NUTRITIONAL STATUS AND MENOPAUSAL SYMPTOMS OF POSTMENOPAUSAL WOMEN RESIDING IN BIRATNAGAR-10, NEPAL

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Nutritional status and Menopausal Symptoms of Postmenopausal Women Residing in Biratnagar-10, Nepal

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Approval Letter

This ***dissertation*** entitled ***Nutritional status and Menopausal symptoms of Postmenopausal Women Residing in Biratnagar-10, Nepal*** presented by **Pallavi Karn** has been accepted as the partial fulfillment of the requirements for the degree of **Bachelors of Science in Nutrition and Dietetics.**

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Abstract

A community based cross- sectional qualitative study was carried out to assess the nutritional status and menopausal symptoms of postmenopausal women residing in Biratnagar-10 municipality. Anthropometric measurements such as Waist Circumference (WC), Waist to Hip Ratio (WHR) and Body Mass Index (BMI) were used as indicators to assess nutritional status according to WHO and Asian cut off points. Microsoft Excel 2013 and IBM SPSS version 26 software were used for data entry and analysis. Also, Chi-square test was used to establish relationship between different variables under study.

Our study revealed 3.9% of respondents were underweight, 35.7% were normal, 44.3% were overweight and 16.1% were obese according to WHO-BMI cut offs. Similarly, 67% were abdominally obese according to WC whereas 84.3% by WHR. The mean BMI was found to be 25.74±4.16kg/m^2 and WC was 93.87±10.27 cm with 0.95±0.08 WHR. Mean menopausal age was found to be 49.02±2.48 years where hot flushes (91.4%), heart discomfort (89.1%), sleep problems (88.7%), anxiety (87%) and joint/muscular discomfort (87%) were the most common postmenopausal health problems. The average daily calories, carbohydrate, protein and fat consumption were found to be 1813.45±189.05 kcal, 291.62±37.38gm, 52±7.8gm and 29.14±5.87gm, respectively. Variables like age, physical activity, pulses, green leafy vegetables, fruits, calories, carbohydrate and protein intake were associated with both BMI and WC while green leafy vegetables was only associated with BMI. The study depicted high prevalence of overweight and obesity among postmenopausal women. Therefore, necessary awareness program regarding the management of nutritional status should be conducted for women of those age group.

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List of Abbreviations

Abbreviation	Full form
ADA	American Dietetic Association
BMI	Body Mass Index
BMD	Bone Mineral Density
CBS	Central Bureau of Statistics
CI	Confidence Interval
CVD	Cardiovascular Diseases
CHO (cho)	Carbohydrate
DR	Dietary Recall
DFTQC	Department of Food technology and Quality Control
EPIC	European Prospective Investigation into Cancer and Nutrition
EI	Energy Intake
FFQ	Food Frequency Questionnaire
F/V	Fruits and Vegetables
FM	Fat mass
FMP	Final menstrual Period
GON	Government of Nepal
GLVS	Green leafy vegetables
GCRF	Global Challenges Research Fund
HDL	High Density Lipoprotein
HRT	Hormone Replacement Therapy
HRQoL	Health –Related Quality of Life
HTN	Hypertension
ICMR	Indian Council of Medical Research
IBM	International Business Machine
IPAQ	International Physical Activity Questionnaire
IGF	Insulin-like Growth Factor
INGO	International Non-Governmental Organization
LBM	Lean Body Mass
LDL	Low Density Lipoprotein
MRS	Menopausal Rating Scale

METs	Metabolic Equivalents
MS	Metabolic Syndrome
MESON	Menopause Society of Nepal
NCDs	Non- Communicable Diseases
NGO	Non-Governmental Organization
NMCTH	Nepal Medical College Teaching Hospital
NDHS	Nepal Demographic and health Survey
NHRC	Nepal Health Research Council
NIN	National Institute of Nutrition
PBF	Percentage Body Fat
PMO	Postmenopausal Osteoporosis
POI	Primary Ovarian Insufficiency
PA	Physical Activity
PFs	Processed Foods
QoL	Quality of Life
RCT	Randomized Controlled Trial
RDA	Recommended Dietary Allowances
SPSS	Statistical Package for Social Sciences
SES	Socio-Economic Status
SWAN	Study of Women's Health Across Nation
TUTH	Tribhuvan University Teaching Hospital
TEE	Total Energy Expenditure
UI	Urinary Incontinence
UKRI	United Kingdom Research an Innovation
UNICEF	United Nations International For Children's Emergency Fund
VIVA	Vaginal Health: Insights, Views and Attitudes
WHO	World Health Organization
WC	Waist Circumference
WHR	Waist to Hip Ratio

PART I

Introduction

1.1 General Introduction

Menopause means the permanent cessation of menstruation for consecutive 12 months marking the end of women's reproductive years due to loss of ovarian follicular activity and a decline in circulating blood estrogen levels. It generally occurs between age of 45-55 years as a natural part of biological ageing (WHO, 2022). The menopausal transition can be gradual usually starting with the changes in menstrual cycle. It generally consists of pre, peri and post menopause where pre-menopause refers to the period prior to menopause, post-menopause refers to the period after menopause and peri-menopause refers to the period around menopause. Menopause can be either natural or the consequence of surgical or medical procedures (Konar, 2016). The age at which menopause occurs is genetically predetermined and can be difficult to predict for an individual women. The mean menopausal age in Nepal was found to be 48.7 years (Rajbhandari *et al.*, 2017).

The drop in estrogen level associated with menopause can produce various symptoms related to somatic, vasomotor, urogenital, psychological, physiological and sexual dysfunction as well as health issues like diabetes, osteoporosis, metabolic syndrome, weight gain, arthritis, cancer, etc. in women. The most common symptoms experienced by the women in Nepal were joint pain, hot flushes and irregular bleeding (Rajbhandari *et al.*, 2017). These symptoms can range from mild to severe and differs from one women to another. Similarly, various studies in the world have documented high prevalence of metabolic syndrome (MS) and cardio-vascular risk factors in postmenopausal women. About 40% of post-menopausal women may have MS which is largely determined by accumulation of excess fat in their body causing overweight or obesity. Weight gain, particularly occurs after menopause where the excess fat deposition starts prior to menopause (Lobo, 2008). Higher prevalence of MS was found among post-menopausal women in Katmandu city of Nepal where 13.3% were diabetic, 23.3% were hypertensive, 82.2% had abdominal obesity (WC>80 cm), 43.3% were overweight and 13.3 % were obese (Sapkota *et al.*, 2015).

The total population of Nepal according to the census report of 2078 is 29.1 million with growth rate of 0.98% where female population constitutes about 51.04% higher than male population constituting 48.96% (CBS, 2022). Also, the life expectancy of women in Nepal

is 71.6 years on an average which suggest the high population of postmenopausal women (WBG, 2020). Thus, due to growing population and elevated incidence of health issues, the non-reproductive health of women is becoming a public health concern in Nepal where menopausal symptoms and ageing are the contributing factors to worsen the health issues. However, adequate balanced diet and nutrient intake plays an important role in alleviating the menopausal complaints (Hagey *et al.*, 2008).

Nepal is considered as one of the top 10 fastest urbanizing countries in the world. The population growth rate in Nepal almost doubled from 3.6% in 1991 to 6.5% in 2001. It consists of 293 urban centers with estimated population of 62% as of 2017 (Timsina *et al.*, 2020). The Biratnagar city of Nepal is the largest city of Koshi province and has been getting rapidly urbanized since 1990s with 2, 42, 548 population according to 2011 census report (Rimal, 2012). As per the preliminary report of 2078 census, the population of Biratnagar has been increased to 2,44,750 suggesting the nutrition transition as its consequence (CBS, 2022).

Rapid demographic changes are occurring in Nepal's urban centers, with a rise in the number of elderly group, particularly postmenopausal women. Changes in lifestyle and eating habits brought on by urbanization include a move toward processed and convenience meal. Research can evaluate how urbanization has affected postmenopausal women's nutritional status. Thus, studies on postmenopausal women's nutritional status and menopausal symptoms is crucial to support the creation of programs and policies.

1.2 Statement of the problem

Menopause is the permanent cessation of menstruation which marks a time of dramatic hormonal and social changes. By 2030, the world population of menopausal and postmenopausal women is projected to increase to 1.2 billion, with 47 million new entrants each year (Hill, 1996). Menopause occurs around 50 years of age where women spend approximately one-third of their lives (Lobo and Gompel, 2022).

The transition phase of menopause gradually brings various physical and mental changes. The hormonal changes across the peri-menopause substantially contribute to increased abdominal obesity leading to additional physical and psychological morbidity (Davis *et al.*, 2012). The most common symptoms experienced by the postmenopausal women in Nepal

are physical symptoms followed by sexual, vasomotor and psychosocial domains. These changes are often viewed as the symptoms of old age (Thapa and Thebe, 2021).

The central adiposity is more common in postmenopausal stage while increased BMI is mostly experienced by the women in their pre-menopausal period (Spritzer and Oppermann, 2013). According to the findings of research in Kaski district, 35.3% of post-menopausal women had normal BMI while 17.3% were obese (Koirala *et al.*, 2020). Also, healthy balanced diet can play a very important role in alleviating symptoms of menopause, maintaining longevity and quality of life. Though further studies needs to confirm the results but the current evidence suggests that low-fat, plant-based diets are associated with beneficial effects on body composition and Mediterranean diet pattern may help for the primary prevention of various metabolic diseases and health problems associated with menopause (Silva *et al.*, 2021).

Menopause is regarded as the taboo in many society regarding which most of the women doesn't feel comfortable to talk about. They may not know that symptoms they experience are related to menopause, or that there are counselling and treatment options that can help alleviate discomfort (WHO, 2022). The large cohort study conducted by MESON, revealed that about 1183 (59.2%) Nepalese women did not know about menopausal health problem and the way to subside its discomfort through healthy diet and lifestyle (Rajbhandari *et al.*, 2017).

Despite the fact that health problems among postmenopausal women is significant which degrades their quality of life, necessary plans and policies targeting this population group are not formulated yet. Also, very few researches are available about the health problems related to menopause in Nepal. In addition to this, increasing population of postmenopausal women has been the alarming situation in the country demanding for more researches and investigations in this topic. With the increasing urbanization and population in Biratnagar municipality, the remarkable nutrition transition is also taking place affecting the nutritional status of women. Thus, this study aims to assess the nutritional status and menopausal symptoms of postmenopausal women in Biratnagar-10 to generate the baseline data for more research on the similar topic.

1.3 Conceptual Framework

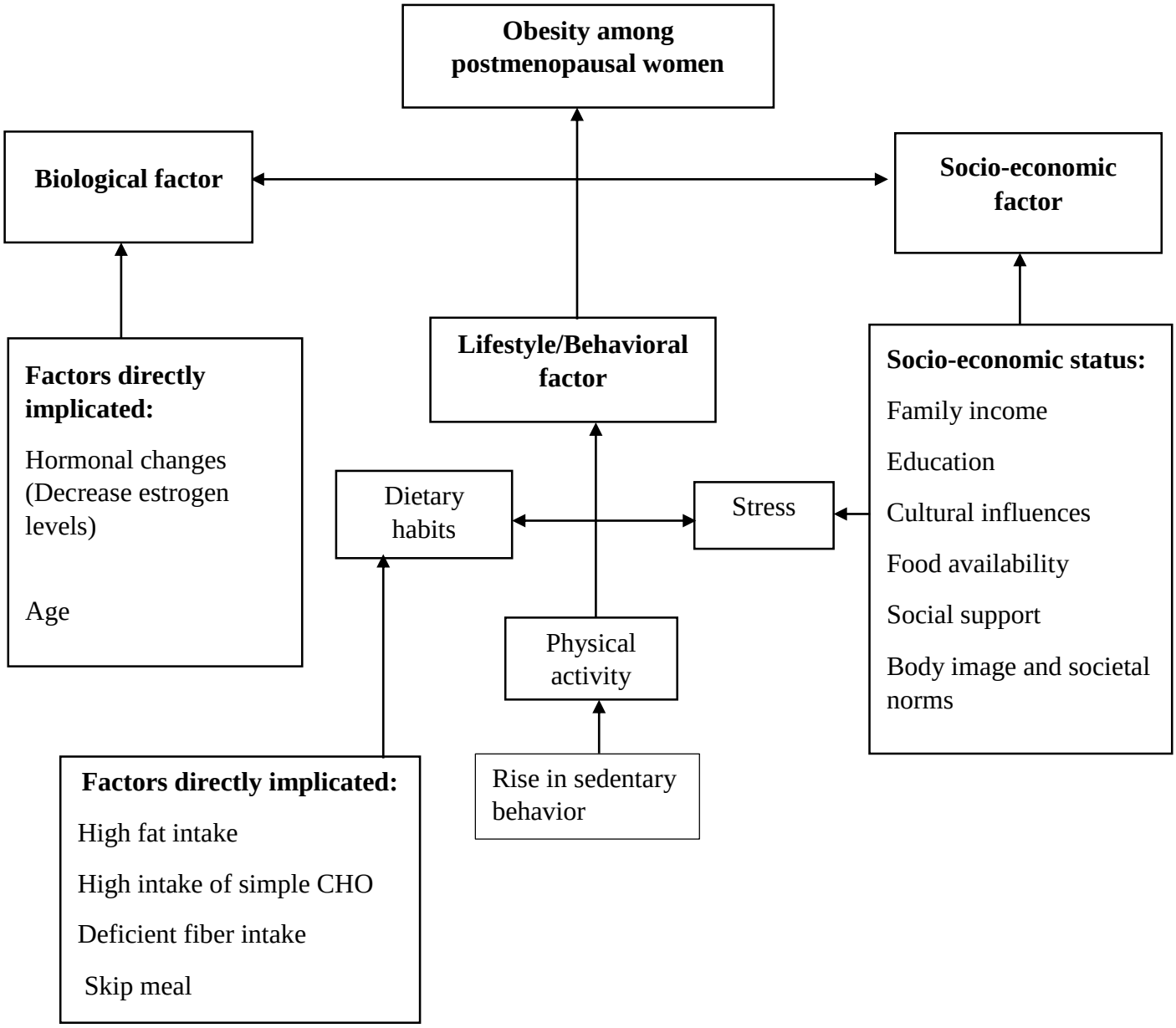

Figure 1.1 Conceptual framework of obesity among post-menopausal women

(Kim *et al.*, 2013; Sartorius *et al.*, 2015)

1.4 Objectives of the study

1.4.1 General objectives

The general objective of the study was to assess the nutritional status and menopausal symptoms of the postmenopausal women residing in Biratnagar-10.

1.4.2 Specific objective

- To assess the nutritional status of the postmenopausal women.
- To study menopausal symptoms and determine its prevalence rate.
- To understand the dietary habits of targeted population group.
- To study factors associated with nutritional status among postmenopausal women.

1.5 Research questions

- What is the nutritional status of postmenopausal women in Biratnagar?
- What are the most common menopausal symptoms and health problems?
- What are the dietary habits of the study population?
- What are the factors associated with the nutritional status among population group?

1.6 Significance of the study

- The study result will be helpful in spreading awareness about the menopausal symptoms and general health outcomes after menopause.
- The study serves as the baseline data for the several NGOs and INGOs to conduct similar researches in the community.
- Motivates young researchers to conduct further researches on the similar topic.
- Encourage women to talk about their menopausal health problems more openly.

1.7 Limitations of the study

- Obesity was not assessed by the body fat percentage due to limited resources.

