2.3.1.3 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.

2.3.2 Based on onset of obesity

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

2.3.2.1 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.

2.3.2.2 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.

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 2 types of obesity (Sheth and Shah, 2006).

2.3.3.1 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 obeserved 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 doesnot curve inwards so the trunk has a somewhat straightup 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.

2.3.3.2 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.

2.4 Risk factors associated with overweight and obesity

A number of factors can play a role in weight gain. These include diet, lack of exercise, factors in a person's environment, and genetics (NIH). 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 Age

It can occur at any age in either sex as long as the person is under positive energy balance at Nutrition Foundation of India have shown more females than males are found to be over weight among all age groups. Harmonal predisposition put women at higher risk of obesity when compared to men (Jayatissa *et al.*, 2012). By the late twenties, many women notices they can't eat the same things they used to eat and that their weight doesn't fall as easily as it once did and the flattening cycle continues. As you lose muscle, your natural calorie burning ability slows down even more. And as you lose muscle and gain fat, fat can develop into the muscle and cause weight gain and metabolic dysfunction.(Fetters)**.** 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).

2.4.2 Marital status

Married men and women are less likely to be conscious of or concerned about their body weight because they are not actively seeking a mate. As a consequence, married individuals are more likely to experience greater increase in body weight than comparable nonmarried individuals who are attempting to minimize weight gain in order to attract a partner (Teachman, 2016). Obesity, the presence of high levels of body fat, has risen dramatically during the late 20th and early 21st centuries in the United States (Flegal *et al.*, 2010). People tend to gain weight as they mature and then lose weight in later lif**e** (Wang and Beydoun, 2007). Despite of 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 least on being attractive, have more social support whereas on the other hand, unmarried subjects manages their weight in an effort to look more attractive to potential marital partner (Janghorbani *et al.*, 2008).

2.4.3 Parity

Parity is known to contribute to obesity due to postpartum weight retention (Martinez *et al.*, 2013). The amount of weight gain is associated with increase in parity (Wolfe *et al.*, 1997)**.** Excessive gestational weight gain (GWG) references weight gain during pregnancy in excess of the recommended range for a woman's pre-pregnancy body mass index (BMI) (Tremblay and Gilbert). In Australia, nearly one-third of women enter pregnancy obese and approximately 50% of pregnant women gain weight excessively. High gestational weight gain (GWG) is the strongest predictor of maternal overweight/obesity post-birth and is also associated with an increased risk of childhood obesity (Hill *et al.*, 2013). 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, 2014).

2.4.4 Socioeconomic status

Socioeconomic status (Indians) is an economic and sociological combined total measurement of an individual's or family's economic and social position based on income, education and occupation. Assessment of socioeconomic status is an important aspect in community based studies. Evaluation of SES of a family would mean the categorization of the family in respect of defined variables such as education, occupation, economic status, physical assets, physical assets, social position etc. Presently, there is no standard questionnaire to assess the Socio economic status of Nepalese people. A modification to Kuppuswamy's scale was used for Nepal (Ghosh and Ghosh, 2009). Although economic and social development can improve health, it can also lead to increasing obesity and widening SES disparities in obesity (Pampel *et al.*, 2012). In developed countries, obesity is widely considered as a condition that affects people with lower SES more than those with higher SES, and low-SES groups have an increased risk of obesity (Wang and Beydoun, 2007). A systematic review by (Monteiro *et al.*, 2004) showed that obesity can be considered a disease which occurs not only in people with higher SES, but also occurs in lower SES populations as gross national product (GNP) is increasing in the developing countries (Monteiro *et al.*, 2004)

2.4.5 Physical activity

Obesity results from energy imbalance. A number of factors influence how many calories people burn each day, among them, age, body size, and genes. But the most variable factor-and the most easily modified-is the amount of activity people get each day. Keeping active can help people stay at a healthy weight or lose weight. It can also lower the risk of heart disease, diabetes, stroke, high blood pressure, osteoporosis, and certain cancers, as well as reduce stress and boost mood. Inactive (sedentary) lifestyles do just the opposite. Despite all those benefits physical inactivity level are declining not only in wealthy countries but also in low and middle income countries such as China. Physical activity decreases fat around the waist and total body fat, slowing the development of abdominal obesity and also reduces depression and anxiety, and this mood boost may motivate people to stick with their exercise regimens over time. The intensity of physical activity is measured in metabolic equivalents or METs. One MET is defined as the calories burned while an individual sits quietly for one minute (WHO, 2011). A study conducted in Indian women showed that women who were more physically active were less overweight and obese (Jayamani *et al.*, 2013). 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

2.4.6.1 Energy density food

High energy density of the diet was found to be associated with obesity in humans. In adults, there is strong evidence that diets high in energy density are associated with increased body weight, whereas diets low in energy density encourages weight maintenance or even weight loss. The body of evidence for an association between high dietary and obesity is less strong in children and adolescents. High ED was found to be associated with greater intakes of energy, fat and added sugars, and with significantly lower intakes of fruits and vegetables (Hebestreit *et al.*, 2014). The changes in diet for the past 30 years have been significant in terms of more fat, more meat, added sugars and

bigger portion sizes. “Nutrition transition,” termed as a combination of improved access to food, decreased physical activity level has been identified to the prime risk for the increasing prevalence and chronic metabolic disease in the developing countries (Hoffman, 2004).

The knowledge emerging with the developmental origins research provides only one dimension of the shift toward greater obesity. While early life exposures and biological insults appear to enhance the adverse effects of dietary change, in the end shifts in energy balance and the entire structure of the diet have played major concomitant and separate roles. 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. Diets rich in legumes, other vegetables, and coarse grains are disappearing in all regions and countries. Access to many new empty calorie foods and beverages relates to current economic and social development has increased. Energy-dense foods and energy-dense diets have been blamed for the global obesity epidemic. In a number of studies, fast foods, snacks, sweets, and desserts, sweetened soft drinks, and large portion sizes have all been linked to greater obesity risk (Drewnowski and Darmon, 2005).

2.4.6.2 Fruits and vegetables

Moreover, fruits and vegetables are rich sources of vitamins and minerals, dietary fibre and a host of beneficial non-nutrient substances including plant sterols, flavonoids and other antioxidants and consuming a variety of fruits and vegetables helps to ensure an adequate intake of many of these essential nutrients. Fruits and vegetables are important components of a healthy diet. Reduced fruit and vegetable consumption is linked to poor health and increased risk of non-communicable diseases (NCDs). An estimated 5.2 million deaths worldwide were attributable to inadequate fruit and vegetable consumption in 2013. (WHO, 2018). The consumption of fruit is known to attenuate obesity and obesity-related diseases such as diabetes and coronary heart disease. Thus, low fruit consumption is considered to be the fourth leading contributor to the global disease burden, and thus one

of the major attributable risk factors for diseases such as being overweight (high body-mass index (BMI), hyperglycaemia, and hypercholesterolemia (S. P. Sharma *et al.*, 2016).

The consumption of fruit can provide essential micronutrients to limit obesity via various mechanisms. Therefore, the presence of various micronutrients in different types of fruit could be one of the underlying mechanisms responsible for their anti-obesity effect (Ghalaeh *et al.*, 2012). Dietary fibre intake is inversely related to body weight and body fat in many studies and high intakes of fibre have been associated with weight loss. Fibre can moderately lower the energy density of meals. These beneficial effects of fibre are thought to be owing to a variety of factors - foods that are high in fibre may displace those foods that are high in fat and energy-dense (Pereira, 2014)

2.4.6.3 Milk and Milk products

Dairy products have long been considered a super food, as they are a source of calcium, high-quality protein, vitamin B2, vitamin D, potassium, and medium-chain fatty acids. Milk is generally considered an important protein source in the human diet, supplying approximately 32 g protein/l. (Pereira, 2014).

Dietary calcium is known to increase lipolysis and preserve thermogenesis, thereby accelerating weight loss (Regina *et al.,* 2012). Research has actually found that people who consume dairy products as part of a calorie-controlled diet lose more weight than people who skip dairy and better still, most of this weight is lost from the waist, which not only makes us look slimmer but also reduces the risk of diseases such as heart disease and type 2 diabetes, both of which are linked to an ‘apple’ shape (Kellow).

The independent, inverse association of daily plain milk consumption with the risk of being obese suggests that high plain milk intake may lower the risk of obesity in adult Indians (Shalek *et al.*, 2013) Greater consumption of total dairy products may be of importance in the prevention of weight gain in middle-aged and elderly women who are initially normal weight (Rautiainen *et al.*, 2016)

2.4.6.4 Salt intake

It has been recommended that adults should consume less than 5 gram of salt per day (WHO, 2013). 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 adiponectin levels in body which subsequently increases fat in body. High salt intake leads to water retention in body which subsequently leads to weight gain. Beside this high salt intake is known to increase adiponectin levels in body which subsequently increases fat in body (Kamari *et al.,* 2010) **.**

2.4.6.5 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). Alcohol is an energy dense nutrient (7 kcal/g) and because of its place at the top of the oxidative hierarchy (Swinburn *et al.,* 2004). 1 gram of alcohol provides 7.1 kcal (29 kJ) and studies showing that energy consumed as alcohol is additive to that from other dietary sources, increased energy intake with alcohol use can certainly promote a positive energy balance and ultimately weight gain. Alcohol has also been shown to influence a number of hormones linked to satiety. Alcohol may influence energy intake by inhibiting the effects of leptin, or glucagon (Traversy and Chaput, 2015).