PART II

Literature review

2.1 Menopause

Menstrual cycle is a complicated process consisting of roughly 28 days where biological changes take place in a woman or girl's reproductive system to prepare her body for a potential pregnancy. Menstruation is the process in which the uterus sheds blood and tissues through the vagina called "period" or "menses". A woman may experience 500 periods on average during her lifetime (Spencer and Brown, 2006). Follicle stimulating hormone, luteinizing hormone, estrogen, and progesterone are the four primary hormones that play a role in this process. For girls and women of reproductive age, this is a normal and healthy procedure. Menstruation, also known as menarche, often begins between the ages of 12-15 and lasts until menopause, which typically happens during the mid-forties (Likis, 2016).

Menopause is generally marked as the end of reproductive life of women. The word Menopause is derived from Greek word where "meno" means month and "pausis" means pause meaning the end of monthly period cycle. According to WHO, the term "natural menopause" is defined as the permanent cessation of menstruation for 12 consecutive months for which there is no other physiological or pathological cause resulting from the loss of ovarian follicular activity and in the absence of clinical intervention. The length and regularity of menstrual cycle differs with every woman but the average age at menopause is found to be 45-55 years worldwide (WHO, 2022).

Climacteric is the period of time during which a woman passes from the reproductive to the non-reproductive stage. This transition phase covers 5–10 years on either side of menopause. It consists of three stages – "Peri-menopause", the part of the climacteric phase when the menstrual cycle is likely to be irregular, "pre-menopause" the phase that comes before menopause and "post-menopause" the phase comes after menopause (Burger *et al.*, 2002). Menopause can be either natural or as a result of surgical/ medical interventions.

2.1.1 Types of Menopause

Menopause can be classified into following three categories on the basis of its etiology (Edwards *et al.*, 2019):

a) Spontaneous menopause

Spontaneous menopause (also referred to as "natural menopause") is diagnosed retrospectively after a year has passed since women's last period. Majority of women experience this menopause between 45-55 years of age and enter the menopausal transition period. It consists of three stages peri-menopause, pre-menopause and post menopause.

b) Premature and early menopauses

Menopause cessation occurring before age 40 is called "premature" menopause and is termed as Primary Ovarian Insufficiency causing various medical diseases while menopause occurring between ages 40-45 years is called as "early" menopause.

c) Induced menopause

It refers to the permanent cessation of menses because of the complication of medical treatment. It constitutes of chemotherapy and radiotherapy for the treatment of cancer or surgeries such as removal of ovaries called oophorectomy, fallopian tubes called Bilateral Salpingo-Oophorectomy or removal of uterus called Hysterectomy.

2.1.2 Age at menopause

The age at menopause is genetically predetermined and consists several factors affecting its onset, however there is no general agreement on them. Studies have shown there are many factors affecting the age of menopause, such as, the age at menarche, gestational age, use of oral pills, irregularity of menstrual cycle, number of conception, body mass index, physical activity, use of tobacco and alcohol, serum lead levels, consumption of polyunsaturated fat, unilateral oophorectomy, socioeconomic status and educational level (Ceylan and Ozerdogan, 2015).

Some women may have "early" menopause i.e. before 40 years of age due to POI or surgical interventions and some may have "delayed" menopause i.e. after 55 years of age. The average age at menopause from the past several studies is found to be approximately 51 years. Consumption of tobacco in the form of cigarette smoking and thinner women mostly tend to have early menopause (Konar, 2016).

Menopause has certain implications. Early menopause is mostly related with increased cardiovascular mortality, osteoporotic fracture, respiratory disease, colorectal cancer and urogenital disease (Lambalk *et al.*, 2009). On the other hand, delayed menopause have been associated with longer reproductive span, reduced cardiovascular disease (like ischemic stroke, myocardial infarction and atherosclerosis), reduced osteoporotic fractures and

decreased cause of overall mortality. However, it may be related with increased risk of breast, endometrial and ovarian cancers (Sapre and Thakur, 2014).

2.2 Menopausal symptoms and related health concerns

2.2.1 Menopausal symptoms

The menopause transition is experienced by 1.5 million women each year. Due to sudden drop in estrogen level women may experience troublesome symptoms, including vasomotor symptoms, vaginal dryness, decreased libido, insomnia, fatigue, and joint pain. Some of these symptoms are associated only with the transition period while few of them persists till postmenopausal period. The 4 core symptoms are described below (Santoro *et al.*, 2015):

i) Vasomotor symptoms

Vasomotor symptoms affect adversely to the women in their transition period although their frequency, severity and duration varies widely across them. It consists of hot flashes and night sweating. Hot flashes is characterized by sudden feeling of warmth in the upper body followed by profuse sweating at night. The exact cause of hot flashes has not been explained. The most accessible theory concluded that this might be due to the resetting and narrowing of thermoregulatory system in association with fluctuation in or loss of estrogen hormone (Freeman *et al.*, 2007).

ii) Vulvo-vaginal atrophy

The urinary tract contains estrogen receptors in the urethra and bladder. When estrogen level falls down during menopausal transition period, patients may develop Urinary Incontinence (UI). Fluctuations in this hormone during the menopause cause urogenital tissues to become fragile and result in upsetting symptoms like vaginal atrophy, narrowing or shortening of the vagina, uterine prolapse, and dyspareunia (Santoro and Komi, 2009). It also causes decreased libido, poor arousal and lubrication, orgasmic dysfunction and lack of sexual pleasure. This sexual dysfunction is also affected by various psychosocial factors.

iii) Sleep disturbances and insomnia

Sleep quality generally degrades with ageing where menopause adds additional layer of complexity to this gradual process. Women report sleep disturbances to occur more during the transition period and becomes worse around the time of menses. Chronic poor sleeps, hygiene habits and mood disorders contribute to sleep problems while hormonal changes alone did not provide complete explanation for the relationship between the sleep problems and menopause (Alexander *et al.*, 2007).

iv) Adverse mood and cognitive function

This includes anxiety, depressive mood, irritability and decline in cognitive function. Many studies have revealed an increased risk of depressed mood during the menopause transition and an approximately 3-fold risk for the development of a major depressive episode during peri-menopause compared to pre-menopause (Bromberger *et al.*, 2007). Several independent risk factors associated are poor sleep, lack of employment, higher BMI, smoking, series of negative events, etc. In addition, there is evidence that hormonal changes may also have association with increased risk for depression during menopause (Freeman *et al.*, 2006).

Decline in the cognitive function is also one of the major complaint during the menopause among women. Cognitive symptoms were found to be more prevalent early in the menopause transition. Although it's still not apparent whether these symptoms are linked to a higher chance of more severe chronic conditions, these symptoms are bothersome and make women concern about their risk for dementia .Dementia is more common in women than in men. Evidence supports a significant role for estrogen in cognitive functioning (Santoro *et al.*, 2015).

Menopause Rating Scale (MRS) is a Health-Related Quality of Life scale which is used for assessing the menopausal symptoms in the ageing women population. It is internationally accepted tool used in various epidemiological studies. It is a self-administered instrument consisting of 11 items and is divided into three sub scales (Heinemann *et al.*, 2004):

- Somatic- hot flushes, heart discomfort/palpitation, sleep problems and joint pain.
- Psychological- depressive mood, irritability, anxiety and physical and mental exhaustion
- Urogenital- sexual problems, bladder problems and dryness of vagina.

The scoring scheme is simple where each of the 11 items are given score according to the severity of symptoms ranging from “0” (no complaints), “1” (mild), “2” (moderate), “3” (severe) to “4” (very severe symptoms). The total score of the MRS is between 0 (asymptomatic) and 44 (highest degree of complaints). Based on literature reviews, total score ≤ 11 is considered as asymptomatic, 12-35 as mild to moderate and ≥ 36 as severe to very severe (Chuni and Sreeramareddy, 2011).

2.2.2 Common menopausal complications

The major health concerns of menopausal women include vasomotor symptoms, urogenital atrophy, osteoporosis, cardiovascular disease, cancer, psychiatric symptoms, cognitive decline, and sexual problems. Most of the symptoms are associated with postmenopausal

syndrome. However, it is difficult to distinguish that whether it has been from the aging process, from the loss of ovarian function or from the socio-environmental stresses of midlife years. Common complications or the long term effects of menopause are explained below (Dalal and Agarwal, 2015):

i) Cardio-vascular disease

Cardio-vascular disease like ischemic stroke, hypertension, dyslipidemia, atherosclerosis and coronary heart disease are the main cause of morbidity and mortality in postmenopausal women. The hormones like estrogen or testosterone have a role in endothelial function, vascular tone and cardiac function. Thus, risk of CVD mainly increases after menopause when the estrogen level is reduced (Mendelsohn and Karas, 2005). Women with early menopause have increased risk of CVD as compared to the one with delayed menopause. Similarly, other risk factor includes high BMI, low physical activity, smoking, alcohol use, stress, ageing and HRT.

ii) Osteoporosis

Osteoporosis is one of the major complications after menopause, starting from the menopausal transition period. Despite the inconsistent result of the impact of menopausal transition on bone density, data from the SWAN, suggests that there is minimal change in bone mineral density at midlife in pre or early peri-menopausal women. In the later peri-menopausal and first few postmenopausal years, the bone loss increases substantially (Finkelstein *et al.*, 2008). Postmenopausal osteoporosis (PMO) is characterized by decreased bone mass, structural degeneration of bone tissue, and an increased risk of fracture in postmenopausal women. Drop in estrogen level leads to more bone resorption than formation causing osteoporosis. In addition to estrogen deficiency, other risk factors such as low body weight and smoking also contribute to the pathogenesis of postmenopausal osteoporosis (Ji and Yu, 2015).

iii) Weight gain

Menopause is associated with significant changes in body composition and the accumulation of excess fat. Menopause alters the way body fat stores-prior to menopause excess fats are stored in thighs and hips leading to a “pear-shaped” figure while after menopause excess fats are stored around the waist leading to “apple-shaped” figure. Weight gain in menopausal women appears to be associated with various factors including loss of ovarian function, physiological, lifestyle and behavioral changes. The deleterious effects of obesity are diverse, it is a major risk factor for various lifestyle diseases like diabetes mellitus,

cardiovascular diseases and menopausal symptoms like urinary incontinence, dementia, some cancers (endometrial, breast and colon) and disease of the joints (Davis *et al.*, 2012).

iv) Cancer

There is 1 in 3 chance of developing cancer in the lifetime of women, and the risk of cancer increases with aging and obesity. Breast cancer is the most common cancer diagnosed among them. Menopause does not cause cancer but risk of developing it increases with age. Delayed menopause increases the risk of developing breast, endometrial and ovarian cancer. Estrogen hormone stimulates the breast and uterus tissues during menstrual cycle. Thus, more the menstrual periods in women, the longer breast and uterus tissues are exposed to the estrogen hormone increasing the risk of cancer (Miller *et al.*, 2016).

2.3 Prevalence of menopausal health problems

Menopause is linked to a variety of long- and short-term consequences during the menopause transition and subsequently, which are common in the majority of women worldwide, including Nepal. As a result, signs of menopause include urogenital and skin shrinkage, metabolic syndrome, weight, cardiovascular, musculoskeletal, and central nervous system issues (Monteleone *et al.*, 2018).

2.3.1 Global prevalence of menopausal health problems

Postmenopausal women are becoming more prevalent worldwide. Women over the age of 50 made up 26% of all women and girls in the world in 2021. This increased from 22% a decade earlier (United Nations *et al.*, 2021).

Approximately 75% of women going through menopause experience vasomotor symptoms like hot flushes and profuse sweating while 12% of women will continue to experience symptoms for up to 11–12 years after their final menopausal period (FMP) (Woods and Mitchell, 2005). In fact, one study found that in Asian countries like China, Bangladesh, and India- joint pain, anxiety, and sleep problems were found to be the most common menopausal symptoms (Kalhan *et al.*, 2020; Rahman *et al.*, 2011; Yang *et al.*, 2008). Likewise, in a large cohort of women experiencing vaginal discomfort, the international Vaginal Health: Insights, Views and Attitudes (VIVA) study found that the prevalence of specific urogenital symptoms was 83% for vaginal dryness, 42% for pain during sexual activity, 30% for involuntary urination, 27% for soreness, 26% for itching, 14% for burning, and 11% for pain when touching the vagina (Nappi and Kierepa, 2012).

The drop in estrogen hormone after menopause also leads to long-term health consequences. Estimates indicate that osteoporosis and bone fractures are a major issue for post-menopausal women, with a lifetime risk of osteoporotic fracture determined to be between 30 -50 %. Similarly, hypertension is also found to be the common problem among women after menopause where most of them remain undiagnosed. In developed countries, 30% of adult women have hypertension, (Kearney *et al.*, 2005) and this prevalence is even higher in low–middle-income countries, reaching up to 53%. In parallel, cancer especially breast cancer is mostly prevalent in women after HRT. The number of premenopausal and postmenopausal breast cancer cases diagnosed globally in 2018 was roughly 6, 45, 000 and 1.4 million, respectively where more than 1, 30, 000 and 4, 90, 000 fatalities occurred from each menopausal group (Heer *et al.*, 2020).

Compared to premenopausal women, postmenopausal women have a higher prevalence of obesity (Davis *et al.*, 2012). Obesity and overweight are both characterized by an abnormal or excessive fat accumulation that could be harmful to one's health. In 2016, the prevalence of overweight and obesity among female population was 40% and 15% respectively (WHO, 2021). Postmenopausal symptoms are highly prevalent and have a rising trend as people get older. Since, population of this group is also increasing, it demands for the introduction of specific postmenopausal women's health interventions in the healthcare settings (Kulkarni *et al.*, 2016).

2.3.2 Prevalence of menopausal health problems in Nepal

In Nepal, according to the 2011 National Population and Housing Census Report, there are 1.5 million women aged 45 to 59 years, making up 11.01% of all total female population with an average life expectancy of 68 years (CBS, 2012).

Joint pain, hot flushes, and irregular bleeding are the three menopausal symptoms most frequently reported in Nepal, with respective prevalence rates of 36.8%, 29.2%, and 29.1%. (Rajbhandari *et al.*, 2017), In one cohort study, sexual problem was found as the most common problem comprising of 81.7% followed by physical and mental exhaustion and joint and muscular discomfort with 81.5% and 78.5% respectively (Ghimire *et al.*, 2015). As of 2017, cardiovascular illnesses were the leading cause of disability-adjusted life years in Nepal, killing 20.3% of women. The two CVDs that were most prevalent were ischemic heart disease and stroke (Bhattarai *et al.*, 2020). Cervical cancer, followed by breast, lung, ovarian, and stomach cancers, are the most typical cancer in Nepalese women (Shrestha *et*

al., 2020). Several population-based studies conducted in various parts of Nepal show that women specifically with breast cancer develop it between the ages of 40 and 50 and that the incidence was highest during the menopausal transition phase, with 34.2% of cases (Acharya *et al.*, 2012). Additionally, a high incidence of osteoporosis among menopausal women in Nepal was indicated by the fact that about 66% of women in the peri- and postmenopausal age group had inadequate BMD (Dhakal *et al.*, 2010).

Overweight-obesity (BMI) $\geq$ 25 kg/m^2) and obesity (BMI $\geq$ 30 kg/m$^{2)}$ are more common among women in Nepal between the ages of 15 and 49. Overweight-obesity prevalence grew from 1.8% to 19.7% between 1996 and 2016, whereas obesity prevalence rose from 0.2% to 4.1% during the same period (Rana *et al.*, 2021). In one study, 21.6% of women who were menopausal experienced weight gain (Prajapati *et al.*, 2018). However, more researches are needed for the better understanding of nutritional status among post-menopausal women in Nepal at national level.

2.4 Factors affecting nutritional status of postmenopausal women

Midlife women are more likely to acquire weight, although the connections between obesity, weight increase, and the menopausal transition are still poorly understood. However, research have indicated that rather than the menopause itself; demographic factors, chronological aging, lifestyle factors, and behavioral factors are the key contributors to weight gain (Alsafi and Polotsky, 2015).