The body is unable to store alcohol, and oxidation of ingested alcohol is given priority over that of other macronutrients. Alcohol consumption therefore meets some of the body's energy needs, allows a greater proportion of energy from other foods eaten to be stored and is thus associated with an increased risk of abdominal fat (WHO, 2000). Alcohol may lead to an increase in energy intake, inducing an increase in body mass index. It is also known that alcohol suppresses the oxidation of fat, thus favouring fat storage (Lukasiewicz *et al.,* 2005).

2.4.7 Behavioural factors

2.4.7.1 Watching T.V. while eating

Certain activities such as television viewing for several hours may contribute to a sedentary lifestyle with increased caloric intake and low levels of physical activity predisposing to overweight and obesity, which in turn contributes to the development of chronic non-communicable diseases (Poterico *et al.*, 2012). 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). Economic constraints as well as modern lifestyles lead people to consume diets with a positive energy balance, but low in micronutrients, resulting in increasing prevalence of obesity and suboptimal nutritional status (Troesch *et al.*, 2015).

A study done among adolescents in Nepal found that watching TV is a risk factor for developing overweight (Priryani *et al.*). 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). In the study done in school of Saudi Arabia, watching TV for more than three hours per day, especially over the weekend, was significantly associated with childhood obesity (H and Al-Ghamdi, 2013).

2.4.7.2 Stress

Stress has been linked to biochemical changes that can trigger cravings and lead to obesity. Learn how to break the cycle (Thompson, 2009). 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 behaviours 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). A study found that women with high WHR secreted more

cortisol as compared to others. Cortisol mobilizes triglycerides from storage and relocates 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 (Arora *et al.*, 2012; Mozaffarian *et al.*, 2011).

2.4.7.3 Sleep

A healthy diet and physical activity are important for the prevention, management and treatment of obesity. But, other factors outside of the energy balance equation have also contributed to our current obesity crisis. Sleep, for instance, is one such factor. Sleep duration and quality has decreased in recent decades, while the prevalence of obesity has increased (Kanagasabai). Alteration in the pattern of food intake, dietary preference is known to be cause of chronic stress. 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). 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., 2015)

2.4.7.4 Eating outside once a day

Away-from-home food consumption is an important determinant of dietary intake and risk for obesity. Research indicates that foods consumed outside the home are generally less nutritious, including larger in portion size. Away-from-home foods contain more calories per eating occasion, higher levels of total fat and saturated fat, lower levels of fibre, calcium, and iron; and more sodium than foods prepared at home (Ayala *et al.*). It has been found that eating outside on a frequent basis is associated with overweight and obesity (Bezerra *et al.*, 2012).

2.4.7.5 Skipping breakfast

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).

2.4.8 Genetic factors

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 (B. srilakshmi, 2014).

2.5 Comorbidities of overweight and obesity

Obesity can be seen as just one of a defined cluster of non-communicable diseases (NCDs) now observed in both developed and developing countries. The global epidemic of obesity is a reflection of the massive social, economic and cultural problems currently facing developing and newly industrialized countries, as well as the ethnic minorities and the disadvantaged in developed countries. The more life-threatening, chronic health problems associated with obesity fall into four main areas: (a) cardiovascular problems, including hypertension, stroke and CHD; (b) conditions associated with insulin resistance (c) certain types of cancers, especially the hormonally related and large bowel cancers; and (Guh *et al.*) gallbladder disease. The evidence is overwhelming on the association of obesity to a number of medical conditions. These include: insulin resistance, glucose intolerance, diabetes mellitus, hypertension, dyslipidemia, sleep apnea, arthritis, hyperuricemia, 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. The relationship between central (or upper body) obesity and the above conditions is positive for most of them but with a lesser number of studies (FX, 1999)**.**

Overweight and obese persons are at risk of a number of medical conditions which can lead to further morbidity and mortality (Guh *et al.,* 2009). Obesity leads to increases in

inflammatory cytokines and adipocytokines and changes in related molecules such as leptin and adiponectin, which may contribute to the development of multiple disturbs in predisposed individuals. Different studies 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)**.**

Obese patients had upwards of 30% increased risk of mortality from their trauma than non-obese patients, and double the risk of major complications. Severely obese females also had more than double the risk of developing wound complications, and quadruple the risk of developing decubitus ulcers (Glance *et al.*, 2014). Being overweight in midlife increases risk of Alzheimer's disease, vascular dementia, or any type of dementia by 35, 33, and 26%, respectively; even higher risk is observed for obesity (Anstey *et al.*, 2012).

2.6 Measurement of overweight and obesity

2.6.1 Body Mass Index (BMI)

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 in Table 2.1

Table 2.1 Classification of adult 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	Increased
pre obese	25-29.9	
obese I	30-34.9	Moderate
obese II	35-39.9	Severe
obese III	40	very severe

Source: (WHO, 2016)

However due to high body fat content in Asians, the cut-offs are slightly less than that of WHO classification as shown in Table 2.2

Table 2.2 Classification of Asian BMI cut-offs

BMI(kg/m)	**Categories**
<18.5	Underweight
18.5-23	Increasing but acceptable risk
23-27.5	increased risk
≥ 27.5	high risk

(WHO, 2004)

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, 2017). 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 generalised obesity (NHMRC, 2004).

South-Asians have an increased body fat percentage (BF %), both total and in the abdominal region, lesser lean mass, skeletal muscle and bone mineral content along with a higher risk for CVD. The significant variability in body composition between ethnic groups may not be truly reflected by measuring only BMI or other markers as each has its (Janghorbani *et al.*, 2008) own limitations. Therefore in 2002, WHO recommended lower cut-off points of BMI (less than 18,5 kg/m2 underweight; 18.5–23 kg/m2 increased but acceptable risk; 23– 27.5 kg/m2 increased risk; and ≤27.5 kg/m2 (higher high risk) for high risk populations including South Asians (Amin *et al.*, 2015a).

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 Absorptometry is one of the most widely accepted methods of measuring body composition (B. srilakshmi, 2014). 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, 2006). According to age the adjusted body fat percentage of women can be categorized is shown in Table 2.2.

Table 2.2 Body fat percentage of women according to age

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, 2008).

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 (S. P. Sharma *et al.*, 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 Hip Ratio (WHR)

The waist to hip ratio (WHR) is a simple measure of central obesity. The score from the WHR predicts the risk of developing several conditions associated with excess abdominal fat. WHR is not the only measure of abdominal obesity (VMC, 2009). 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 .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, 2008).

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. 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, 2008).

2.7 Prevalence and trends of overweight and obesity

2.7.1 Global trend 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). Worldwide obesity has nearly tripled since 1975. In 2016, more than 1.9 billion adults, 18 years and older, were overweight. Of these over 650 million were obese. 39% of adults aged 18 years and over were overweight in 2016, and 13% were obese. Over 340 million children and adolescents aged 5-19 were overweight or obese in 2016. Most of the

world's population lives in countries where overweight and obesity kills more people than underweight (WHO, 2016) .

The prevalence of obesity in adults has been increasing in all countries. In 2014, 39% of adults aged 18 years and older (38% of men and 40% of women) were overweight. The worldwide prevalence of obesity nearly doubled between 1980 and 2014 (Nishida *et al.*). 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, 2000)**.** 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, 2002). South East Asia and Western Pacific region are currently facing an epidemic of diseases associated with obesity such as diabetes and CVD. India has the highest number of people with diabetes in the world and China occupies the second position (Ramachandran and Snehalatha, 2010).

The prevalence of overweight and obesity were highest in the WHO Regions of the Americas (62% for overweight in both sexes, and 26% for obesity) and lowest in the WHO Region for South East Asia (14% overweight in both sexes and 3% for obesity). In all WHO regions women were more likely to be obese than men. In the WHO regions for Africa, Eastern Mediterranean and South East Asia, women had roughly double the obesity prevalence of men (WHO, 2018).

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, 2016)

The increment in obese individuals can be easily seen by comparing data of 2015 and 2016 when 38.7% 0f adult females were obese worldwide which increased to 39.2% in 2016. In 1995 and 2000, 200 million obese adults were found worldwide which increased to over 300 million in 2000 and now in 2016 it has reached 600 million Similarly in South East Asia 21.3% 0f adult females were obese worldwide which increased to 24.1% in 2016 (WHO, 2016)

About 70% of global deaths each year are caused by non-communicable diseases,where a majority of the deaths are related to cardiovascular diseases, followed bycancers, respiratory diseases, and diabetes. The Lancet Medical Journal (2014) revealed that global obesity increased from 3.2% in 1975 to 10.8% among men, while it increased from 6.4% in 1975 to 14.9% in 2014 among women.(Helble and Francisco, 2017).