2.4.1 Age

Recent studies concluded that overweight and obesity have become widespread around the world, especially among postmenopausal and middle-aged women. (Dunneram *et al.*, 2013). There is debate concerning the proportional contributions of aging vs. menopause to weight gain in midlife women, even though aging has been linked to weight gain in both the sexes. However, much of the existing data suggests that chronological aging is the main cause of weight gain in midlife women and that, after adjusting for aging, menopause itself does not cause appreciable weight gain (Gutierrez and Kim, 2016).

Ageing is linked to reduction in total lean mass and increase in fat-free mass. From early adulthood until midlife, weight gain is associated with an increase in both muscle and fat mass (Newman *et al.*, 2005). Waist circumference and intra-abdominal visceral fat increases at greater rate with age as compared to total body weight, reflecting changes in the

distribution of fat and muscle quality (Fantin *et al.*, 2007). Women tend to put on weight as they become older, regardless of their menopausal status.

2.4.2 Ethnicity

BMI and body fat percentage have a different relationship depending on age, sex, and ethnicity. One study conducted in Nepal indicated a substantial relationship between ethnic group and obesity, with terai and native hill people having higher rates of obesity and overweight, respectively (Vaidya *et al.*, 2006).

A cross-sectional telephone survey of middle-aged women at various menopausal stages who belonged to different ethnic groups was carried out in seven locations, and it revealed a strong relationship between ethnic disparities and obesity. The fact that some ethnic groups have a higher proportion of people with lower levels of education, money, and occupational status may contribute to some racial disparities in BMI. A larger prevalence of other obesity risk factors, such as smoking and physical inactivity, may also contribute to some ethnic disparities in BMI (Matthews *et al.*, 2001).

2.4.3 Education and Socio-economic status

Numerous research have shown the positive association between BMI and education. The main factor in lowering weight and BMI is teaching them how to change their lifestyle and develop better self-control while they eat (Ostovan *et al.*, 2013). The health and welfare of postmenopausal women are significantly impacted by better dietary habits and nutritional understanding. Majority of postmenopausal women were overweight with little knowledge of nutrition, and this was strongly correlated with socioeconomic level and education. When comparing women's obesity rates by SES, which is often determined by wealth and education, it was shown that those with less education were more likely to be fat than those with college degrees (Ogden *et al.*, 2010).

The association between SES and BMI has been a matter of debate over a long period of time. Thus, as a result of urbanization, the tendency of becoming overweight and obese that is evident in high-income countries is now appearing in low-income ones. Evidence also suggests that low-income women's capacity to buy nutrient-dense foods may be hampered by their insufficient financial resources (Townsend *et al.*, 2009). The job status and education level are related. The level of formal education is one important aspect that might affect a person's knowledge of nutrition and health; as a result, those with higher levels of education

are better able to choose the appropriate health inputs (Spasojevic, 2010). In Mauritius, pre- and postmenopausal women with low SES were found to have an increased risk of obesity (Bhurosy and Jeewon, 2013).

2.4.4 Menopausal symptoms

Menopause causes alteration in the hormonal environment which is linked to an increase in both total body fat and abdominal fat. Thus, its symptoms directly or indirectly assist in weight gain. Vasomotor symptoms can cause sleep disturbances among women (Alsafi and Polotsky, 2015).

2.4.4.1 Sleep disturbances

Menopausal women frequently experience sleep problems, which can have a variety of negative effects on their health and ability to function, including a lower quality of life, deteriorated mental health, and an increase in physical morbidity. Almost 50% of midlife women suffer from insomnia (Hall *et al.*, 2015). Sleep is a key regulator of neuroendocrine function and glucose metabolism. Sleep deprivation has been linked to a number of metabolic and endocrine changes, including decreased glucose tolerance, reduced insulin sensitivity and elevated cortisol levels in the evening. In one cohort study, it was discovered that shorter sleep durations (5 versus 8 hours per night) were linked to greater ghrelin and lower leptin levels, regardless of BMI. This finding suggests that persistently short sleep durations may increase hunger, resulting in overeating (Taheri *et al.*, 2004).

2.4.4.2 Psychosocial factors

While midlife weight gain is frequently attributed to biological factors such as changing estrogen levels and changes in body fat distribution, psychosocial factors also contribute to increases in BMI during this time (Ogden *et al.*, 2015). Given changes in hormone levels and lifestyle circumstances, depression is one of the causes of weight gain in women in their transition stage. Negative emotions and/or stress can affect appetite by causing it to increase or decrease. Acute stress and emotional mood swings commonly cause a decrease in appetite, however chronic stress and persistent sadness tend to enhance hunger and the need for foods high in energy. The depressive symptom—weight association was strongly influenced by both stress eating and menopausal status. Compared to premenopausal women, postmenopausal women are less likely to experience depression-related decreased appetite because their estrogen levels are lower, which is linked to a stress-eating response (Kornstein *et al.*, 2010).

2.4.5 Physical activity

The body tries to achieve homeostasis through a process known as energy balance. Energy intake and energy output are the two components of the equation for weight management, and an imbalance in this energy leads to weight gain. The key to weight loss and weight maintenance is physical activity. Majority of obesity-related problems can be lowered by physical activity alone. To be precise, exercise is planned, scheduled physical activity, whereas physical activity is any movement that results in an energy expenditure (Cox, 2017).

Physical activity was found to be negatively correlated with changes in weight and waist circumference in a longitudinal analysis of the SWAN cohort, regardless of aging or menopausal status changes. Women's weight and waist circumference increased most rapidly in those whose physical activity decreased the most. In addition, it has been discovered that PA also improves the quality of life of women in their mid-life by reducing general menopausal symptoms (Sternfeld and Dugan, 2011).

The WHO recommends that adults between the ages of 18 and 64 engage in 150 minutes of moderate-intensity physical activity (PA), 75 minutes of vigorous activity per week, or an equivalent combination of the two, along with muscle-strengthening exercises (such as body and weight lifting, yoga, and Pilates) twice a week (WHO, 2010). According to research, a decline in PA levels correlates with a drop in estrogen during the menopausal transition, which may be a factor in midlife women's lower PA and move to more sedentary behavior. (Duval *et al.*, 2013). Moreover, metabolic equivalents, or METs, are used to assess the level of physical activity. One MET is the number of calories expended while sitting still for one minute. This equates to around one calorie per every 2.2 pounds of body weight per hour for the typical adult.

The International Physical Activity Questionnaire (IPAQ) was created as a tool for measuring populations' levels of health-related physical activity. The IPAQ's reduced form has undergone extensive testing and is now employed in numerous global investigations. Four areas of a questionnaire were especially created for individuals (18-65 years old): while transportation, at work, while doing housework and gardening, and during leisure time, which included participating in exercise and sports (Hagstromer *et al.*, 2006).

Table 2.1 MET values Computation

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

(IPAQ, 2004)

After calculation of the total MET score of each participant, the physical activity level can be categorized according to IPAQ scoring protocol as:

a) Low: Low level of physical activity with MET scores less than 600 MET-minutes/week.

b) Moderate: The activity to be classified as 'moderate' include following criteria:

- 3 or more days of vigorous-intensity activity of at least 20 minutes per day.
- 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day.
- 5 or more days of any combination of walking, moderate-intensity or vigorous- intensity activities achieving a minimum total physical activity of at least 600 MET-minutes/week.

c) High: A 'high' category can be computed by participation in physical activity under following two criteria:

- Vigorous-intensity activity on at least 3 days achieving a minimum total physical activity of at least 1500 MET-minutes/week.
- 7 or more days of any combination of walking, moderate-intensity or vigorous- intensity activities achieving a minimum total physical activity of at least 3000 MET-minutes/week.

Moderate-intensity physical activity is defined as activities that are strenuous enough to burn three to six times as much energy per minute when sitting quietly, or 3 to 6 METs. Vigorous-intensity activities burn more than 6 METs (IPAQ, 2004).

2.4.6 Dietary intake

Dietary habits are the systematic selections of foods made by individuals or groups of people. Vitamins, minerals, carbs, proteins, and fats must be consumed as part of a healthy diet (Preddy, 2012). Women in the peri- and postmenopausal stages of life are more likely to gain weight, where the weight gain among postmenopausal women is due to genetic, physiological, psychological, and behavioral factors such as age at menopause, dietary fiber, fat, alcohol consumption, and smoking (Jung *et al.*, 2015). Nutritional practices are crucial for health promotion and lifestyle adaptation to the postmenopausal stage since they affect all women; are modifiable, and have an impact on both longevity and quality of life (Silva *et al.*, 2021).

Results of the Women's Health Initiative Dietary Modification Trial highlighted the significance of diet on general health and weight maintenance in postmenopausal women (Howard *et al.*, 2006). To meet energy needs, recommended diets included 50%–60% carbohydrates, ≤30% fats, and 10%–20% protein (Patsopoulos *et al.*, 2008). Dietary interventions have a stronger impact on body weight and body composition profile markers in peri- and postmenopausal women than routine care without lifestyle changes. Exercise interventions lead to increased weight loss, but they had no effect on lean mass or fat mass. For these reasons, overweight and obese peri- and postmenopausal women will benefit most from combining fitness training with a calorie-restricted diet, thus it should be encouraged (Cheng *et al.*, 2018).

a) Dietary protein

Ageing is related to the decrease of lean body mass (LBM) and increase in fat mass (FM) associated with high WC and BMI. Decrease in LBM is also related to protein breakdown and thus increases the protein demand. The physiological energy value of protein is 4kcal/g. There is no concrete evidence regarding high-protein diet with weight loss or gain in lean body mass. One observational studies have shown that postmenopausal women who consume more protein i.e. ≥1.2g/kg body weight have higher LBM (Silva and Spritzer, 2017). In contrary, when compared to the recommended dietary allowance (RDA) which is equivalent to 0.8g/kg body weight, the few interventional trials on postmenopausal women that are currently available have demonstrated that high protein intake did not promote LBM gain (Rossato *et al.*, 2017). The available evidence indicates that RDA and Mediterranean diet components may be sufficient to maintain LBM in older women, even after accounting

for the metabolic and physiological changes associated with aging that may affect protein metabolism (Silva *et al.*, 2021).

b) Dietary carbohydrate

Considering that one of the macronutrients that gives us energy is carbohydrate, it is possible that eating too many of them can cause weight gain. The physiological energy value of carbohydrate is 4kcal/g. It is still unclear how dietary carbohydrates contribute to FM loss. An earlier systematic analysis found that modest low-carbohydrate diets (40 % of total calories) did not reduce fat mass in obese people (Hashimoto *et al.*, 2016). There isn't sufficient data to suggest that changing the amount of total carbohydrates is the significant determining factor of energy intake. It is recommended that the best sources of dietary carbohydrates include whole grain cereals, vegetables, legumes, fruits and not the refine carbohydrates (Dam and Seidell, 2007). WHO's healthy guidelines for adults state that they should consume 180g of whole grains which is a significant source of carbohydrates each day (WHO, 2019). The ingestion of whole grains for six weeks had favorable effects on the resting metabolic rate and stool energy excretion, which altered the energy balance favorably in an RCT with 81 males and 32 postmenopausal women (Karl *et al.*, 2017). Even though there are few interventional research focusing on postmenopausal women, the current evidence are in favor of dietary advice that suggests choosing whole grains over refined grains to minimize adiposity.

c) Dietary fats

The topic of whether dietary fat intake alone predicts obesity and weight gain, is the subject of an ongoing, heated scientific dispute. Since fat is the most energy-dense macronutrient in the diet, with a physiological energy value of 9 kcal/g, diets with higher percentages of energy from fat typically result in higher overall energy intake (Donahoo *et al.*, 2008). A low-fat diet (≤20% of total calories) was linked to higher decrease in percentage body fat and FM during one and three years of follow-up, according to the Women's Health Initiative Nutritional Modification trial (Carty *et al.*, 2011). In contrast, no correlation was discovered between the quantity or type of dietary fat in the EPIC study (European Prospective Investigation into Cancer and Nutrition) (Forouhi *et al.*, 2009). However, to what extent the amount of fat in the diet affects weight gain, with or without adjusting for total calorie intake, is still unclear. Further research is required to confirm that low-fat, plant-based diets are more effective for FM than diets based on animal fats in postmenopausal women (Hall *et al.*, 2021).

d) Dietary fiber

Dietary fiber is made up of lignin, which is an intrinsic component of plants and is not digested. Functional fiber is made up of separate, indigestible carbohydrates that benefit human physiology. Dietary fiber and functional fiber are added together to form total fiber. The mains sources of dietary fiber include whole grains, nuts, green leafy vegetables, other vegetables and fruits. Consumers of low-calorie diets are especially vulnerable to low fiber intakes since fiber consumption is closely connected to total food intake. Moreover, the popularity of low-carb, high-protein diets for weight loss has further decreased dietary fiber intakes. The dietary reference intakes for fiber have a relationship with calorie consumption, which is why the advice for males is 38 g/d while the recommendation for women is 25 g/d (Slavin, 2005). According to a study, consuming an additional 4 grams of fiber daily led to considerable weight loss of an additional 3 ¼ pounds over the course of six months. Dietary fiber was therefore discovered to be a predictor of weight loss (Miketinas *et al.*, 2019).

e) Milk and milk products

A calcium supplementation trial conducted over three years found a minor effect on the pace of weight gain (Caan *et al.*, 2007). In fact, the North American Menopause Association advises postmenopausal women to consume 1000 to 1500 mg of dietary calcium daily (Menopause, 2006). Protein, calcium, magnesium, and B vitamins are abundant in dairy foods with high nutritional value and are essential elements for keeping strong bones and preventing fractures, especially in the elderly and women who have gone through menopause. Additionally, there is some evidence suggesting that dairy products like milk may contain substances like estradiol and insulin-like growth factor I (IGF-I) that may affect when a woman goes through menopause. Milk consumption has also been linked to higher plasma estradiol levels in postmenopausal women (Carwile *et al.*, 2013). Greater consumption of total and low-fat dairy is linked to fewer menopausal symptoms, therefore diet that includes enough dairy can be utilized to treat menopause complaints is recommended (Abshirini *et al.*, 2020). However, there is currently insufficient data to support the idea that dairy or calcium consumption alone, or in combination with calorie restriction, causes weight or fat reduction over the course of a short or long period of time (Lanou and Barnard, 2008) .

f) Fruits and vegetables

Diet rich in fruits and vegetables can help people feel fuller for longer period and consume fewer calories since they are high in water and fiber content. Evidence suggests that combining recommendations to enhance intake of these items with advice to decrease energy intake is a particularly successful method for weight management, even though few treatments have specifically addressed fruit and vegetable consumption (Rolls *et al.*, 2004). F/V provide minerals, fiber, and a variety of phytochemicals, many of which are linked to lowered risk for diseases like diabetes, certain malignancies, and heart disease (Kaiser *et al.*, 2014). A recent meta-analysis of cohort studies found that higher intakes of fruits and vegetables—but not fruit juices or potatoes—peaked at about five servings per day were linked to lower mortality rates. This finding supports the current dietary recommendations to increase intake of fruits and vegetables (Wang *et al.*, 2021). A weight management strategy centered on increasing fruit and vegetable consumption, in post-menopausal women, leads to a considerable loss of weight and is associated with a decline in impulsive behavior and hunger without increasing dietary constraint (Lapointe *et al.*, 2010)

g) Soy products

Biologically active substances generated from plants called phytoestrogens have characteristics similar to those of estrogen. The two most common phytoestrogens are isoflavones (genisten and diadzein), which are plentiful in soybeans, and lignans, which are also present in whole grains, legumes, vegetables, and fruits (Cano *et al.*, 2010). Menopausal symptoms were reduced by specific phytoestrogen supplementation, according to a recent meta-analysis of clinical trials (Franco *et al.*, 2016). Menopausal women frequently use phytoestrogen-based drugs to treat menopausal symptoms, including obese postmenopausal women in particular. In weight loss regimens, soy protein is particularly utilized in place of animal protein. In one systematic-review and meta-analysis it was found that in postmenopausal women, phytoestrogen supplementation was linked to a small decline in WHR but not to changes in body weight, BMI, WC, HC, FM, or PBF (Glisic *et al.*, 2018).

h) Processed foods

Processed foods (PFs) are characterized as composites of ingredients obtained from foods and additives, coupled with substances such as colorings, flavorings, sweeteners, and emulsifiers (Ares *et al.*, 2016). It consists of beverages with added sugar, desserts, ice cream, chocolates, salty snacks, hamburgers, processed meat, and frozen foods. In contrast to other

food types, PFs are frequently long-lasting, prepared for consumption, inexpensive, and extremely appealing. They typically have delicate packaging and concentrated marketing. The energy density is defined as the amount of energy present in per gram of meals, food or diet. They are typically energy-dense, greasy, sweet or salty, and low in protein, dietary fiber, micronutrients, and a number of bioactive substances (Louzada *et al.*, 2015).

The patterns of food consumption have undergone a drastic change around the globe. Freshly made meals and lightly processed foods gradually make way for PFs. The change first became apparent in high- and middle-income countries before spreading worldwide (Ayton and Ibrahim, 2019). According to one study, using PFs increases the risk of a number of health problems. Excessive PF consumption is also linked to postmenopausal women's worse quality of life and more severe menopausal symptoms (Noll *et al.*, 2022). The consumption of such foods has significantly increased in Nepali society. As a result, the Nepalese population is experiencing an early onset of diabetes, high blood pressure, heart disease, kidney disease, digestive issues, and obesity-related illnesses (Gautam, 2021).

2.4.7 Behavioral factors

Recent study has focused on the behavioral influences on obesity, or the precise actions that may lead to weight gain through overeating or decreased physical activity, as well as the mechanisms by which the environment can alter health conditions (Affenito *et al.*, 2012). In parallel, skipping breakfast, higher dis-inhibition scores after dieting were found to be few significant behavioral factors associated with weight regain after weight loss among postmenopausal women (Bajerska *et al.*, 2020).

a) Food habit

Food habits describe the ways in which various people choose, prepare, serve, and consume the food that is accessible to them. Individual preferences are simply one aspect of what influences food choices; societal, cultural, and economic factors also play a role (Paroi *et al.*, 2020).

Vegetarian is someone who abstains from eating any meat, poultry, or fish. They can be further divided into vegans, who do not eat any animal products, and lacto-ovo-vegetarians, who consumes dairy products and/or eggs. Non-vegetarians are those who eat both plant-based and animal-based foods. Of the total population of the world, vegetarians make up a sizable minority. But more lately, vegetarianism has grown in popularity, particularly among

adolescents, as this diet is thought to have health benefits (Appleby and Key, 2016). Vegetarian diets include plenty of whole grains, nuts, fortified foods, and fruits and vegetable which increases their fiber, antioxidants, and micronutrients content enhancing overall quality of diet. While some non-vegetarian diets are high in red meat, eggs increasing total saturated fat content which ultimately results in several negative health outcomes including weight gain. Thus, American Dietetic Association (ADA) supported the idea by pointing out that well planned vegetarian meals may offer health benefits, including the prevention of obesity, in comparison to non-vegetarian diet. Contrary to western studies, the Asian Indian cohort study found that vegetarian dietary patterns were linked to a higher incidence of morbid obesity that eventually led to bariatric surgery, contradicting the misconception that all vegetarian diets are healthy diets. It implies that the opposite outcome might be caused by the Indian population's increased consumption of processed and refined vegetarian diets as well as the nutrition transition (Borude, 2019).

b) Breakfast skipping

Evidence from randomized controlled trials demonstrates that, as long as total calorie consumption is decreased, diets with a variety of macronutrient composition can successfully aid in weight loss (Foster *et al.*, 2010). Many eating behaviors may have a substantial impact on weight management, both positively and negatively. Following a diet-based weight loss strategy, postmenopausal women may experience better 12-month weight loss if they eat meals at regular intervals (Kong *et al.*, 2012).

Breakfast is frequently referred to as "the most important meal of the day," breaking the overnight fast, as the name implies. It provides other crucial nutrients needed for optimum health while replenishing the flow of glucose to increase energy and alertness. Ideally, 15–25% of our daily energy requirements during breakfast should be ingested each day. Daily breakfast improves insulin sensitivity and encourages more exercise in obese individuals, but skipping breakfast results in partial dietary adjustment later in the day (Chowdhury *et al.*, 2016). According to cross-sectional studies, people who regularly eat breakfast tend to weigh less than those who don't. It was found that postmenopausal women's body weight recovery was significantly predicted by their weight loss during dieting, higher dis-inhibition scores after dieting, and skipping breakfast before dieting (Bajerska *et al.*, 2020).

c) Snacks skipping

Food consumption habits, such as frequency, quality, timing, and quantity, have a significant impact on body weight and EI- energy intake. Weight management may be aided by snacking and may lead to weight gain because of the positive correlations between frequency of snacking and calorie consumption (Forslund *et al.*, 2005). Snacking patterns may reflect harmful eating habits and impair the progress of weight loss, but snacks can be used to include nutritious items like fruits and vegetables. Thus, both beneficial and detrimental effects of snacking were seen (Kong *et al.*, 2011). Moreover, increased energy frequency and self-reported snacking frequency are linked to decreased BMI and EI in postmenopausal women, regardless of the EI demand. The dietary fiber density of a diet may be increased by snacking (Rubinska *et al.*, 2021).

d) Smoking

Several cross-sectional research show that smokers have lower body weight or BMI than nonsmokers. Smoking's impact on body weight may cause weight loss through an increase in metabolic rate, a decrease in metabolic efficiency, or a reduction in caloric absorption—all of which are linked to tobacco use. Smokers' lower body weight may be due to the metabolic effects of smoking. In addition, many people, both smokers and non-smokers, think that smoking is a good approach to manage body weight (Potter *et al.*, 2004). On the other hand, studies have shown that heavy smokers have a higher body weight than light smokers, which likely reflects a clustering of dangerous behaviors such as a lack of physical exercise, a poor diet, and other factors that contribute to weight gain. It is well evident from many studies that smoking may lead to early menopause among women. Also positive association between smoking cessation and weight gain with an increase in fat and muscle mass was found among postmenopausal women (Kleppinger *et al.*, 2010).

e) Alcohol consumption

Humans have been consuming alcoholic drinks for a variety of purposes since the beginning of time. Alcohol usage for recreational purposes has become widespread in modern society, and the health and social issues it causes are becoming concerns for people (Poli *et al.*, 2013). Increased energy intake with alcohol use can undoubtedly produce a positive energy balance, which will ultimately lead to weight gain. This is because 1 gram of alcohol contains 7.1 kcal, and studies have demonstrated that the energy from alcohol is added to the energy from other food sources (Yeomans, 2010). In contrast to men, due to lack of alcohol metabolizing

hormone and a relatively high body fat percentage, women experience alcohol-related difficulties earlier and at lower drinking levels than males. Alcohol use may have an effect on postmenopausal women's health and wellbeing in two ways: directly, when alcohol is consumed, transported through the blood, and then processed for removal; and indirectly, when sex hormone levels are changed in the blood concentration. This is in addition to the weight gain that results from excessive alcohol consumption. Circulating hormones are known to affect the chance of developing breast cancer, osteoporosis, and coronary heart disease, which are major contributors to serious illness and death in postmenopausal women (Register *et al.*, 2002).

2.5 Assessment of nutritional status

Assessment of nutritional status is essential, either to determine whether a person has nutritional imbalance caused by an underlying condition or to determine whether a person is prone to acquire a pathological condition as a result of nutritional imbalance (Kesari and Noel, 2022). The evaluation of dietary, laboratory, anthropometric, and clinical research might be referred to as nutritional assessment. It is used to assess how the intake and use of nutrients affect the nutritional status of an individual or population group (Gibson, 2005). Analyzing nutritional status simultaneously assists in determining the prevalence of nutritional problems, planning corrective actions, and evaluating the efficiency of implemented strategies (Shrivastava *et al.*, 2014).

The assessment of the nutritional status involves two methods (Lee, 2010):

a) Direct method - Deals with individuals and measures the objective criteria and summarized as ABCD method as given below:
   - Anthropometric methods
   - Biochemical methods
   - Clinical methods
   - Dietary evaluation methods

b) Indirect method - Uses community health indices reflecting nutritional influences. These includes three categories:
   - Ecological variables including crop production
   - Economic factors e.g. per capita income, population density & social habits
   - Vital health statistics particularly infant & under 5 mortality & fertility index

2.6 Assessment of dietary intake

A significant lifestyle-related risk factor for many chronic diseases is diet. Both subjective reporting and objective observation can be used to evaluate dietary intake. Surveys with open-ended or closed-ended questions can be used for subjective evaluation. It contains the 24-hour dietary recall, dietary record (DR), dietary history, and food frequency questionnaire (FFQ). Data are gathered either through self-reporting or with the aid of a trained interviewer. Dietary intake can be evaluated by objective observation using a duplicate diet technique, or a food consumption record by a skilled research team. The duplicate diet approach involves taking duplicate samples of a subject's typical diet and analyzing them to determine potential dietary exposures (Shim *et al.*, 2014).

a) 24-hour dietary recall and Dietary Record

The 24HR and DR are entirely open-ended questionnaires that gather a range of particular details about the food ingested during a predetermined time frame. Depending on the research question, specific information regarding food preparation techniques, materials used in mixed dishes, and the name of commercial products may be required. A common size container (such as bowls, cups, or glasses), standard measurement spoons and cups, a three-dimensional model of the food, or two-dimensional aids like images are used to estimate the amounts of each food ingested. Finally, the amount of nutrient intake of the food is calculated using the food composition database or food table (FCT) (Shim *et al.*, 2014).

b) Dietary history

Dietary history approach to assess the dietary intake of an individual was developed in 1947 by Burke to evaluate a person's long-term nutritional intake. For this procedure, respondents are required to fill out a 24-hour, 3-day food diary as well as a list of typical things they eat. An in-depth interview with a highly qualified specialist is required to gather details on the participant's typical diet. Because of this, epidemiological studies rarely employ this strategy (Shim *et al.*, 2014).

c) Food frequency questionnaire

The FFQ, an improved version of the checklist in the dietary history approach, asks participants how frequently and how much food they consumed over a specified time period. This questionnaire, which presents 100–150 foods, takes 20–30 minutes to complete and can be self-administered or gathered through an interview. This technique makes it possible to evaluate long-term dietary intakes in a way that is reasonably easy, affordable, and quick. Thus, a variety of FFQs have been widely used as a practical instrument (Shim *et al.*, 2014).

2.7 Indicators of nutritional status

The assessment of nutritional status can be done using a variety of indicators. Only a few of the numerous available nutritional status markers are appropriate for field program evaluation. An improved knowledge of the significance of anthropometric measures of nutritional status has come about as a result of studies conducted over the past ten years.

2.7.1 Body Mass Index (BMI)

BMI serves as a measure for indicating nutritional status in adults. It is expressed as a ratio of a person's weight in kilograms to their height in meters square (kg/m^2). The BMI ranges are based on the connection between adiposity and disease and mortality caused by excessive body fat. The use of BMI as a disease risk factor has shown that various diseases are more likely to develop when BMI rises. The BMI cut-off given by WHO as shown below:

Table 2.2.1 WHO BMI Classification

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

(WHO, 2000)

However, because it might not correspond to the same level of fatness in various people, it should only be used as a general reference. Moreover, it does not differentiate between extra weight from fat mass and nonfat mass like muscle, edema, or bone (WHO, 2010). Asian populations experience unfavorable health effects at lower BMIs than western populations because of their high levels of body fat. As a result, Asians have redefined obesity using cut-offs that are marginally lower than those used by WHO to classify it as:

Table 2.2.2 Classification of Asian BMI cut-offs

Classification	BMI ((kg/m^2)	Risk of comorbidities
Underweight	<18.5	Low risk
Normal	18.5-22.9	Acceptable Risk
Overweight	23-24.9	Increased Risk
Obese	≥25	High Risk

(Pan and Yeh, 2008)

2.7.2 Waist to Hip Ratio (WHR)

The WHO Expert Consultation on Obesity from 1997 acknowledged the significance of abdominal fat mass, often known as abdominal, central, or visceral obesity, which can vary greatly within a constrained range of total body fat and body mass index (BMI). It also emphasized the need for additional metrics for BMI measurement to identify people at higher risk of obesity-related morbidity due to accumulation of abdominal fat (WHO, 2000). Waist-hip ratio as an alternate way to assess the distribution of body fat was suggested, which is calculated by dividing the waist circumference by the hip circumference of the same unit. As a measure of both subcutaneous and intra-abdominal adipose tissue, the ratio is more accurate to measure than skin folds. A non-elastic tape that is held horizontally and unrestricted at the spot that produces the maximum diameter over the buttocks is used to measure the Hip Circumference (WHO, 2011).

WHR was widely employed in numerous investigations to determine the distribution pattern of fat. It demonstrated a strong correlation with myocardial infarction in several ethnic groups when compared to BMI (Murray, 2006) . To determine the appropriate cutoffs related to metabolic and cardiovascular risk factors, extensive study has lately been conducted in many ethnic groups. Compared to other measures of adiposity distribution, WHR has a weaker correlation with body fat percentage (Lutoslawska *et al.*, 2014). The WHO has established cutoffs for the WHR of 0.90 cm in males and 0.85 cm in women (WHO, 2011).

2.7.3 Waist circumference

The 2002 WHO Expert Consultation on Appropriate Body Mass Index for Asian Populations and its Implications for Policy and Intervention Options examined the issue of ethnic variations in the interpretation of BMI cut-off values (WHO, 2004). The consultation

proposed that, whenever practicable, waist circumference should be utilized to refine action levels based on BMI in populations with a tendency to central (i.e. abdominal or visceral) obesity and the associated elevated risk of developing metabolic syndrome (WHO, 2011). WC is a reliable indicator of abdominal obesity. Recent research has revealed that the metabolic implications of obesity are more strongly linked to mesenteric adipose tissue inflammation (Kranendonk *et al.*, 2015). Following the development of MS components has shown that the intra-abdominal fat mass predisposes to the emergence of hypertension. This was oddly unrelated to BMI and happened even in people with BMIs < 25 kg/m^2 (Nakao *et al.*, 2012).

WC adjustment for the BMI revealed a significant connection with mortality risk (Jacobs *et al.*, 2010). The two most popular places to measure the WC are at the superior border of the iliac crest or at the middle of the lower border of the rib margin and the higher border of the iliac crest with a flexible, non-elastic tape. However, measuring the WC requires training and uniformity. Waist circumference and the waist-to-hip ratio are two measures of central adiposity that postmenopausal women are more likely to have (Donato *et al.*, 2006). The WHO lists the following cutoffs for WC in women and risk of metabolic complications:

Table 2.3 WHO waist-circumference cut-offs in women

Classifications	Cut-offs	Metabolic Risk
Centrally overweight	>80cm	Increased
Centrally obese	>88cm	Substantially increased

(WHO, 2011)

PART III

Materials and methods

3.1 Study area

The study was carried out in Biratnagar Municipality, the administrative center of Nepal's Koshi Pradesh, Nepal. With a 77km^2 area, it is the largest city in the province and the administrative center of the Morang district. According to the preliminary report of the 2021 Nepal census, Biratnagar has 2,44,750 residents living in 45,204 households, making it the sixth most populated city in Nepal (CBS, 2022). Biratnagar is connected to an important customs route with the Indian Jogbani border. The city's expanding public health concerns are being caused by the country's open borders and rapid urbanization.