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, 2016)

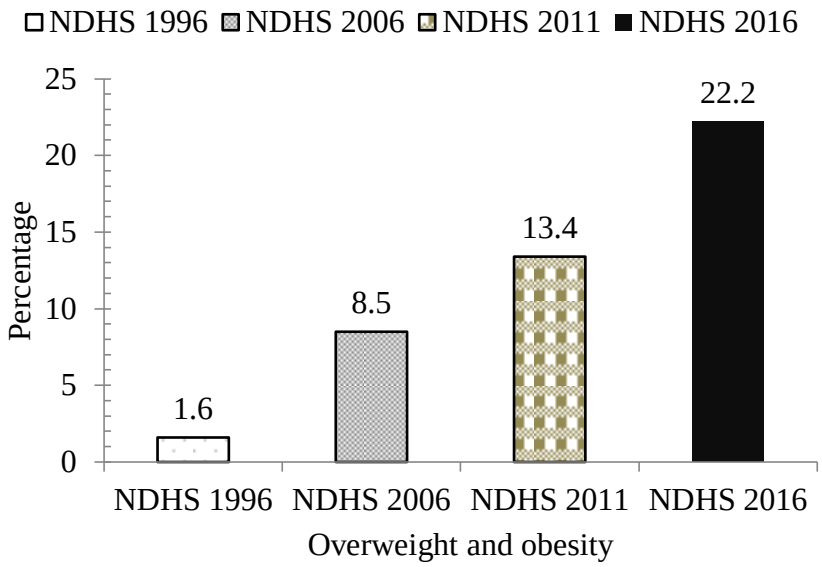
Asian countries are experiencing alarming rates of increase in prevalence of overweight and obesity in recent years, although they have some of the lowest prevalence. The rise in economic development and cultural factors are often cited as drivers to overweight and obesity. Vietnam and India have the 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 adults 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).

In East Asia the prevalence increased by 31.5% between 1990 and 2013, in South East Asia by 22.1%.the South Asia region, we see that Bangladesh appears to be following in the PRC's footsteps as overweight and obesity prevalence increased from 8% in 1990 to 17% in 2013. Nepal and Sri Lanka are also exhibiting a rapid increase in the number of overweight and obese people. Within this region, Afghanistan, Bhutan, Maldives, and Pakistan had rates above 30% in 2013. Malaysia and Maldives are among the most overweight, with a prevalence of 48.6% and 54.0% respectively (Helble and Francisco, 2017).

2.7.2 Overweight and obesity in Nepal

For Nepal, the increase in the combined prevalence of overweight and obesity in female was about 1.6% in 1996 versus 8.5% in 2006 versus 13.4% in 2011 as shown in Figure 2.1. It has now increased to 22.2% in 2016, in reproductive aged women.



(MOHP, 1996, 2006, 2011)

Fig. 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, 2013) . A survey done 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 done 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 done 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.*, 2013)

2.8 Religion of Nepal

According to National Population and Housing Census, 2011, five major religions of Nepal are Hindu (21,551,492), Buddhism (2,396,099), Islam (1,162,370), Kirat (807,169), and Christianity (375,699) (CBS, 2011).

The Kirant Religion also known as the Kirati Mundhum and is the religion of the Kirat people of Nepal. According to some scholars, such as Tom Woodhatch, it is a blend of animism, ancestor worship, Hinduism and Buddhism.

Part III

Materials and methods

3.1 Materials

Research instruments used in the survey were as follows.

3.1.1 Weighing Scale

For meauring the weight of respondents, Digital weighing machine with the capacity of 100kg and having the least count of 0.1 kg manufactured by Microlife Pvt Ltd was used.

3.1.2 Stadiometre

Stadiometre was used to measure height with the capacity of approx 200 cm and having the least count of 0.1cm (UNICEF).

3.1.3 Measuring tape

A non-stretchable whitecroft measuring tape that measured upto 150cm was used to measure waist and hip circumfernce.

3.1.4 Questionnaire

A well designed, structured and pretested set of questionnaire was used to collect information on socio-demographic and economic data such as age, sex, ethnicity, marital status, education, income, education, caste, religion.

3.1.5 Measuring utensils

Standardised utensils like bowls and glasses were used for taking 24 hour dietary recall.

3.2 Research design

A community based cross- sectional survey of reproductive aged kirati female residing in Kirat colony of Bhadrapur municipality was conducted which includes:

a) Anthropometric measurements

b) Survey with the help of questionnaire

3.3 Research variables

3.3.1 Dependent variables

The dependent variables under this study were defined as :

3.3.1.1 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).

3.3.1.2 Waist circumference in cm

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

3.3.1.3 Waist to Hip ratio

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

3.3.2 Independent variables

Independent variables included in this study were as follows:

3.3.2.1 Socio-economic and demographic variables

Age, caste, religion, marital status, income, occupation, education, parity, family size.

3.3.2.2 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 or3 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 .

3.3.2.3 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 . 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, 2002). 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, 2017).

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

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

3.4 Target population

All women of 15-49 years of age residing in kirat colony of Bhadrapur Metropolitan city were target population of the study

3.5 Inclusion criteria and Exclusion criteria

a) Inclusion criteria**:** Kirati Women residing in kirat colony of Bhadrapur municipality of age between 15-49 years of age were included in the study.

b) Exclusion criteria

✓ Female who were below 15 yrs and above 49 yrs of age.

- ✓ Females who were seriously ill, mentally unfit, pregnant and lactating women.
- ✓ Females residing in hospital, prisons and nursing home.
- ✓ Females who would not be available at household during the time of survey.
- ✓ Females who were temporarily residing in Kirat colony like family living in rent and those coming from another place for visit.

3.6 Sample size and techniques

Method of census technique was applied in the survey. The sample size was equal to the total number of reproductive aged women between the ages of (15-49) years living in kirat colony belonging to kirat family. Altogether 112 reproductive aged females were selected during the survey.

3.7 Study area

The study was conducted in kirat colony of Bhadrapur city of jhapa district. Bhadrapur is located in kirat colony of bhadrapur metropolitican city of Jhapa. At the time of the 2011 Nepal census, it had a population of 50,249. It lies on the right bank of mechi river nepal's eastern border with Bihar state india. Kirat colony is a small community situated in Bhadrapur ward number 7 and 8 where most of the kirati people lives. A map of Kirat colony is included in appendix.

3.8 Pretesting

First of all the prepared sets of questionnaire and anthropometric instruments were pre-tested among few reproductive aged women respectively under the sampling plan. Pre-testing should be conducted in order to maintain accuracy and clarity of questionnaire, to check the consistency in interpretation of questions by respondents and to identify ambiguous item. Errors found in nutritional assessment tools can be minimized as pre-testing helps to minimize or remove if any errors are found. When pre- testing is done all the ambiguous, misleading and wrongly interpreted questions will be removed and questionnaire will be revised in accordance with the findings of pre-testing.

3.9 Validity and reliability

For the purpose of ascertaining the degree to which the data collection instruments measure what they were purposed to measure, the instruments were validated by a group of professionals from Central Campus of Technology, Central Department of Nutrition and Dietetics. The questionnaire was also pretested prior to data collection to ascertain content and face validity.

Questionnaire was checked daily for completeness, consistency and clarity. In addition the academic supervisor also checked the collected questionnaire during the process of data entry and analysis.

3.10 Data Collection Techniques

Data collection was divided over two phases, firstly initial contact with the participant, completing the 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.

3.10.1 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).

3.10.2 Dietary intake

Data were collected using a food frequency questionnaire and the 24-hour recall method. The food frequency questionnaire was used to record a finite list of foods and beverages with response categories to indicate usual frequency of consumption over the time period queried.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 .

3.10.3 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.

3.10.3.1 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.

3.10.3.2 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.

3.10.3.3 Weight

Weight was measured to the nearest 100 grams (0.1kg) using a weighing scale, 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).

3.10.3.4 Height

Height was measured using stadiometre 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).

3.11 Data analysis

After the data were manually edited and coded, they were entered into a database immediately. Microsoft excel 2010 and SPSS version 20 and excel were used to analyse data. Descriptive analysis was used to describe percentage and distribution of respondents by socio demographic variables, physical activity, dietary patterns, medical characteristics and behavioural 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.

3.12 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 of collected data was ensured.

Part IV

Result and Discussion

A community based cross sectional census survey was conducted to assess the prevalence of overweight and obesity as indicated by BMI, WC, and WHR in 112 reproductive aged Kirati women (15-49years) of kirat colony of Bhadrapur municipality and result obtained are explained in the following headings.

4.1 Demographic and Socio-economic characteristics

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

4.1.1 Age distribution of the study population

There were relatively more women in the youngest age group (<30), 45.5% (51) of the total sample. The age group with the least number of participants was 41-49 with 20.5% (23). Age distribution of female population is shown in table 4.1

Table 4.1 Distribution of age of surveyed population (n=112)

Age	Frequency	Percent
<30	51	45.5
>30	38	33.9
41-49	23	20.5
Total	112	100

4.1.2 Religion and caste distribution of study population

Almost all the respondents, 77% (87) were Kirati. Minority of them, 0.9% were Christian followed by Hindu 17% (19) and Buddhist 4.5% (5). As this survey was on Kirati women of reproductive aged group, all the respondents were kirati. Kirati comprises of 4 sub-castes in it they are Limbu, Rai, Yakha and Sunuwar and in the survey, the population of Limbu 55.4% (62), Rai 4.5% (5), Yakha 35.7% (40), Sunuwar 4.5% (5) were found to be residing in Kirat colony respectively. Religion and ethnicity distribution of reproductive aged group kirati female residing in Kirati colony of Bhadrapur municipality is shown in Table 4.2

Table 4.2 Distribution of religion and ethnicity of surveyed population

Factors	Frequency	Percentage
Religion		
Kirati	87	77
Hindu	19	17
Buddhist	5	4.5
Christian	1	0.9
Total	112	100
Ethnicity		
Limbu	62	55.4
Rai	5	4.5
Yakha	40	35.7
Sunuwar	5	4.5
Total	112	100

4.1.3 Marital status and parity

The majority of females respondents were married 68.8% (77) followed by the females who were unmarried that is 30.4% (34) and the percentage of females who were divorced or separated was only 0.9% (Ayala *et al.*). This study also found that most of the respondents, 50.9% (57) had one to two parity as most of them were married beside that 35.7% (40) had zero parity as they were unmarried and while remaining 13.4% (15) of them had parity level more than 3. Overweight or weight development related to pregnancy has also mean been associated with number of deliveries. Parous women have been reported to have a high risk of later obesity in Finland and other countries(Luoto *et al.*, 2011). The distribution of marital status and parity is shown in below table no 4.3.

Table no 4.3 Distribution of marital status and parity (n=112)

Variables	Frequency	Percentage
Marital status		
Married	77	68.8
Unmarried	34	30.4
Separated	1	0.9
Total	112	100
Parity		
0	40	35.7
1-2	57	50.9
≥3	15	13.4
Total	112	100

4.1.4 Socioeconomic Factors

According to the study the majority of respondents 33% (37) had their monthly income in range of 22852-45750 followed by >45751whereas the minority of respondents have income less than 2300. Likewise for occupation the majority of population were employed as skilled worker 43.8% (49) followed by clerical, shop owner, farmer 18.8% (21) whereas the remaining were semi profession, semiskilled and unemployed respectively as shown in below table 4.4. Similarly for education, majority of respondents had passed there high school 34.8% (39) followed by intermediate 26.8% (30), graduate 18.8% (21) and only fewer number of obtained primary 5.4% (6) and illiterate. After evaluating all these SES factors, SES score had been calculated in which 85.8% (96) belonged to middle class, 9.8% (11) belonged to lower class, 4.5% (5) belonged to upper class. Distribution of socioeconomic factors and SES score is shown in Table 4.4

Table 4.4 Distribution of socioeconomic factors and its status (n=112)

Variables	Frequency	Percent
Monthly income		
≤2300	2	1.8
2301-6850	3	2.7
6851-11450	10	8.9
11451-17150	14	12.5
17151-22850	17	15.2
22851-45750	37	33
≥45751	29	25.9
Total	112	100
Occupation		
Unemployed	11	9.8
Semiskilled	11	9.8
skilled worker	49	43.8
clerical, shop owner, farmer	21	18.8
semi profession	14	12.5
Profession	6	5.4
Total	112	100
Education		
Illiterate	3	2.7
Primary	6	5.4
middle school	13	11.6
High school	39	34.8
Intermediate or post diploma	30	26.8
Graduate or Post graduate	21	18.8
Total	112	100
Socioeconomic status		
upper class	5	4.5
upper middle	71	63.4

lower middle	25	22.4
upper lower	11	9.8
Total	112	100

4.1.5 Type of family

The study showed that 66.8% (77) of females lived in a nuclear family while the remaining 31.3% (35) of them lived in joint family. Nowadays the nuclear family is rapidly replacing the joint family, leading to breakdown of traditional family structures in the country. The new census report puts the average household size in Nepal at 4.88, a remarkable decrease from the 5.44 that was recorded a10 years ago. In fact this was the first time the number has shrunk below 5 since the census was initiated in 1911. Family size had shrunk below 4.32 while it was still around five in the rural areas that means the Nepali family that used to have more than 5-6 members just a decade ago now had 4-5."Nepali society appears to have adopted a new value system in the name of modernisation," said Tej Prasad Adhikari, a demographer. The increasing number of nuclear families suggests we are slowly discarding the traditional joint family (Ghimire, 2012). The distribution of size of family and type of family is shown in table no 4.5

Table 4.5 Distribution of size of family and type of family (n=112)

Factors	**Frequency**	**Percent**
Size of Family		
less than 5	56	50
more than 5	56	50
Total	112	100
Type of family		
Nuclear	77	66.8
Joint	35	31.3
Total	112	100

4.2 Behavioural characteristics

More than half of them did not watch television while eating. However 17.9% (20) of them watch television while eating on the daily basis, 16.1% (18) of respondents watch television while eating twice a week followed by the 8% (9) of them watch while eating 3-4 times a week. This showed that at certain period in a week female consumed food while eating T.V that could sub-consciously lead to over consumption. In addition to availability of T.V. in every home also occurrence of nuclear family could be the reason behind watching T.V. and eating simultaneously. In this study it was found that only 1.8% (2) of them experience stress on a daily basis while 59.8% (67) of them never experienced stress followed by 38.4% (42) of them experienced stress 2-3 times a week. Similarly this study showed that 59.8% (67) of them slept for 7-8 hours in night while 13.9% (15) of them slept 9 hours or more at night respectively. Majority of females 42.9% (48) of them ate once a day outside the home while 31.3% (35) of them never ate outside while the remaining of them ate twice and thrice a week. Distribution of behavioural factors is shown in the below table no 4.6

Table 4.6 Distribution of behavioural factors (n=112)

Factors	Frequency	Percentage
Eating while watching TV		
Daily	20	17.9
twice a week	18	16.1
3-4 times week	9	8
Never	65	58
Total	112	100
Stress		
Daily	2	1.8
2-3 times a week	43	38.4
Never	67	59.8
Total	112	100
Sleep		
<7	30	26.8
7-8	67	59.8
>9	15	13.4
Total	112	100
Outside eating		
Once	48	42.9
twice a week	21	18.8
3-4 times week	8	7.1
Never	35	31.3
Total	112	100
what you use to eat		
with hand	98	87.5
by spoon	14	12.5
Total	112	100
skip breakfast		
Daily	30	26.8

twice/thrice a week	25	22.2
Never	57	50.9
Total	112	100

4.3 Physical activity pattern

Physical activity was assessed by short IPAQ questionnaire and the subjects were categorised into low, moderate, vigorous physical activity according to scoring of IPAQ. Similarly analysis was also done according to WHO recommendation on physical activity. More than half of them performed heavy physical activity that is 84.8% (95) followed by moderate physical activity 11.6% (13) .and the minority that is 3.6% (4) of them performed low physical activity. Similarly majority of them 93.8% (105) of them performed adequate physical activity whereas only less of them 6.3% (7) of them performed inadequate physical activity.

Table 4.7 Distribution of physical activity (n=112)

Physical activity	**Frequency**	**Percent**
Low	4	3.6
Moderate	13	11.6
Heavy	95	84.8
Total	112	100
Physical activity		
Adequate	105	93.8
Inadequate	7	6.3
Total	112	100

4.4 Health related factors

In this survey, it was found that majority 88.4% (99) of the females did not used contraceptives as their husband were not living together due to their occupation. Most of their husbands were employed in army in foreign countries. Similarly 81.3% (91) of them had no any menstrual disorders and minor females 18.8% (21) of them had menstrual disorder.

Table 4.7 Distribution of health related factors (n=112)

Factors		**Frequency**	**percentage**
Contraceptives use	Yes	13	11.6
	No	99	88.4
Total		112	100
Medication	Yes	21	18.8
	No	91	81.3
Total		112	100
menstrual disorder	Yes	32	28
	No	80	71.4
Total		112	100

In this study it was found that majority of respondents 81.3% (91) were suffering from some kind of illness and were taking medicines and only few 18.8% (21) were not taking any medication. Weight gain is a common side effect of many widely used drugs that may lead to significant overweight and obesity, especially in susceptible individual (Verhaegen and Van Gaal, 2017).

4.5 Dietary intake

4.5.1 Dietary intake in preceding one day

It was found that majority half of the people 52.7% (59) of them had adequate fat intake followed by 33% (37) of them had low fat diet whereas only 14.3% (16) of females had low fat intake diet. Similarly protein intake was found to be 51.8% (58) of them had adequate protein intake whereas 48.2% (54) of them had inadequate protein intake. Likewise for energy intake, majority of respondents were not having an adequate energy i.e. 92% (103) and the remaining few were only having an adequate energy.

The carbohydrate intake was low in majority of respondents 84.8% (95) followed by adequate carbohydrate intake and high respectively. As for calcium majority of respondents were having inadequate calcium intake rather than adequate .Epidemiological data have shown that low calcium intake is a risk for overweight and obesity.

Calcium/dairy supplementation may promote the weight reduction in obese consumer. It promotes faecal fat loss and fat oxidation (Tremblay and Gilbert, 2011). The distribution of nutrients intake is shown in the below table 4.9.