3.2 Study population

The population under study were postmenopausal females of 45-60 years age group residing in Biratnagar-10 Municipality who had been living at their place of residence for at least six months.

3.3 Selection Criteria

a) Inclusion criteria: The females

- Residing in Biratnagar ward no.-10 who were in their postmenopausal period and aged between 45-60 years.
- Having no menstrual period for 12 consecutive months.

b) Exclusion criteria:

- Females who were in their peri-menopausal period.
- Postmenopausal women who were on hormone replacement therapy (HRT) within the last 6 months of time.
- Those who had undergone hysterectomy or oophorectomy.
- Those who had cancer, mental illness or seriously ill bed-ridden patient.
- Those unable or unwilling to give informed consent.
- Those who are not available at household during the time of survey.

3.4 Research Design

In the survey area of Biratnagar-10, Morang, a community based cross-sectional and descriptive study was conducted to determine the nutritional status and dietary practices of postmenopausal women, which includes:

- Individual survey with the help of questionnaire
- Anthropometric measurements of the population: Height, weight, BMI, WHR and WC
- The food frequency questionnaire: The respondents were asked to remember how often they consumed a specific food group using this technique.
- 24 hour diet recall: In this method, the respondents were asked to recall all food and beverages they consumed in last 24 hours.
- International Physical activity Questionnaire: In this method, respondents were asked questions according to the standard format of IPAQ to assess their physical activity level (IPAQ, 2004).
- Menopause rating scale: In this method, respondents were asked about the menopausal symptoms they experienced and the scoring was done accordingly (Heinemann *et al.*, 2004).

3.5 Sampling technique

The survey was conducted in Biratnagar Municipality Ward No. 10, which has a total population of 12295 comprising of 1037 women ranging between 45-60 years age group (GON, 2018). A cross – sectional study followed by convenience sampling method was used to select postmenopausal females from households. The main prerequisite for selecting the sample of households was that they must contain at least one postmenopausal female between 45- 60 year age range and meet the inclusion criteria of the study. If a family had more than one female, one sample was chosen by lottery method from each household.

3.6 Sample size

The sample size was determined by using a single proportional formula where the combined prevalence rate of overweight and obesity was taken to be 56.6% in the survey area (Sapkota *et al.*, 2015), 95% confidence interval (CI), 6% margin of error (d) and 10% non-response rate was added to the total calculated sample size.

Prevalence of overweight and obesity (p) = 56.6%= 0.566

Z value at 95% confidence interval (Z) = 1.96

Margin of error (d) = 6%= 0.06

Now, sample size was calculated using formula for infinite population as:

Sample size (N) = Z^2 x p x (1-p) / d^2

= 1.96^2 x 0.566 x (1-0.566)/ (0.06^2)

= 262.12 ≈ 262

New sample size in finite population = N / [1+ (N-1) / POP]

= 262 / [1+ (262-1) / 1037]

= 209.6

Considering non-response rate as 10%, the adjusted sample size was calculated to be 230.

3.7 Research instruments

The following tools and equipment were required for conducting the survey:

- Weighing Machine: - Crown classic weighing machine with the capacity of 130 kg and having the least count of 0.1Kg was used (1 piece).
- Height measuring scale (Stadiometer): - The wooden plank stadiometer with the maximum capacity of 197cm and having the least count of 0.1cm was used (1 piece).
- Measuring tape: A non-stretchable flexible measuring tape was used to measure waist and hip circumference (1 piece).
- Measuring cups: 1 set
- Questionnaire: - A well designed structured and pretested set of questionnaires was used to collect individual information.

3.8 Study variables

3.8.1 Independent variables

i) Socio-economic and demographic variables

Chronological age, ethnicity, religion, marital status, occupation, education, parity, family size, income

ii) Physical activity

According to the estimated score for each person from the IPAQ-short questionnaire, physical activity was divided into three levels: low, moderate, and high. The appropriateness of each person's physical activity was also determined in accordance with the international guidelines for physical activity and health (WHO, 2022).

iii) Dietary intake

Food frequency questionnaire and 24-hour dietary recall were used to assess dietary intake among respondents. The collected data was converted to macro and micronutrient intake, namely-carbohydrate, proteins, fats and calcium level. The recommended dietary allowance (RDA) for Nepalese adult females (DFTQC, 2012; ICMR, 2020) was used to estimate the sufficiency of the nutrients, and the intake of fruits and vegetables was based on WHO recommendations (WHO, 2010).

iv) Behavioral characteristics

Food habit, smoking, alcohol intake, skipping breakfast and number of meals

v) Menopausal symptoms

The Menopause Rating Scale (MRS) was used to evaluate menopausal symptoms in the sample population. It is a self-administered standard set of questionnaire consisting of 11 items and a likert scale with a score range of 0 to 4. Menopausal age of the respondents was also taken.

3.8.2 Dependent variables

i) Body Mass Index (BMI)

Those with a BMI of 18.5 to 24.9 kg/m^2 or less were considered underweight, 25.0 to 29.9 kg/m^2 were considered overweight, and 30.0 kg/m^2 or more were considered obese according to WHO classification guidelines, whereas Asian BMI cut-offs classified women with a BMI of 23 to 24.9 kg/m^2 as overweight and 25 kg/m^2 as obese. (Pan and Yeh, 2008; WHO, 2021).

ii) Waist to Hip Ratio (WHR)

WHR greater than 0.85 in women were considered as abdominally obese (WHO, 2011).

iii) Waist Circumference (WC)

A women with WC ≥ 80 cm were considered as abdominally obese (WHO, 2011).

3.9 Pretesting

Pretesting study was conducted in few postmenopausal women to determine whether the tool was efficient and viable. The questionnaire was initially created in English, which was also translated into Nepali to improve readability and comprehension. Following pre-testing study- any confusing, deceptive, and incorrectly understood questions were removed. Also questionnaire was updated in accordance with the findings of pre-testing study.

3.10 Validity and Reliability

The degree to which the data gathering tools will measure what they were intended to measure is referred to as validity. By comparing the data produced by the weighing balance with standard weights, the validity of the weighing balance was determined. The measurement from the stadiometer and the UNICEF stadiometer were compared in order to determine the validity of the stadiometer. The calibrating stadiometer was used to calibrate the measuring tape. To verify the data, the instruments were checked and reset each day.

Reliability is a term for the quality assurance test of the gathered data. In order to assess the validity of the questionnaire's content, a pre-test was conducted before data collection. Daily checks were made to ensure the questionnaire was accurate, consistent, and understandable to respondents.

3.11 Data Collection Techniques

Data on the month of December, 2022, was gathered in two steps: a preliminary interview with the respondent to complete a semi-structured questionnaire, and then an anthropometric evaluation.

i) Socio-demographic information

The socio-demographic questions involved asking the respondents about their chronological age, ethnicity, religion, marital status, occupation, education, parity, family size and income.

ii) Anthropometric assessment

a. Weight- A portable digital weighing scale was used to measure weight. The tool was carefully placed on a firm, flat surface. Participants had to take off their shoes and socks, dress in loose-fitting clothing, stand in the scale with one foot on each side, face front, and hold their arms at their sides until instructed to get off. The steps to measure weight was repeated for three times to maintain accuracy. Also, the weighing scale was calibrated everyday beforehand to maintain quality data. The weight was recorded in kilograms (WHO, 2017).
b. Height- A portable, standardized stadiometer was used to measure height. Participants were requested to take off their shoes and any hats or hair ties before having their height measured. They were instructed to take a position on the flat board facing towards the interviewer, heels against the back board, and their feet together with their knees straight. They were directed to maintain their heads level, look straight ahead, and

make sure their eyes and ears were at the same level. Height was measured in centimeters (Bista *et al.*, 2021).

c. Waist and Hip circumference- Using a stretch-resistant tape that provided a constant 100 g tension and at a level parallel to the floor, the waist circumference was measured at the midpoint between the lower margin of the lower palpable rib and the top of the iliac crest, and the hip circumference was measured at the maximum over the buttocks. The body was wrapped with tape, but it wasn't pulled too tightly that it was restricting. Also, the participants were asked to stand straight with their arms at their sides, their feet close together, their weight evenly distributed across both feet, and their bodies relaxed while measurements were collected at the end of a normal breath. The measurement was read to the closest 0.1 cm at the level of the tape (WHO, 2011).

iii) Physical activity

The respondents' physical activity was described in terms of its type, intensity, duration, and frequency throughout the course of a week for transportation, work, and leisure activities. Data were gathered using the short form of "International Physical Activity Questionnaire (IPAQ)". The abbreviated form of IPAQ is a tool created primarily for population surveillance of adult physical activity. It is a reliable tool for measuring PA that enables international comparisons and investigates PA comprehensively (IPAQ, 2004).

iv) Dietary assessment

A food frequency questionnaire and the 24-hour recall method were employed for gathering the data. The food FFQ was used to gather data on the types of foods consumed by the respondents over the course of the previous days as well as their frequency of intake. In the 24-Hour Recall, participants were asked to list all the meals and beverages they had in the previous 24 hours (the day before), in sequence from the first meals eaten in the morning to the final meals eaten before going to bed. A variety of standardized measuring cups were used to estimate how much food and beverage the respondents actually ingested. The gram equivalents of those foods were determined, and the food composition table was then utilized to determine the amounts of nutrients consumed.

v) Menopausal symptoms

Menopause Rating Scale (MRS) tool was used for assessing the menopausal symptoms among the postmenopausal women in the survey. It is internationally accepted tool used in various epidemiological studies. It is a self-administered instrument consisting of 11 items.

One by one, each question was asked, and the scores were calculated accordingly. The questionnaire also contained menopausal age.

3.12 Data Analysis

Microsoft Excel 2013 was used to manually code and enter the acquired data sets into the database. Here, qualitative data were coded and transcribed by giving labels to different groups. The database was examined for any missing values and for consistency. For additional analysis, it was then moved to IBM SPSS Statistics program (version 26). The percentage and distribution of respondents by socio-demographic factors, physical activity, dietary habits, menopausal symptoms and behavioral traits were described using descriptive analysis. In the given data set, the chi square test was employed to determine the causal links between the explanatory factors.

3.13 Logical and Ethical Considerations

Permission to conduct survey in Biratnagar ward no.-10 was obtained from the Central Campus of technology administration, department of Nutrition and Dietetics and ward-10 office of Biratnagar municipality. Verbal and written consent from all the participants were obtained and the objective of the study was explained lucidly to them. Privacy and confidentiality of collected information was ensured at all level.

PART IV

Result and Discussion

The cross-sectional study was carried out to assess the nutritional status and menopausal symptoms among postmenopausal women residing in Biratnagar-10, Nepal. Indicators like BMI, WC, and WHR were used to assess the nutritional status of postmenopausal women. The results are explained under the following headings:

4.1 Demographic and socio-economic characteristics

The information on demographic and socio-economic characteristics is shown below:

4.1.1 Chronological age distribution of the study population

The average age of the respondents was 52.47± 3.035 years, with two thirds (54.3%) of the participants belonging to the 51–55 years age range, which is about the same as the average age of menopause for the majority of Nepalese women (Koirala *et al.*, 2020; Prajapati, 2020). The distribution of the study population according to the chronological age is shown below in Table 4.1:

Table 4.1 Distribution by the chronological age of the respondents (n=230)

Variables	Frequency	Percentage
Chronological age		
45-50	59	25.7%
51-55	125	54.3%
56-60	46	20%

4.1.2 Religion and caste distribution of study population

Biratnagar is a highly multicultural city with many different ethnic, cultural, and religious groups. *Hindu* comprised 92.6% of the study's participants (213), followed by *Muslim* with 4.3% (10), *Christian* with 1.7% (4), and *Buddhist* with 1.3%. (3). On the other side, *Madhesi* had the biggest percentage of the ethnic group, accounting for 35.2% (81) of the total, followed by *Brahmin* (32.2%), *Chhetri* (10.9%), *Newar* (9.1%), *Janjati* (7%), and *Marwari* (5.7%). (13). Distribution of the study population by ethnicity and religion is shown in Table 4.2 below:

Table 4.2 Distribution by the religion and ethnicity of the respondents (n=230)

Factors	Frequency	Percentage
Religion		
Hindu	213	92.6
Muslim	10	4.3
Christian	4	1.7
Buddhist	3	1.3
Caste/Ethnicity		
Madhesi	81	35.2
Brahmin	74	32.2
Chhetri	25	10.9
Newar	21	9.1
Janjati	16	7.0
Marwari	13	5.7

4.1.3 Marital status and Parity

The study revealed that majority of the women were found to be married constituting of 91.3% (210) in total whereas 8.7% (20) of the women were either divorced, widowed or separated. The distribution of the respondents according to the marital status and parity is shown below in Table 4.3:

Table 4.3 Distribution by the marital status and parity of the respondents (n=230)

Factors	Frequency	Percentage
Marital status		
Married	210	91.3
Divorced/Separated/Widow	20	8.7
Parity		
0	2	0.9
1-3	156	67.8
≥4	72	31.3

Also, the study found that, of the total population majority of the women comprising of 67.8% (156) had children from 1 to 3 in number followed by 31.3% (72) of women having four or more children. Only 0.9% (2) women had no children.

4.1.4 Socioeconomic factors

Education level and socioeconomic status influence the nutritional status, food choice and food consumption pattern among postmenopausal women. In this study, it was found that majority about 34.8% (80) of postmenopausal women were literate with secondary level of education whereas only 20% (46) of the women were illiterate as shown in Table 4.4 below:

Table 4.4 Distribution of respondents by socioeconomic factors (n=230)

Factors	Frequency	Percentage
Education		
Illiterate	46	20
Primary	62	27
Secondary	80	34.8
Higher secondary	35	15.2
Graduate	7	3
Occupation		
Housewife	154	67
Daily wage worker	7	3
Job service	34	14.8
Self-employed	23	10
Farmer	12	5.2
Income		
<30,000	139	60.4
≥30,000	91	39.6
Family size		
<4	24	10.4
4	103	44.8
5	75	32.6
>5	28	12.2

More than half of the women were housewife comprising of 67% (154), followed by 14.8% (34) involved in job-services, 10% (23) were self-employed in business like shops or social worker, 5.2% (12) were farmer and 3% (7) were daily wage workers. The average monthly income defined for Nepalese is Rs. 30,121 (NRB, 2016). The study showed that 60.4% (139) of postmenopausal women had their income below the average line while 39.6% (91) had higher income. In addition to this, the study result showed that about 44.8% (103) of women had 4 family members which stood with the average family size of Nepal according to 2021 census as of 4.32 members (Shrestha, 2022) .

4.2 Behavioral characteristics

The study results showed that 40.4% (93) skipped their breakfast daily, 30.4% (70) of women skipped their breakfast sometimes. Likewise in the context of snacks skipping it was found that, very few women of about 5.7% (13) skipped snacks on the daily basis while majority of them comprising of 84.3% (194) never skipped their snacks.

The study also revealed that 64.3% (148) postmenopausal women were non-vegetarian whereas only 35.7% (82) of them were vegetarian specifically lacto-vegetarian. In addition, few of the women also had smoking habits comprising of 4.8% (11) and drinking habits was found in 7.4% (17) of the total study population. The number of meals eaten per day plays special role on nutritional status. In the study, women having only 2 meals per day were 5.7% (13), 3 meals per day were 10% (23), 4 meals per day were 60% (138) and having 5 meals were 24.3% (56).