Mean intake of energy was found to be (1776.54±580.84)gm which was low as compared to Southern Terai females (1930±457)gm. As the females of the surveyed area were more engaged in household and moderate works their energy might not be sufficient according to their work done regularly. As for carbohydrate intake, the mean intake of fat was found to be (270.69±97.96) gm which was low as compared to southern females of terai. This may be due to food fads and belief that cutting carbohydrates from diet may lead to weight loss. The mean intake of fat was found to be (64.91±31.08) gm that was higher than the mean fat intake of southern female i.e. (26.1±13.8) gm. Similarly the mean protein intake was found to be (51.32±14.30) gm and this was higher than the mean intake of females living in southern areas. The distribution of nutrient intake is shown in below table (Ohno *et al.*, 2007)**.**

Table 4.9 Distribution of nutrient intake (n=112)

Nutrients	Frequency	Percentage
Fat		
Low	37	33
Normal	59	52.7
High	16	14.3
Total	112	100
Protein		
Adequate	58	51.8
Inadequate	54	48.2
Total	112	100
Calorie		
Adequate	9	8
Inadequate	103	92
Total	112	100
Carbohydrate		
Low	95	84.8
Normal	13	11.6
High	4	3.6
Total	112	100
Calcium		
Adequate	29	25.9
Inadequate	83	74.1
Total	112	100

This study also revealed that higher number of respondents 84.8% (95) of them had salt intake more than 5 gram. It has been estimated that reduction in salt intake from 10g/d to the WHO recommended level of 5g/d would reduce fluid consumption by ≈350ml (Anon., 2006). The study also revealed that majority of female respondents did not drink alcohol i.e 72.3% (81) while only 27.7% (31) of them consumed alcohol. Similarly only 9.8% (11) of them were vegetarian and majority of them were non-vegetarian that is 90.2% (101). As

kirati people consume more of the meat the non-vegetarian respondents were higher. The dietary factor distribution is shown in Table 4.10.

Table 4.10 Dietary factors distribution (n=112)

Variables	Frequency	Percentage
Salt intake		
<5 gm	17	15.2
≤5gm	95	84.8
Total	112	100
Drinking alcohol		
Yes	31	27.7
No	81	72.3
Total	112	100
Vegetarianism		
Vegetarian	11	9.8
Non vegetarian	101	90.2
Total	112	100

4.5.2 Food frequency questionnaire

For data analysis purposes, the foods were distributed into three groups of consumption: "frequent", "regular" and "rare". This categorization was based on recommendations of the Food Guide for the Brazilian Population (Sato *et al.*, 2010). The consumption of cereal products like wheat flour was consumed rarely that is 72.3% (81) followed by regular intake 18.8% (21) and only 8.9% (10) of them consumed frequently. As for maize, millet and barley only 1.8% of respondents consumed on a frequent basis whereas 18.8% (21) of them consumed on a regular basis and the remaining majority of respondents consumed rarely. This study also found that consumption of fibre in form of unpolished dahl was higher on regular basis 58% (65) of the respondents followed by rare consumption that is 32.1% (36) and only minor number of respondents consumed on a frequent basis. Consumption of green leafy vegetables was high with 54.5% (61) consuming on a frequent

basis followed by 37.5% (42) of them on regular basis whereas remaining consumed on rare basis. The distribution of food/food group intake is shown in Table no.4.11

Majority of respondents consumed fruits on a regular basis 46.4% (52) followed by 28.6% (32) of them on a frequent basis and the remaining consumed rarely. Dairy products consumption was found to be 34.8% (39) on a frequent basis, 28.6% (32) on a regular basis and 36.6% (41) rarely. Similarly the consumption of red meat was rare in respondents because mostly kirati prefer to eat pork meat. As for fast foods, majority of females are addicted to fast food on a regular basis.

Table 4.11 Distribution food/food group intake (n=112)

Variables	Frequency of Consumption					
	Number			Percentage		
	Frequent	regular	Rare	Frequent	Regular	Rare
Fibre intake						
Whole wheat flour	10	21	81	8.9	18.8	72.3
Maize, millet, barley	2	6	104	1.8	5.4	92.9
Unpolished dahl	11	65	36	9.8	58	32.1
Grams and beans	14	59	39	12.5	52.7	34.8
Green leafy vegetables	61	42	9	54.5	37.5	8
other vegetables	97	12	3	86.6	10.7	2.7
Fruits	32	52	28	28.6	46.4	25
Dairy products	39	32	41	34.8	28.6	36.6
Red meat	2	19	91	1.8	17	81.3
Fast food	3	95	14	2.7	84.8	12.5

4.6 Prevalence of overweight and obesity in female

4.6.1 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 about 27.7% and 19.6% of the kirati women of reproductive age in Kirat colony of Bhadrapur municipality were overweight or obese.

Likewise comparing these figures with a survey done in Srilanka, 22.8% were overweight while only 6.6% were obese. As overweight and obesity is increasing year by year the high prevalence could be due the time difference (Jayatissa *et al.*, 2012).

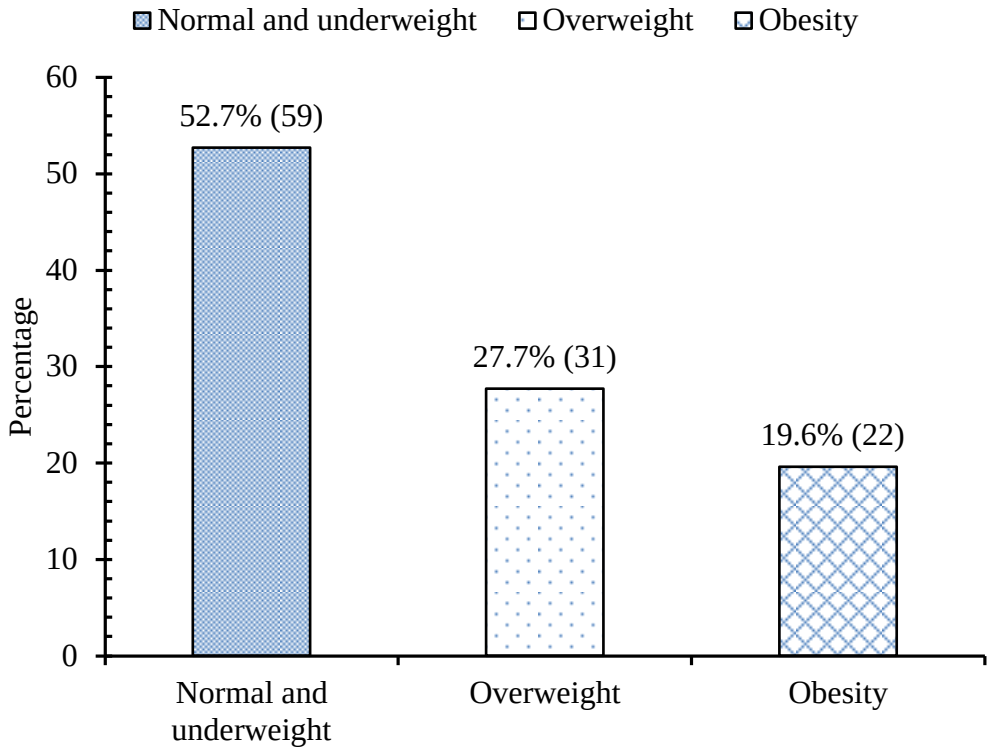


Fig. 4.1 Prevalence of overweight and obesity in reproductive aged kirati female residing in Kirat colony of Bhadrapur Municipality

4.6.2 According to Asian BMI cut-off

According to Asian BMI cut-off 33% (37) of respondents were overweight and 32.1% (36) of females were obese according to Asian BMI cut off as shown in figure 4.2. This prevalence was 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 1.8% was obese (Shah *et al.*, 2006). According to the research done in the prevalence of hypertension, Obesity, Diabetes, and metabolic syndrome in the eastern part of Nepal, 28% were overweight, and 32% were obese (S. K. Sharma *et al.*, 2011).