The distribution of behavioral characteristics of the study population is presented below in the Table 4.5:

Table 4.5 Distribution of the respondents by behavioral characteristics (n=230)

Factors	Frequency	Percent
Breakfast skipping		
Daily	93	40.4
Sometimes	70	30.4
Never	67	29.1
Snacks skipping		
Daily	13	5.7
Sometimes	23	10.0

Never	194	84.3
Food habits		
Veg	82	35.7
Non-veg	148	64.3
Smoking		
Yes	11	4.8
No	219	95.2
Alcohol intake		
Yes	17	7.4
No	213	92.6
Number of meals in a day		
2	13	5.7
3	23	10.0
4	138	60.0
5	56	24.3

4.3 Physical activity

All respondents were divided into three categories of physical activity, namely low, moderate, and high, based on the results of the IPAQ-short questionnaire and the IPAQ scoring protocol. In accordance with WHO standards, a different analysis was also conducted to determine the appropriateness of physical exercise as shown in Table 4.6 below:

Table 4.6 Distribution of respondents by physical activity (n=230)

Physical activity pattern	Frequency	Percentage
Levels of physical activity		
Low	115	50.0
Moderate	96	41.7
High	19	8.3
Adequacy of physical activity		
Adequate	115	50.0
Inadequate	115	50.0

The study result shows that majority of participants about 50% (115) engaged in low levels of physical activity, while 41.7% (96) and 8.3% (19) respectively engaged in moderate and vigorous levels. The findings correlates with various other studies which showed that a decline in PA level was associated with a drop in estrogen during the menopausal transition, which shifts midlife women more towards sedentary behavior (Duval et al., 2013).

4.4 Menopausal symptoms

The mean age at menopause was found to be 49.02±2.48 years which is consistent to the other studies conducted in Nepal (Ghimire *et al.*, 2015; Subedi *et al.*, 2022b). Only two women were found to have delayed menopause defined as occurring after 55 years of age. The distribution of the respondents by their menopausal age is shown in the Table 4.7 below:

Table 4.7 Distribution of respondents by their menopausal age (n=230)

Menopausal age	Frequency	Percentage
45-55	228	99.1
>55	2	0.9

The study indicated that among postmenopausal women, somatic domain symptoms were most common, followed by psychological and urogenital problems. The most prevalent menopausal symptoms were found to be hot flushes, 91.4% (210) of cases, followed by heart discomfort with 89.1% (205), sleep issues with 88.7% (204), joint pain, and anxiety with 87% (200) each. The study's results corresponded with other studies conducted in Nepal, where it was found that hot flashes and joint pain were the most prevalent menopausal symptoms (Ghimire *et al.*, 2015; Rajbhandari *et al.*, 2017). In contrary, physical and mental tiredness was shown to be the most common complaint among postmenopausal women in the studies carried out at Pokhara and Kathmandu valley, followed by symptoms of urogenital and psychosocial domains. (Koirala *et al.*, 2020; Sharma *et al.*, 2021).

The study also revealed the mean MRS score as 15.31±2.78 indicating mild to moderate risk implications among postmenopausal women which was in accordance to the study conducted in the Nepal Medical college Teaching Hospital (NMCTH), Kathmandu where the majority of women had MRS score <16 (Marahatta, 2012). The distribution of respondents according to the severity of menopausal symptoms is shown in Table 4.8 below:

Table 4.8 Distribution of respondents by the severity of menopausal symptoms (n=230)

Domains	Menopausal symptoms	Frequency (%)	Mild Frequency (%)	Moderate Frequency (%)	Severe and extremely severe Frequency (%)
Somatic	Hot flushes	210 (91.4)	39 (17)	154(67)	17(7.4)
	Heart discomfort	205(89.1)	76 (33)	114(49.6)	15(6.5)
	Sleep problems	204 (88.7)	91(39.6)	112(48.7)	1 (0.4)
	Joint pain	200 (87)	100(43.5)	73(31.7)	27(11.8)
Psychological	Depressive mood	191 (83)	121(52.6)	69(30)	1(0.4)
	Irritability	199 (86.5)	124(53.9)	74(32.2)	1(0.4)
	Anxiety	200 (87)	100(43.5)	96(41.7)	4(1.7)
	Physical and mental exhaustion	198 (86.1)	28(12.2)	150(65.2)	20(8.7)
Urogenital	Sexual Problems	195 (84.8)	8(3.5)	186(80.9)	1(0.4)
	Bladder problems	190 (82.6)	125(54.3)	64(27.8)	1(0.4)
	Dryness of vagina	193 (83.9)	142(61.7)	44(19.1)	7(3)

4.5 Dietary intake

4.5.1 Food Consumption Pattern

The food frequency questionnaire (FFQ) was used to analyze the respondents' dietary habits. Food consumption was classified as "frequent" if it occurred at least once a day, "regular" if it occurred 2-4 times per week, and "rare" if it occurred just once a week or less (Sato *et al.*, 2010).

The study revealed that cereals were consumed by all the Nepalese women as a major staple food of their diet while majority of the women were consuming pulses on a daily basis given by 61.7% (142) while 30% (69) consumed it regularly and only few of them about 8.3% (19) consumed rarely. However, majority of them reported having daal only once a day, which suggested that they were unaware of the benefit of pulses.

The consumption of vegetables was found in every mid-life women where more than half of the surveyed population consumed green leafy vegetables frequently 53% (122) while 37.4% (86) consumed it regularly and only 9.6% (22) consumed it rarely. Likewise, as compared to GLVs, it was found that women preferred other vegetables on the daily basis with 67.8% (156) while 27.8% (64) consumed it regularly and only 4.3% (10) women consumed it rarely. Also, fruits consumption was found poor among the postmenopausal women with only 37.4% (86) of them ingesting it on the daily basis. Most of the women preferred seasonal fruits that were easily available in their locality and confirmed that the consumption of the fruits servings was less than 5 per day due to economic factors.

Due to the religious beliefs, majority of the participants favored red meat, particularly mutton and fish, to white meat, poultry, and eggs. It was found that of total population, nearly half of the population constituting 46.15% (106) never consumed chicken. Similarly, it was found that about 40.4% (93) of total postmenopausal women never consumed red meat while more than half of them 56.5% (130) consumed it once a week. Also, the consumption of fish was found in the highest share of the study participants comprising of 58.3%. Likewise, eggs was found to be consumed by 57% of total population where 8.7% (20) consumed it on the daily basis, 25.7% (59) consumed it regularly and 22.6% (52) consumed it once a week or less.

Interestingly, all study participants consumed dairy products, whether they were milk, curd, paneer, or in other forms. However, the servings of milk was not uniform among all the respondents due to socioeconomic factors. Majority of the surveyed population consumed it on the daily basis comprising of 94.3% (217). Likewise, few women were found to consume ghee on the daily basis comprising of only 24.34% (56) while 12.17% (28) never consumed it. In addition, poor consumption of nuts was found among postmenopausal women with majority of them, 39.1% (90) consuming it rarely followed by 32.6 consuming it regularly and 19.6% (45) consumed it on the daily basis. Tea and coffee was found to be the most common beverage in the Nepalese society with 96.5% (222) of total population

consuming it on the daily basis. Most of the women consumed milk tea twice a day. Similarly, sugar was consumed by 67.78% (156) of the total women which makes the majority share of total population. The distribution of study population by food consumption pattern is shown in Table 4.10 below:

Table 4.9 Distribution of respondents from FFQ (n=230)

Variables	**Frequency (%)**			
	Frequent	**Regular**	**Rare**	**Never**
Cereals	230 (100)	0	0	0
Pulses	142 (61.7)	69 (30)	19 (8.3)	0
Green leafy vegetables	122 (53)	86 (37.4)	22 (9.6)	0
Other Vegetables	156 (67.8)	64 (27.8)	10 (4.3)	0
Fruits	86 (37.4)	110 (47.8)	34 (14.8)	0
Chicken	4 (1.7)	59 (25.7)	61 (26.5)	106 (46.1)
Red meat	0	7 (3)	130 (56.5)	93 (40.4)
Fish	0	9 (3.9)	125 (54.3)	96 (41.7)
Eggs	20 (8.7)	59 (25.7)	52 (22.6)	99 (43)
Dairy	217 (94.3)	9 (3.9)	4 (1.7)	0
Ghee	56 (24.34)	109 (47.39)	37 (16.08)	28 (12.17)
Nuts	45 (19.6)	75 (32.6)	90 (39.1)	20 (8.7)
Tea and coffee	222 (96.5)	2 (0.9)	3 (1.3)	3 (1.3)
Sugar	156(67.8)	14(6.1)	11(4.8)	49(21.3)
Soft drinks	0	0	53 (23)	177 (77)
Processed foods	2 (0.9)	10 (4.3)	101 (43.9)	117 (50.9)

Carbonated beverages was found very unusual among postmenopausal women where majority of them comprising of 77% (177) never consumed it while 23% (53) consumed it rarely. Processed food (PFs) are most common among teenagers as compared to the old age adults (Bohara *et al.*, 2021). It was found that, majority of the surveyed population constituting of 50.9% (117) never consumed it due to unfavorable taste.

4.5.2 Dietary intake in preceding day

The 24-hour dietary recall method was used to record all the meals and beverages consumed by the participants during the prior 24-hour period (the previous day). The RDA for energy according to 2020 guidelines is 1900 to 2200 kcal/day for adult women (ICMR-NIN, 2020). Based on this the energy requirement was interpreted where it was found that the majority of postmenopausal women, 59.6% (137) consumed more calories, followed by 25.7% (59) who consumed adequate calories, and only 14.8% (34) consumed fewer calories. However, the average consumption of calories among the study population was found to be 1813.45±189.05 kcal which was lower than the minimum average adequate requirement set by Government of Nepal (NPC and CBS, 2013).

The RDA for protein according to 2020 guidelines is 0.83g/kg/day while 1 g/kg for the people consuming low-quality protein from cereals (ICMR-NIN, 2020). Based on this criteria, participants' protein consumption was assessed where it was found that highest share of total population constituting of 89.1% (205) met their average protein requirement, followed by 8.7% (20) who consumed more than basic requirements while 2.2% (5) didn't met their minimal requirements. The average protein consumption was found to be 52±7.8 gram in the study. Also, depending on the amount of energy required, the visible fat is recommended to restrict at 20-50g (4 to 10 teaspoonful) per day and total fat was recommended to ≤30% of total energy needs (ICMR-NIN, 2020). On the basis of this standards fat consumption was assessed. The average visible fat consumption in this study was found to be 29.14±5.87 gm. In addition to this, more than half of total population 69.1% (159) consumed sufficient total fats followed by 26.1% (60) who had high fat intake while only 4.8% (11) consumed less than recommended fats.

The carbohydrate intake was assessed according to the estimated energy needs as 50-60% of carbs (Patsopoulos *et al.*, 2008) where it was found that the average carbohydrate consumption was 291.62±37.38 grams among the study population. Also, majority of the respondents comprising of 75.2% (173) consumed higher than the recommended requirements. In addition, the average calcium intake was found to be 841.25±216.78 mg among the participants which was less than recommended RDA of 1000mg for females (ICMR-NIN, 2020). The research findings was found contrast to the study conducted in North India among postmenopausal women where energy intake was 2304±29.56 kcal, carbohydrate 327.91±3.98 grams, protein intake was 45.59±17.23 grams, fat 29.42±17.13

grams and calcium intake was 432.23±6.14 mg (Dubey *et al.*, 2022). The distribution of these nutrients intake among respondents is depicted below in Table 4.11:

Table 4.10 Distribution of nutrients intake among respondents (n=230)

Variables	Frequency	Percent
Calorie		
Adequate	59	25.7
High	137	59.6
Low	34	14.8
Carbohydrates		
Adequate	57	24.8
High	173	75.2
Low	-	-
Protein		
Adequate	205	89.1
High	20	8.7
Low	5	2.2
Fat		
Adequate	159	69.1
High	60	26.1
Low	11	4.8
Calcium		
Adequate	145	63
Inadequate	85	37

4.6 Prevalence of overweight and obesity

4.6.1 According to WHO BMI classification

The BMI of study population was analyzed according to the international BMI classification given by WHO which concluded that the majority of respondents 44.3% (102) were overweight, 35.7% (82) were normal, 16.1% (37) were obese and only 3.9% (9) were underweight. The average BMI was found to be 25.74±4.16 kg/m^2 of study population.

This result was consistent with the result conducted in Kaski district where 17.3% of postmenopausal women were obese and 35.3% were normal and also with the study carried

out in Bhaktapur district in which 12.8% of midlife women were obese (Koirala *et al.*, 2020; S. Shrestha *et al.*, 2018). The prevalence of nutritional status among postmenopausal women according to WHO BMI cut-off is depicted in Figure 4.1 below:

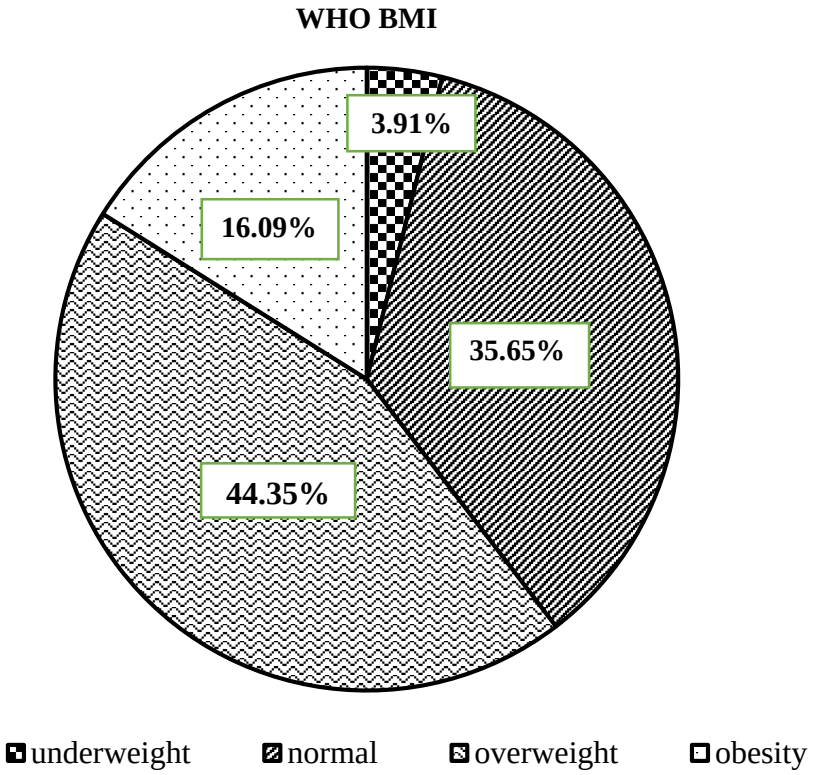

Figure 4.1 Nutritional status based on international BMI cut-off among postmenopausal women under study in Biratnagar-10

4.6.2 According to Asian BMI cut-off

On the basis of Asian BMI cut-off point it was found that, 3.9% (9) of postmenopausal women under study were underweight, 27% (62) were normal, 10% (23) were overweight and more than half of the participants comprising of 59.1% (136) were obese.