Also comparing this result to the international prevalence, Srilankan reproductive aged women where 28.7% were overweight and 15.2% were obese which was much lower in comparison to our survey (Jayatissa *et al.*, 2012)

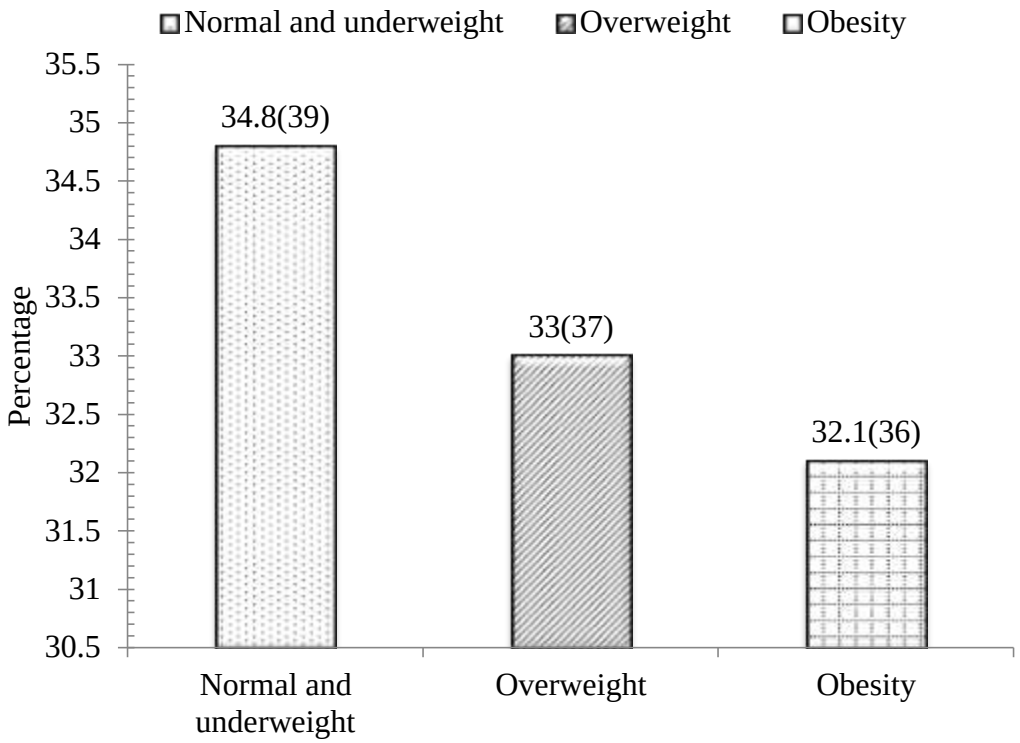


Fig. 4.2 Prevalence of overweight and obesity in reproductive aged kirati females residing in Kirat colony of Bhadrapur municipality (Asian cut off)

4.6.3 According to waist circumference measurement

The mean waist circumference was found to be 87.57cm ± 16.54 which was more than the mean WC of NCD STEPS survey 2013 (76.7%) conducted in Nepal (MOHP, 2013).

According to waist circumference 71.4% were found to be abdominally obese while 28.6% 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 kirati female. The figure below shows the prevalence of abdominal obesity in females. It was also noticed that 25.9% (29) of them were found to be on level I risk and 44.6% were found to be on level II risk. The bar graph is shown in Fig. 4.3

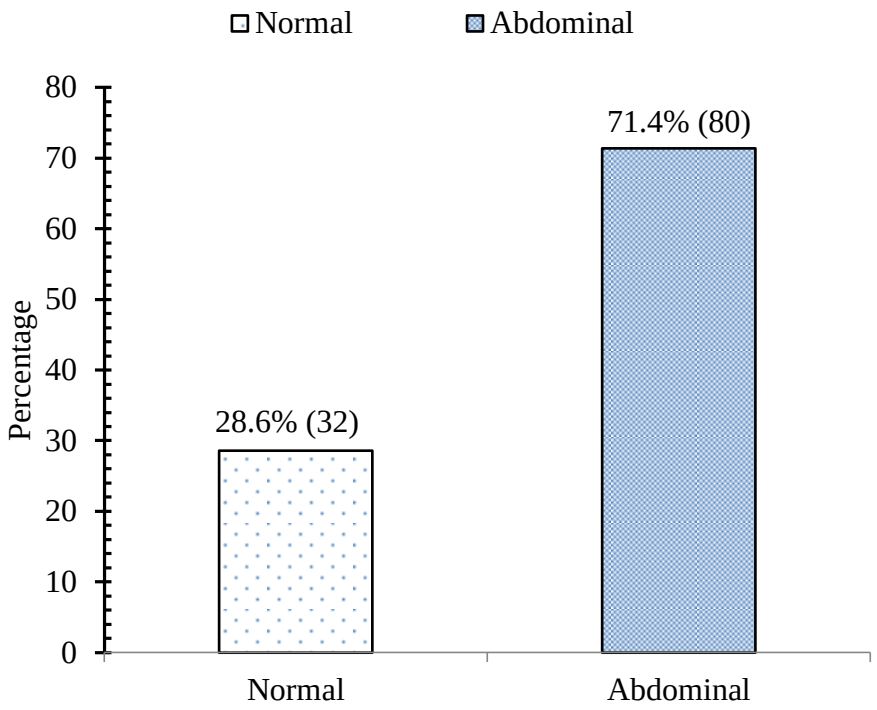


Figure 4.3 Prevalence of abdominal obesity in reproductive aged kirati female in Kirat colony of Bhadrapur municipality

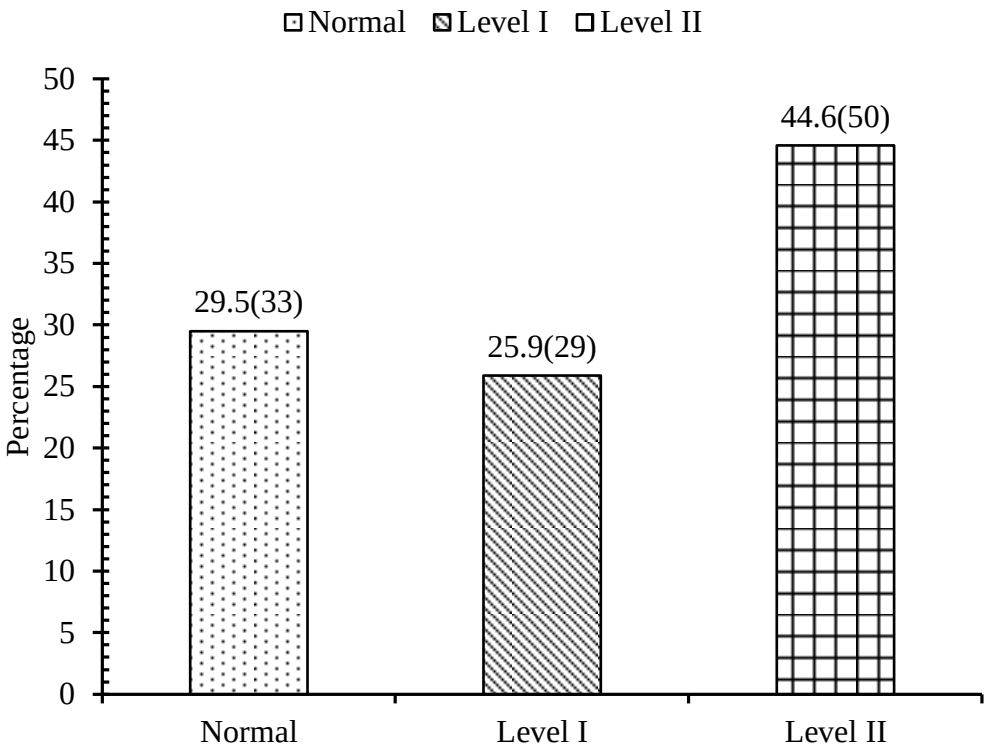


Fig. 4.4 Prevalence of risk of abdominal obesity in reproductive aged Kirati female residing in Kirat colony of Bhadrapur municipality

4.6.4 According to waist hip ratio measurement

The prevalence of abdominal obesity was found to be 67%, this result could be compared with the study South Asian countries. In this ethnic group, abdominal obesity has been recognized as important risk factors for T2DM, the metabolic syndrome and CVD. In Tamilnadu, using Asian cut offs, abdominal obesity was present in 17.6% males and 23.7% females. In a recent study on urban population of Delhi, abdominal obesity was observed in 68.9% (62.2% males and 74.8 %). The result obtained was comparatively very high in kirati females as compared. The available data suggest that South Asian women are comparatively more obese than men (Prasad *et al.*, 2011). As most of the females were married in this study, postpartum weight gain could be the reason behind high prevalence of abdominal obesity. The mean waist to hip ratio was found to be 0.88 which is lower than NCD risk factors survey 2013 result that is 0.9 (MOHP, 2013) . As NCD STEPS

survey represents whole Nepal, both rural and urban part, it could be due to the lower prevalence in rural part.

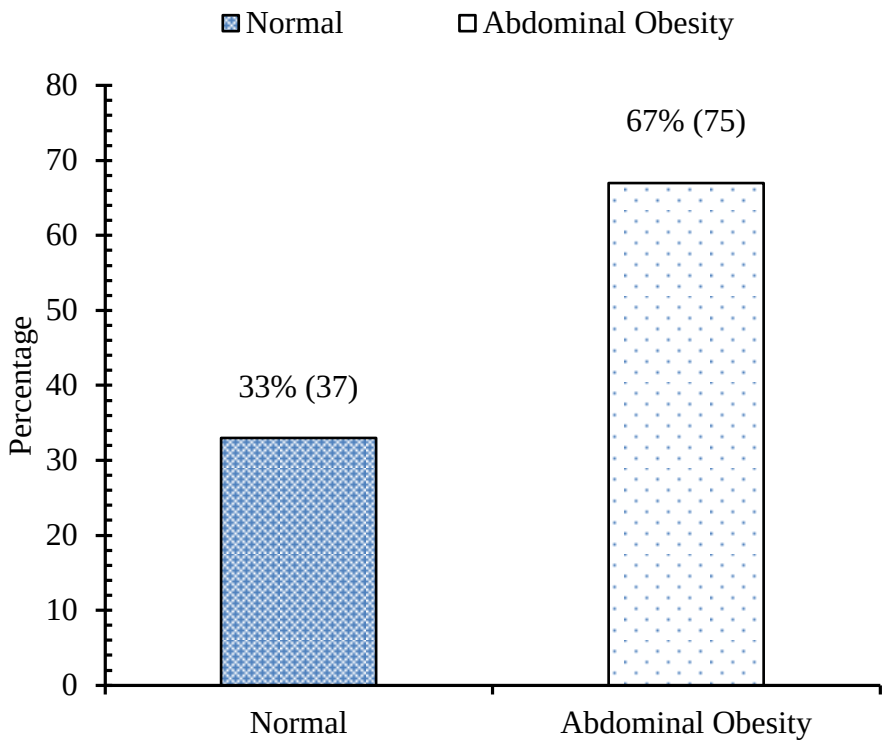


Fig. 4.5 Prevalence of abdominal obesity among reproductive aged females residing in Kirat colony of Bhadrapur municipality

4.7 Factors associated with overweight and obesity in females

The survey was done to assess the over nutrition by calculating BMI using WHO international cut-off, waist circumference, WHR and chi-square were used to identify the characteristics that were related to overweight and obesity

4.7.1 Factors associated with BMI (WHO cut-off)

Age, Parity, Medication, Protein intake, Salt are the factors that were significantly associated with BMI categorized according to WHO cut-off as shown in table no 4.12. It was found that increase in age drops the BMR and more of the body fat gets deposited (Fetters, 2015). The amount of weight gain is associated with increase in parity (Wolfe et

al., 1997). Parity is known to contribute to obesity due to postpartum weight retention (Martinez *et al.,* 2013). “There are certain medications that are known to cause weight gain but that doesn’t mean that if you take one of them, gaining weight is inevitable,” says Prudence Hall, MD, Rabbit M. Medication related weight gain can have many causes. Some drugs might stimulate your appetite. This causes you to eat more and gain extra weight. Some drugs might affect your body’s metabolism. This causes your body to burn calories at a slower rate. Other drugs might affect how your body stores and absorbs sugar and other nutrients (Anon., 2018).

Protein along with carbohydrates and fat is a major macronutrient that helps your body function optimally. Protein is also essential for weight loss, especially in the obese, as it helps to stabilize blood sugar, curb hunger and potentially increase the number of calories you burn through digestion. Protein takes longer to digest as compared to carbohydrates and thus can play a role in making us feel more satisfied when trying to cut calories. A 2008 paper in an issue of the American Journal of Clinical Nutrition reported that a higher protein intake may help you reduce overall food consumption, even when you're not on a diet (Cespedes).

Salt is not a direct cause of obesity but it is a major influencing factor(S. K. Sharma *et al.*, 2011). Recently high salt intake has also been found to both be associated and predict the development of obesity, insulin resistance, and metabolic syndrome (Lanaspa *et al.*, 2018) In 2015, British and Chinese researchers reported that body fat increased for children and adults on high-salt diets. Eating an extra gram of salt each day increased the risk of obesity in children by 28% and in adults by 26% (McMillen, 2017). Using the data from four waves of NHANES (1999-2006), it was found that each 1 g increment in sodium intake led to 15% and 24% increases in the risks of obesity and central obesity, respectively. Additionally, the results also revealed that increases in daily sodium intake or dietary sodium density were linked with significant elevations in measures of body composition, such as body fat mass, body lean mass, and total percent fat in the U.S. general population (Zhang *et al.*, 2006).

Table 4.12 Factors associated with BMI (WHO cut-off) among reproductive aged kirati female residing in Kirat colony of Bhadrapur municipality

Factors		Overweight/obese	Percentage	chi-square	p-value
Age	<30	12	23	23.071	0.000*
	30-40	23	60.5		
	41-49	18	62.5		
Marital status	Married	43	55.8	7.18	0.07
	Unmarried	10	28.57		
Socio-economic status	Upper	5	100		
	upper-middle	34	47.83	6.876	0.07
	lower-middle	9	36		
	Lower	5	45.45		
Parity	0	13	32.5	7.885	0.01*
	1-2	29	50.87		
	≥3	11	73.3		
Medication	Yes	14	16.67	3.88	0.04*
	No	39	42.86		
Protein Intake	Adequate	19	32.75	10.234	0.001*
	Inadequate	34	62.96		
Salt	greater than 5 gm	49	51.57	4.551	0.03*
	less than 5gm	4	23.52		
Physical activity	Low	2	50		
	Moderate	6	46.15	0.19	0.99
	High	45	47.36		

4.7.2 Factors associated with waist circumference

Age, marital status (P=0.00), parity (P=0.00), drinking alcohol (P=0.02), medication (P=0.03), protein intake (0.02) were found to be significantly associated and contraceptives, member categorisation were found to be closely significantly association with WC measurement and physical activity did not show any association with waist circumference as shown in table 4.13

Table 4.13 Factors associated with abdominal obesity among reproductive aged kirati females residing in Kirat colony of Bhadrapur municipality

Factors		**Abdominal Obesity**	**Percentage**	**chi-Square**	**P-Value**
Age	less than 30	23	45		
	30-40	36	94	31.89	0.00*
	41-49	21	91		
Marital status	Married	67	87		
	Unmarried	13	37.14	29.324	0.00*
Parity	0	18	45		
	1-2	48	84.2	16.67	0.00*
	≥3	14	93.33		
Drinking Alcohol	Yes	27	72	21.78	0.02*
	No	53	65		
Medication	Yes	19	90.4	4.595	0.03*
	No	61	67.03		
Protein	Adequate	36	62.06	5.164	0.02*
	Inadequate	44	81.48		
Contraceptives	yes	12	92.3	3.142	0.07
	No	68	68.68		
Member categorisation	<5	44	78.5	2.80	0.09
	>5	36	64.28		
Physical activity	Low	3	75	0.715	0.6

Moderate	8	61.53
High	69	72.3

Increasing BMI is associated with increasing body fat content, but for any given BMI value South Asians tend to have substantially greater body fat, in particular abdominal fat, than Europeans (Wells, 2007). High prevalence of abdominal obesity is a characteristic feature of Asian Indians and all South Asians. Furthermore, abdominal obesity can occur even in the absence of elevated body mass Index (BMI) (Indians, 2012) In a study conducted in South Asian population, it was found that with age, waist circumference too increases (Amin *et al.*, 2015a). It is because with age BMR decreases and utilization of fat decreases (Fetters, 2015). 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).

Alcohol consumption has probably contributed to the excess energy intake associated with weight gain in some individuals over the past years. Also moderate drinking of alcohol is still an important recommendation, together with a healthy lifestyle not conducive to weight gain (Traversy and Chaput, 2015). Alcohol may lead to an increase in energy intake, inducing an increase in body mass index. It is also known that alcohol suppresses the oxidation of fat, thus favouring fat storage (Lukasiewicz *et al.*, 2005)

Weight gain is a common side effect of many widely used drugs that may lead to significant overweight and obesity, especially in susceptible individual (Verhaegen and Van Gaal, 2017). There are certain medications that are known to cause weight gain but that doesn't mean that if you take one of them, gaining weight is inevitable," says Prudence Hall, MD, Rabbit M. Medication related weight gain can have many causes. Some drugs might stimulate your appetite. This causes you to eat more and gain extra weight. Some drugs might affect your body's metabolism. This causes your body to burn calories at a slower rate. Other drugs might affect how your body stores and absorbs sugar and other nutrients (Anon,. 2018).

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).

4.7.3 Factors associated with waist hip ratio

Age, marital status, parity, drink, medication were the factors that were seen to be associated with waist hip ratio as shown in Table 4.14.

Table No 4.14 Factors associated with waist hip ratio among reproductive aged Kirati females residing in Kirat colony of Bhadrapur municipality

Factors		Abdominal Obesity	Percentage	Chi-Square	P-Value
Age	<30	21	41.17		
	30-40	32	84.21	28.997	0.000*
	41-49	22	95.65		
Marital status	Married	63	81.81	24.575	0.000*
	Unmarried	12	34.28		
Parity	0	18	45		
	1-2	43	75.43	15.288	0.000*
	>3	14	93.33		
Drinking alcohol	Yes	26	83.87	5.538	0.01*
	No	49	60.49		
Medication	Yes	20	95	9.34	0.02*
	No	55	60.43		

Part V

Conclusion and Recommendation

5.1 Conclusions

This study has assessed the nutritional status of female of reproductive aged women in terms of overweight and obesity. The results of this study indicate that overweight and obesity is an important health issue in kirati female of reproductive age residing in kirat colony of Bhadrapur municipality.

- The prevalence of overweight and obesity among the respondents according to International BMI cut-off was found to be 47.3%.
- The prevalence of abdominal obesity (WHR) and WC were found to be 71.4% and 67% respectively.
- The main determinants of overweight and obesity using International BMI cut-off were age, Parity, medication, protein, salt. Also marital status and socioeconomic status were also found to be closely significantly associated determinants.
- The determinant of abdominal obesity were age, marital status, parity, drink, medication, protein were the factors significantly affecting abdominal obesity. Also other factors such as family member and contraceptives use were found to be closely significantly associated with determinants.
- The main determinants of abdominal obesity (WHR) were age, marital status, parity, drinks, medication.
- There was high prevalence of overweight and obesity in reproductive aged kirati females residing in kirat colony of Bhadrapur municipality.