Inversely, a study conducted in 2008 indicated that 41.4% of women in rural Andhra Pradesh, South India, were overweight when measured using Asian BMI-cutoffs (Chow *et al.*, 2008). Similar to this, a study of post-menopausal women living in New Delhi's urban slums found that overweight and abdominal obesity affected 23.7% and 28% of the women, respectively (Misra *et al.*, 2001). The prevalence of nutritional status among postmenopausal women according to Asian BMI cut-off is depicted in Figure 4.2 below

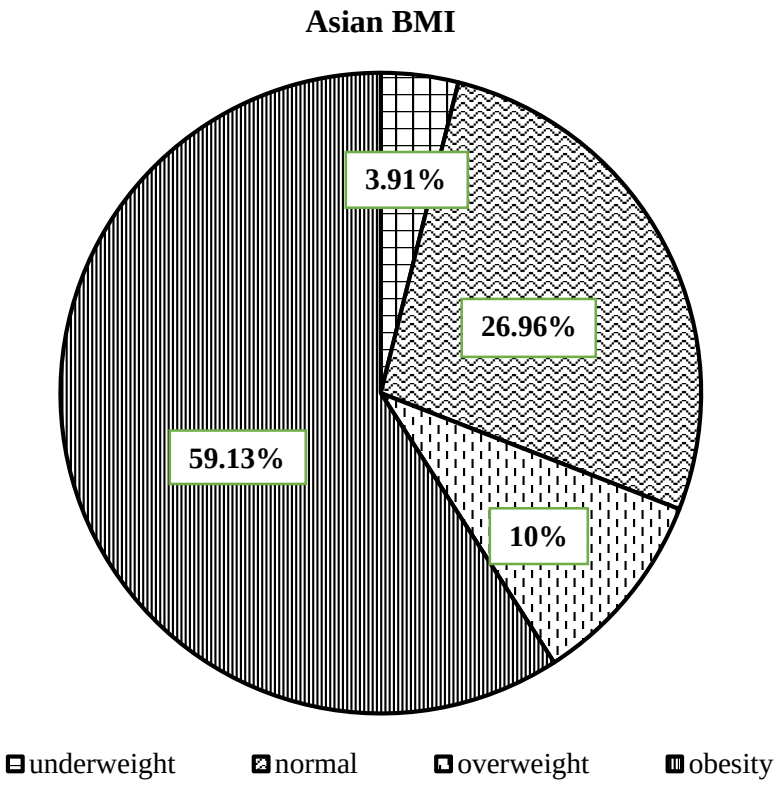

Figure 4.2 Nutritional status based on Asian BMI cut-off among postmenopausal women under study in Biratnagar-10

4.6.3 According to Waist circumference

The results of the study was classified using the WHO's International WC standard. The mean waist circumference was found to be 93.87±10.27 cm which is higher than the average waist circumference of Nepalese women which was found to be 79cm (Bista *et al.*, 2021).

The study revealed, 8.3% (19) of total participants were normal, 24.7% (57) were overweight and more than half comprising of 67% (154) were obese. The survey result was higher than the findings of the study conducted in TUTH in which 82.2% had raised WC (>80cm) (Sapkota *et al.*, 2015). The prevalence of nutritional status among postmenopausal women by waist circumference is depicted in Figure 4.3 below:

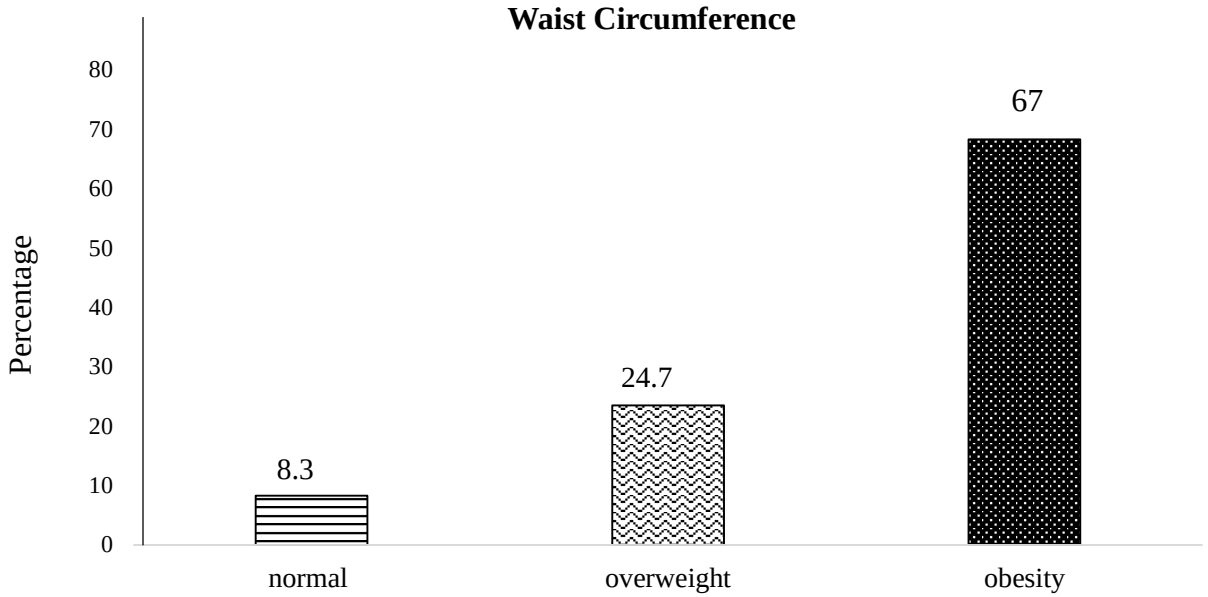

Figure 4.3 Nutritional status among respondents by Waist Circumference in Biratnagar-10

4.6.4 According to Waist to Hip Ratio measurement

The results of the study was classified using the international WHR categorization given by WHO. The mean WHR was found to be 0.95±0.08 which is higher than the average waist circumference of Nepalese adults which was found to be 0.90 (Bista *et al.*, 2021).

Similarly, 84.3% (194) of total participants were abdominally obese while only 15.7% (36) had normal waist to hip ratio. The results were almost identical but slightly higher when compared to the mean prevalence of abdominal obesity in Koshi pradesh and across Nepal which was found to be 69.4% and 70.2% respectively (Bista *et al.*, 2021). The prevalence of nutritional status among postmenopausal women by waist to hip ratio is shown in Figure 4.4 below:

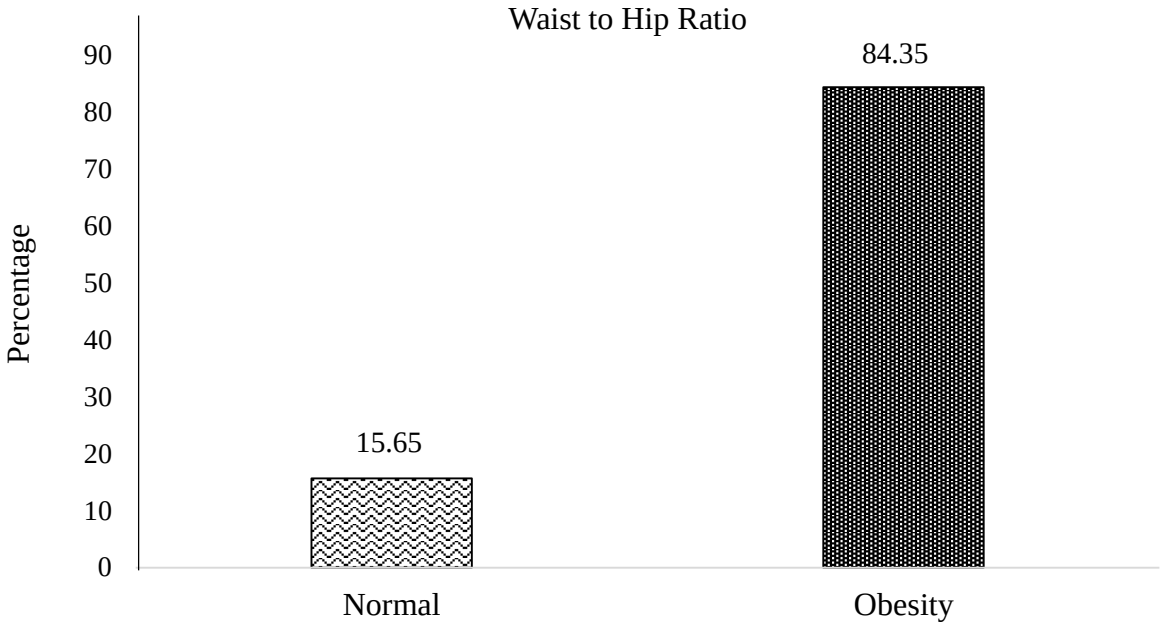

Figure 4.4 Nutritional status among respondents by Waist to Hip Ratio in Biratnagar-10

4.7 Factors associated with nutritional status among postmenopausal women

4.7.1 Factors associated with BMI (WHO cut off)

The chi-square analysis showed that age (p=0.014), physical activity (p=0.001), pulses (p=0.023), green leafy vegetables (p=0.010), fruits (p=0.047), calories intake (p=0.000), carbohydrate intake (p=0.000) and protein intake (p=0.000) were significantly associated with BMI as shown in Table 4.12.

The study revealed that majority of women from different age groups had high BMI were the highest share of population 58.4% (73) was from 51-55 years age group. The result was consistent with the study conducted among Brazilian postmenopausal women which found that women tend to gain weight as they age despite of their menopausal age (Gravena *et al.*, 2013). A significant association was also found with the physical activity where 65.22% (75) of women with low physical activity had high BMI. Low physical activity among midlife women is accompanied by drop in estrogen level during menopause transition leading to high chances of weight gain (Duval et al., 2013). Similar findings was also evident in the study conducted in Karnataka, India (Ranasinghe *et al.*, 2017).

Table 4.11 Factors associated with BMI among postmenopausal women (n=230)

Factors	Category	Frequency (%)		Chi-square	p-value
		Non-overweight and obese	Overweight and obese		
Age	45-50	29 (49.16)	30 (50.84)	8.598	*0.014
	51-55	52 (41.6)	73 (58.4)		
	56-60	10 (21.74)	36 (78.26)		
Physical activity	High	15 (78.94)	4 (21.06)	13.595	*0.001
	Moderate	36 (37.5)	60 (62.5)		
	Low	40 (34.78)	75 (65.22)		
Pulses	Frequent	64 (45.07)	78 (54.93)	7.526	*0.023
	Regular	18 (26.08)	51 (73.92)		
	Rare	9 (47.36)	10 (52.64)		
Green leafy vegetables	Frequent	48 (39.35)	74 (60.65)	9.303	*0.010
	Regular	28 (32.56)	58 (67.44)		
	Rare	15 (68.18)	7 (31.82)		
Fruits	Frequent	36 (41.86)	50 (58.14)	6.126	*0.047
	Regular	36 (32.72)	74 (67.28)		
	Rare	19 (55.88)	15 (44.12)		
Calories	Adequate	40 (67.80)	19 (32.20)	99.815	*0.000
	High	19 (13.87)	118 (86.13)		
	Low	32 (94.12)	2 (5.88)		
Carbohydrate intake	Adequate	35 (61.40)	22 (38.60)	15.114	*0.000
	High	56 (32.36)	117 (67.64)		
Protein intake	Adequate	73 (35.60)	132 (64.40)	19.408	*0.000
	High	17 (85)	3 (15)		
	Low	1 (20)	4 (80)		

*statistically significant ($p<0.05$)

Similarly, majority of women about 54.93% (78) who consumed pulses frequently had high BMI. This might be explained by the fact that the RDA for pulses was not met by most of the postmenopausal women (Ranasinghe *et al.*, 2017). Likewise, the study findings also revealed that majority of women 67.28% (74) who consumed fruits on the regular basis had high BMI. In parallel, 60.65% (74) of women who consumed GLVs on the daily basis also had high BMI. This might be explained by the fact that women didn't consume minimum servings of F/V per day. The study conducted in Hunan, China, clearly warrants the prevention of obesity among postmenopausal women by increasing the intake of fruits and vegetables to five servings per day (Su *et al.*, 2022).

Similarly, it was found that highest share of study population 86.13% (118) consumed more than the average caloric requirement leading to high BMI. Likewise, women with high carbohydrate intake 67.64% (117), had high BMI suggesting that they mostly consumed cereals to meet their energy requirement. The study result was also aligned to other study results conducted among women in Germany and Japan (Hashimoto *et al.*, 2016; Rossato *et al.*, 2017). The study also revealed that majority of women 64.40% (132) with adequate protein intake had high BMI. This might be due to the high consumption of overall calories among postmenopausal women.

4.7.2 Factors associated with Waist circumference

The chi-square analysis of this study showed that age (p=0.013), physical activity (p=0.000), pulses (p=0.026), fruits (p=0.032), calories intake (p=0.000), carbohydrate intake (p=0.008) and protein intake (p=0.006) were significantly associated with waist circumference among postmenopausal women in Biratnagar-10 as shown in Table 4.13.

The study revealed that majority of postmenopausal women from each age group were abdominally obese where highest share 64% (80) was from 51-55 years age group. Whether or not they are menopausal, women tend to gain weight as they become older. Age-related physiologic changes and alterations in lifestyle are the causes of this weight gain (Demerath *et al.*, 2011). Similarly, 73.05% (84) of women with low physical activity had high WC which was consistent with the findings of the study conducted at a major Western university in the United States (Choi *et al.*, 2012). It was also revealed that 61.26% (87) of midlife women who consumed pulses on the daily basis had high WC. This can be explained by the fact of the overall diet quality and low RDA of pulse consumption among these women.

Table 4.12 Factors associated with waist circumference among postmenopausal women (n=230)

Factors	Category	Frequency (%)		Chi-square	p-value
		Non-obese	obese		
Age	45-50	24 (40.68)	35 (59.32)	8.655	*0.013
	51-55	45 (36)	80 (64)		
	56-60	7 (15.22)	39 (84.78)		
Physical activity	High	14 (73.68)	5 (26.32)	16.134	*0.000
	Moderate	31 (32.29)	65 (67.71)		
	Low	31 (26.95)	84 (73.05)		
Pulses	Frequent	55 (38.74)	87 (61.26)	7.274	*0.026
	Regular	14 (20.29)	55 (79.71)		
	Rare	7 (36.84)	12 (63.16)		
Fruits	Frequent	35 (40.69)	51 (59.31)	6.884	*0.032
	Regular	27 (24.54)	83 (75.46)		
	Rare	14 (41.17)	20 (58.83)		
Calories intake	Adequate	32 (54.23)	27 (45.77)	91.048	*0.000
	High	14 (10.21)	123 (89.79)		
	Low	30 (88.24)	4 (11.76)		
Carbohydrate intake	Adequate	27 (47.36)	30 (52.64)	7.029	*0.008
	High	49 (28.32)	124 (71.68)		
Protein intake	Adequate	62 (30.24)	143 (69.76)	10.342	*0.006
	High	13 (65)	7 (35)		
	Low	1 (20)	4 (80)		

*statistically significant ($p<0.05$)

Likewise, majority of women 75.46% (83) who consumed fruits 2-3 times a week had high WC suggesting the fact that they didn't meet the minimum servings of fruit per day leading to abdominal obesity (Lapointe *et al.,* 2010). In parallel, women with high intake of calorie 89.79% (123), carbohydrate 71.68% (124) and adequate protein intake 69.76% (143)

had high abdominal obesity. The study result aligned to the findings of research conducted in Srilanka where a positive correlation between high carbohydrate diet and increased waist circumference was found among women (Rathnayake *et al.*, 2014).

4.7.3 Factors associated with Waist to Hip Ratio

The chi-square analysis was performed which showed the relationship between different variables like physical activity (p=0.029), eggs (p=0.027), calories intake (p=0.000) and protein intake (p=0.042) with abdominal obesity using waist to hip ratio measurement among postmenopausal women under study as presented in Table 4.14.