5.2 Recommendation

- As more number of females were found to be overweight and obese, nutritional awareness programmes regarding overweight and obesity should be conducted.
- Also the study could be conducted in same peoples using body fat as an indicators of overweight and obesity.
- Different physical exercises and activities should be promoted in the area in order to promote females physical fitness to reduce obesity.

- Knowledge regarding the portion size and serving sizes should be given so that people will know about their food intake.
- Awareness regarding the obesity related different diseases should be given to the females so that they may be more concerned about their health.

Part VI

Summary

Overweight and obesity is one of the growing health problems in developing countries. We used many anthropometric measurements like BMI, WC, WHR and found that most of the women were overweight and obese. There is increase in overweight and obesity trends in Nepal according to recent data.

A cross sectional census survey was conducted in kirat colony of Bhadrapur municipality to assess the overweight and obesity and their risk factors related to it in that area. In this study anthropometric measurements with the set of structured questionnaire that includes her personal information, physical activity questionnaires, and behavioural factors, dietary recall and food frequency questionnaires are taken The obtained data was analysed by using SPSS version 20 and Microsoft excel 2010. BMI was classified based on WHO that determine generalised overweight and obesity. Waist circumference and waist to hip ratio was analysed using IDF and WHO criteria respectively. It was found that 47.3% of women were overweight or obese. Likewise 71.4% of women were abdominally obese using WHO i.e. WHR >0.84 criteria while 67% were abdominally obese using IDF criteria i.e. WC>80 cm.

There are various factors namely dietary factors, socio demographic and economic factors, behavioural factors, physical activity, health related factors that affect the indicators of overweight and obesity. In this study, it was noticed that mainly age, parity, medication, protein intake, salt were found to be significantly associated with overweight and obesity and also the other factors like marital status(0.07) and socioeconomic status(0.07) was also closely associated factors (WHO cut-off). Also for abdominal obesity we found that age, marital status, parity, drinking alcohol and medication were associated factors (WHO cut-off) in female while age (p=0.000), marital status, parity, protein intake, drink, medication were found to have significant association with waist circumference measurement (IDF cut-off). As for food frequency questionnaire it was found that there was rare consumption of whole wheat flour, maize barley and we found that the consumption of fast food was very high among the population and this might be the reason for the high prevalence of overweight and obesity. 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

Participant's code:…….Date of interview (B.S):……

A. General Information

1. Name of female:

2. Date of birth(B.S)

3. Age:

4. Religion:

a. Hindu
b. Buddhist
c. Muslim
d. Christain
e, others

5. Caste/Ethnicity:

a. Limbu
b. Yakha
c. Rai
d. Sunuwar (Marapucche)

6. Marital status:

a. Married
b. Unmarried
c. Divorce
e. Separated
f. Widow

B. Address :Bhadrapur

Ward no:

C. Anthropomatic Measurement

	Readings
Weight	
Height	
Waist circumference	
Hip circumference	

D. Family Information

7. Number of family members:
8. Number of female members:
9. Types of family:
   a. single b. joint
10. Socioeconomic Status (kuppuswamy scale)
    a. Education level
       1. Profession or honor
       2. Graduate or post graduate
       3. Intermediate or diploma
       4. High school certificate
       5. Middle school
       6. Primary school
       7. illiterate
    b. Family monthly income (Guh *et al.*)
       1. ≤2300
       2. 2301-6850
       3. 6851—11450
       4. 11451-17150
       5. 17151-22850
       6. 22851- 45750
       7. ≥45751
    c. Occupation
       1. Employed
       2. Semiskilled
       3. Skilled
       4. Profession
       5. Semi profession
       6. unskilled
       7. unemployed
11. Parity :
12. Number of miscarriage

E. Physical Activities Questionare

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

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

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

1. __ __ Hours per day __ __ __ Minutes per day
2. Don't Know/Not Sure
3. Refused

OR

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

1. __ __ Hours per week __ __ __ __Minutes per week
2. Don't Know/Not Sure
3. Refused

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

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

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

1. __ __Hours per day __ __ __ Minutes per day
2. Don't Know/Not Sure
3. Refused

OR

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

1. __ __ __ Hours per week __ __ __ __Minutes per week
2. Don't Know/Not Sure
3. Refused

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

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

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

1. __ __ Hours per day __ __ __ Minutes per day
2. Don't Know/Not Sure
3. Refused

OR

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

1. __ __ __ Hours per week __ __ __ __Minutes per week
2. Don't Know/Not Sure
3. Refused

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

1. __ __ Hours per weekday __ __ __ Minutes per weekday
2. Don't Know/Not Sure 3. Refused

OR

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

1. __ __ Hours on Wednesday __ __ __ Minutes on Wednesday
2. Don't Know/Not Sure 3. Refused

F. Behavioural Factors

21. Do you smoke or not?

a. Past smoking

b. current smoking

c. non smoker

22. Do you drink?

a. yes

b. No

23. How frequently do you consume?

a. daily

b. weekly

c. twice a week

d. once a month

e. twice a month

f. others___

24. How much do you drink at a time?

a. Half glass (tea cup)

b. One glass

c. two or more

25. How often do you skip breakfast?

a. Daily

b. once a week

c. twice/thrice a week

d. never

26. How often do you eat infront of tv?

a. Daily

b. twice a week

c. 3-4 times week

d. never

27. How do you often have stress?

a. Daily

c. never

b. 2-3 times a week

28. Do you use food as a stress relieving method?

a. yes b . no

29. If yes which type of food do you prefer?

a. processed fast food c. cereals

b. fruits and vegetables

30. How many hours do you sleep at night?_____ hours

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

a. always c. 3-4 times a week

b. twice a week d. never

32. Do you use contraceptives?

a. yes b. no

33. If yes what type?

a. depo provera c. injection

b.pills d. others_____

34. Do you have menstrual disorder/ irregular menstruation or thyroid problems?

a. yes b. no

35. Are you on medications?

a. yes b. no

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

a. once c. 3-4 times

b. twice d. >4 times

37. How do you take your meal?

a. with spoon b. by hand

G. Dietary Factors

38. What are you?

a. vegan c. lacto-vegan

b. lacto ovo vegan d. non-veg

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

40. How many packets of salt do you use monthly? _____

41. Which cooking oil do you use monthly?

a. animal fat c. ghee

b. vegetable fat d. combination

42. How many glasses of water do you drink in a day? _____glasses(specify your volume)

43. When do you take water?

a. before the meal c. along with meal

b. in between meal

H. Food Frequency table

Types of food	More than once a day	daily	Thrice a week	Once a week	Once a fortnight	Once a month	Never	Remark
Cereals								
Rice								
Wheat								
Maize/millet/barley								
Pulses/Legumes								
Whole dhal								
Polished dahl								

GLV/spinach								
Mustard leaves/rape leaves/simsaag/asparagus/latte saag/gardencress(chamsoor)/ fenugreek leaves/niguro								

Other vegetables Beans/okra/cauliflower/brinjal/cabbage/gourd/barela/broccoli/capsicum								
Fruits Papaya/mango/guava/pomegranate/apple/oranges/junar/peaches								
Dairy products								
Milk								
Curd								
Ghee								

Appendix B

Informed consent

Namaste!

I, Miss Nabina Lawoti, a graduate student of Nutrition and Dietetics in Central Campus of Technology, Dharan; am going to conduct dissertation work in Bhadrapur municipality for the award of bachelor's degree in Nutrition and Dietetics.

The topic for the study is "**Risk Factors Associated with overweight and obesity in reproductive aged kirati female in kirat colony of Bhadrapur Municipilaity"**

Under this study, nutritional status and risk factors associated with it will be surveyed among reproductive aged kirati females residing in kirat colony of Bhadrapur municipality. This study will provide information about the overweight and obesity status and risk factors associated with it among reproductive aged kirati females residing in kirat colony of Bhadrapur municipality. During the study height and weight of the participants will be measured and socio demographic and economic factors, behavioural 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 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

Government of Nepal

Nepal Health Research Council (NHRC)

Estd. 1991

Ref. No.: 1305

27 December 2017

Ms. Nabina Lawoti
Principal Investigator
Central Campus of Technology

Ref: **Approval of thesis proposal** entitled **Risk Factors Associated with overweight and obesity in reproductive aged kirati female in kirat colony of Bhadrapur Municipilaity**

Dear Ms. Lawoti,

It is my pleasure to inform you that the above-mentioned proposal submitted on **20 November 2017** (**Reg. no. 470/2017**) 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. Expiration date of this proposal is **January 2018.**

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 in between and full or summary report upon completion.**

As per your thesis proposal, the total research budget is **Rs. 25,000.00** and accordingly the processing fee amounts to **Rs. 1,000.00.** It is acknowledged that the above-mentioned processing fee has been received at NHRC.

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

Thanking you,

Prof. Dr. Anjani Kumar Jha
Executive Chairman

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

Color plates

P.1 Measuring height

P.2 Measuring weight

P.2 Measuring hip circumfernce

Map of Kirat colony of Bhadrapur Municipality