Table 4.14: Factors associated with waist to hip ratio among postmenopausal women (n=230)

Factors	**Category**	**Frequency (%)**		**Chi-square**	**p-value**
		Normal	**Obese**		
Physical activity	High	7 (36.84)	12(63.15)	7.049	0.029*
	Moderate	13(13.54)	83(86.45)		
	Low	16 (13.91)	99(86.08)		
Eggs	Frequent	1(5)	19(95)	9.201	0.027*
	Regular	16(27.11)	43(72.88)		
	Rare	5(9.61)	47(90.38)		
	Never	14(14.14)	85(85.85)		
Calories intake	Adequate	13(22.03)	46(77.96)	52.57	0.000*
	High	5(3.64)	132(96.35)		
	Low	18(52.94)	16(47.05)		
Protein intake	Adequate	28(13.65)	177(86.34)	6.36	0.042*
	High	7(35)	13(65)		
	Low	1(20)	4(80)		

*Statistically significant (p<0.05)

The study revealed association between physical activity and WHR where majority of postmenopausal women comprising of 86.08% (99) with low physical activity were abdominally obese. This finding was also evident in the study conducted among postmenopausal women in US where positive correlation was found between WHR and

physical activity (Sims *et al.*, 2012). Likewise, majority of women of about 85.85% (85) who never consumed eggs had high WHR. The result was contrast to the findings of various researches which shows the significant association of obesity and central adiposity with high egg consumption due to its high cholesterol and fat content (Ghosh *et al.*, 2003; Wang and Beydoun, 2009). Similarly, the study revealed that majority of women with high calorie intake 96.35% (132) and adequate protein intake, 86.37% (177) had high WHR. The result was in agreement to the study where high calorie diet causes central obesity (Mathew and Chary, 2013).

PART V

Conclusions and Recommendations

5.1 Conclusions

The research work emphasized on assessing nutritional status and menopausal symptoms of postmenopausal women residing in Biratnagar-10. Following conclusions can be drawn from the study:

a) 3.9% of respondents were underweight, 35.7% were normal weight, 44.3% were overweight, and 16.1% were obese based on BMI (WHO cut-off). While on the basis of WC and WHR, 67% and 84.3% of the study population were abdominally obese respectively. The mean BMI was 25.74±4.16 kg/m2, WC was 93.87±10.27 cm, and WHR was 0.95±0.08.

b) The mean menopausal age among the study population was found to be 49.02±2.48 years. In addition, hot flush (91.4%), heart discomfort (89.1%), sleep issues (88.7%), joint/muscular discomfort (87%) and anxiety (87%) were the most common menopausal symptoms while the mean MRS score was found to be 15.31±2.78.

c) The average daily calorie, carbohydrate, protein and fat consumption among study participants was found to be 1813.45±189.05 kcal, 291.62±37.38gm, 52±7.8gm and 29.14±5.87gm respectively.

d) The study revealed that factors like age, physical activity, pulses, fruits, calories intake, carbohydrate intake and protein intake were associated with both BMI and WC whereas green leafy vegetables was associated only with BMI.

e) The study's findings showed significant prevalence of overweight and obesity and menopausal symptoms. Thus, considering all the relevant aspects, suitable and prompt action should be taken to reduce the prevalence rate.

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5.2 Recommendations

Based on the study results, following recommendations can be practiced in order to improve the overall health status and dietary practices of postmenopausal women:

a) Weight gain is one of the most important concern which was also evident in the current study's findings. To reduce the various health consequences of obesity, these women should be educated on how to maintain a healthy body weight after menopause in different regions of the country.
b) The study revealed that majority of women experienced mild to moderate menopausal symptoms together with additional comorbidities. Thus, it's crucial to aware the women about these health issues and the way to handle them.
c) To investigate the relationship between food habits and menopausal symptoms experienced by women, importance of soy product consumption and Mediterranean diet is recommended.
d) The research based on nutritional status and dietary habits of postmenopausal women in Nepal is minimal. Thus, similar researches should be segregated to explore whether the prevalence rate and determinants are common.
e) Concerned authorities such as municipal officials, NGOs and INGOs should work collectively to aware women about menopausal health problems and the way to reduce its deleterious effect.

PART VI

Summary

Every woman experiences menopause naturally in their mid- forties. It may result in a range of menopausal symptoms and health issues. The most common health consequence among postmenopausal women is observed to be weight gain. Menopausal health issues are becoming an increasing global health concern because of the rising proportion of postmenopausal women, and Nepal is not an exception. So, the purpose of this study was to evaluate the nutritional condition and menopausal symptoms of postmenopausal women in Biratnagar-10, Nepal. The cross-sectional study was carried out among postmenopausal women in the 45–60 age range who reside in Biratnagar-10 municipality. BMI, WC, and WHR were the three anthropometric markers used, and they were examined using MS Excel 2013 and IBM SPSS version 26. Out of 230 participants it was found that 3.9% were underweight, 35.7% were normal, 44.3% were overweight and 16.1% were obese as defined by BMI (WHO criteria). While based on WC and WHR, 67% and 84.3% were found abdominally obese respectively.

The study population's mean menopausal age was found to be 49.02 years, with the most prevalent menopausal symptoms including hot flashes, heart discomfort, difficulty sleeping, joint and muscle pain, and anxiety. The average daily calorie consumption among study participants was found to be 1813.45±189.05 kcal with macro-nutrients such as carbohydrate, protein and fat at 291.62±37.38gm, 52±7.8gm and 29.14±5.87gm respectively. The study found that variables like age, physical activity, pulses, fruits, calorie intake, carbohydrate intake and protein intake were all associated with both BMI and WC while green leafy vegetables was associated only with BMI. Similar to this, WHR was correlated with parameters like PA, eggs, irritability, calories intake, and protein intake.

The study's findings demonstrated a considerable prevalence of overweight and obesity as well as poor dietary habits. Thus, to combat the situation, programs should be implemented to raise awareness of maintaining an ideal body weight, managing menopausal health issues, and changing one's lifestyle.

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Appendices

Appendix A

INFORMED CONSENT LETTER

Namaste!

I'm Miss Pallavi Karn, an undergraduate student pursuing degree in BSc. Nutrition and Dietetics at Central Campus of Technology, Dharan. I'm currently working on my dissertation work in Biratnagar Municipality for this degree. The topic for the study is - **"NUTRITIONAL STATUS AND MENOPAUSAL SYMPTOMS OF POSTMENOPAUSAL WOMEN RESIDING IN BIRATNAGAR-10, NEPAL".**

In this study, postmenopausal women living in Biratnagar-10 municipality will have their nutritional status, menopausal health issues and dietary habits examined. The nutritional status and factors influencing it, prevalence of menopausal health concerns and dietary practices among these midlife women will all be covered in this study. Participants' height weight, waist and hip circumference, menopausal health issues, socioeconomic and behavioral characteristics, physical activity, dietary considerations, will all be measured throughout the course of the study.

You will be questioned and have your physical parameters recorded if you agree to participate in this study. You will learn more about your nutritional status through this study. Some of the questions may be personal, but all the information you supply will be valued, the privacy of which will be upheld, and it won't be used improperly. Your participation in this study is entirely optional. If you believe the questions are sensitive or personal, you may choose not to answer any or all of them. I hope that you'll be able to assist me with this research. Do you want to get participated in this study?

Yes, I am willing to participate in the study and allow the concerned surveyor to take all measurements and ask the necessary questions required for this study.

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

Date: Date:

Place: Place:

Appendix B

Survey Questionnaires

Participant's Code: Date of Interview (B.S.): ……. /….. /…..

A. GENERAL INFORMATION

1. Participant's name: ……..
2. Age (in years): …….
   i. 45-50 ii. 51-55 iii. 56-60
3. Religion
   i. Hindu iii. Christian
   ii. Muslim iv. Buddhist
4. Ethnicity
   i. Madhesi iii. Chhetri v. Marwari
   ii. Brahmin iv. Janjati vi. Others
5. Marital status
   i. Married ii. Divorced/separated/widow
6. Occupation
   i. Housewife iv. Business
   ii. Daily wage worker v. Framer
   iii. Job service
7. Education
   i. Illiterate iv. Higher secondary
   ii. Primary level v. Graduate
   iii. Secondary level
8. Parity: …….
   i. 0 ii. 1-3 iii. 4 or more
9. Family size: ……..
   i. <4 iii. 5
   ii. 4 iv. >5
10. Family income
    i. <30,000 ii. ≥30,000

B. ANTHROPOMETRIC MEASUREMENT

INDICATORS (in cm)	READINGS			MEAN	REMARKS
	1	2	3		
Weight					BMI (kg/m^2) =
Height					
Waist circumference					WHR=
Hip circumference					

C. PHYSICAL ACTIVITY QUESTIONNAIRE (IPAQ-Short form)

1. During the last 7 days, on how many days did you do vigorous physical activities (heavy lifting, digging, aerobics, or fast bicycling for more than 10 minutes at a time)?
   i. ……..…Days per week ii. None
2. How much time did you usually spend doing vigorous physical activities on one of those days? ……. Hours …… Minutes per [day/ week]
3. During the last 7 days, on how many days did you do moderate physical activities (carrying light loads, bicycling at a regular pace, or double tennis)? Do not include walking.
   i. ……. Days per week ii. None
4. How much time did you usually spend doing moderate physical activities on one of those days? ……... Hours …… Minutes per [day/ week]
5. During the last 7 days, on how many days did you walk for at least 10 minutes at a time? This includes walking at work and at home, walking to travel from place to place, and any other walking that is done solely for recreation, sport, exercise or leisure
   i. …..…… Days per week ii. None
6. How much time did you usually spend walking on one of those days? ……Hours …Minutes per [day/ week]
7. During the last 7 days, how much time did you usually spend sitting on a week day? This includes time spent sitting at a desk, visiting friends, reading, travelling on a bus or sitting or lying down to watch TV. …… Hours ……... Minutes per weekday.

D. BEHAVIORAL FACTORS

a. What is your food habit?

i. Vegetarian

ii. Non-vegetarian

b. How many meals do you consume in a day?

i. 2 iv. 5

ii. 3 v. more than 5

iii. 4

c. How often do you skip Breakfast meal?

i. Daily ii. Sometimes iii. Never

d. How often do you skip Snacks meal?

i. Daily ii. Sometimes iii. Never

e. Do you drink alcohol or any sort of hard drinks?

i. Yes ii. No

f. Do you smoke or not?

i. Yes ii. No

E. DIETARY ASSESSMENT

a. 24-Hour Dietary Recall

Timing	**Description of food**	**Amount**
Breakfast		
Lunch		
Mid-snacks		
Snacks		
Dinner		
Bed-time		

b. Food Frequency Questionnaire (FFQ)

S.N.	Type of food	Frequent (at least once in a day)	Regular (3-4 times a week)	Rare (once in a week or less)	Never
1.	Cereals				
2.	Pulses				
3.	Green Leafy Vegetables				
4.	Other Vegetables				
5.	Fruits				
6.	Chicken				
7.	Red meat				
8.	Fish				
9.	Eggs				
10.	Dairy				
11.	Ghee				
12.	Nuts				
13.	Tea and coffee				
14.	Sugar				
15.	Soft drinks				
16.	Processed Foods				

F. MENOPAUSAL HEALTH PROBLEMS QUESTIONNAIRE

a. What was your age at menopause? .....

i. 45-55 ii. >55

b. Menopausal symptoms using Menopause Rating Scale (MRS) tool:

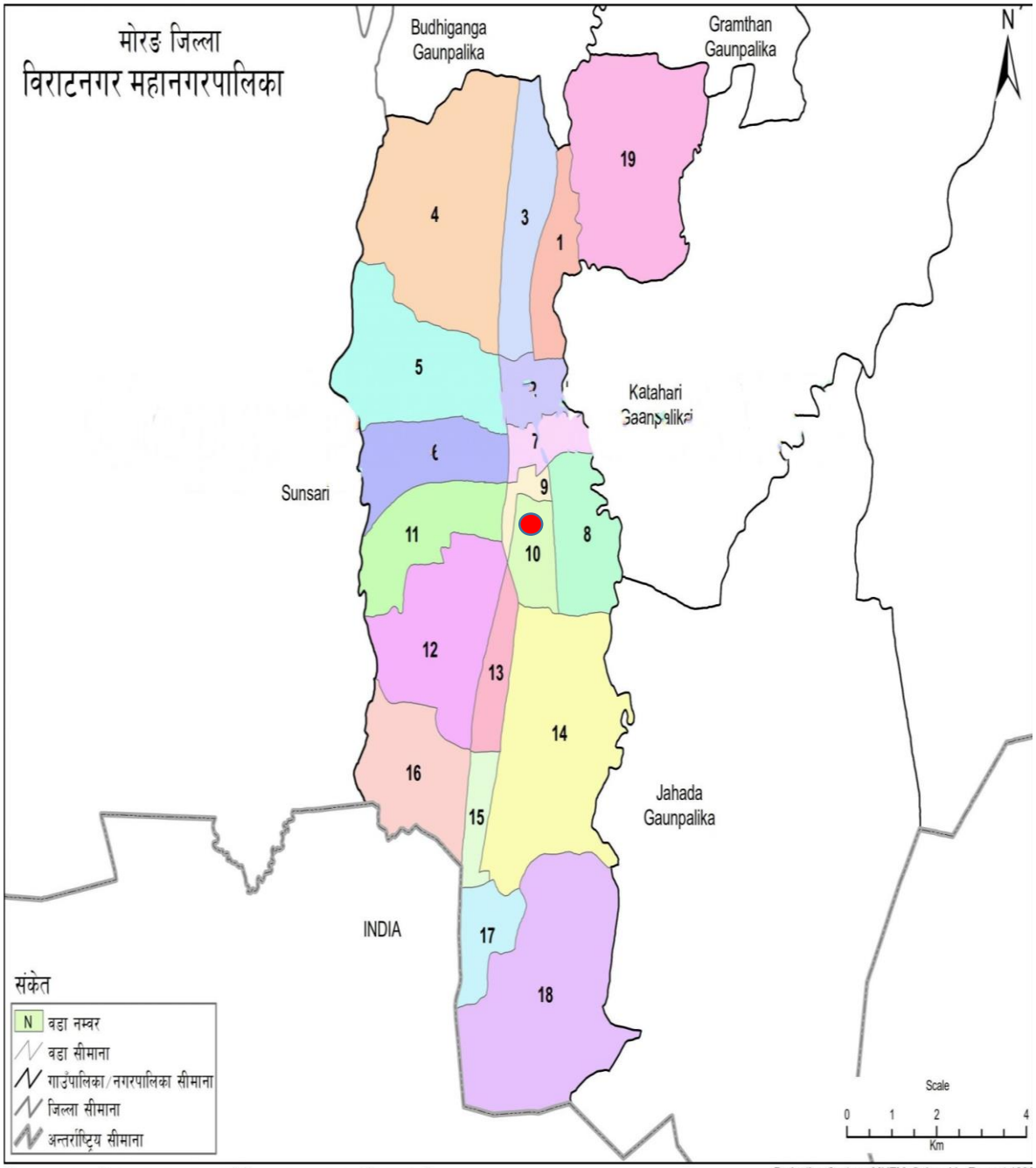
Symptoms:	None	Mild	Moderate	Severe	Extremely severe
	I----------	I----------	I----------	I ----------	I
Score =	0	1	2	3	4

1. Hot flashes, sweating (episodes of sweating).....
2. Heart discomfort (unusual awareness of heart beat, heart skipping, heart racing, tightness) ……
3. Sleep problems (difficulty in falling asleep, difficulty in sleeping through the night, waking up early).....
4. Depressive mood (feeling down, sad, on the verge of tears, lack of drive, mood swings.....
5. Irritability (feeling nervous, inner tension, feeling aggressive) ……
6. Anxiety (inner restlessness, feeling panicky) …….
7. Physical and mental exhaustion (general decrease in performance, impaired memory, decrease in concentration, forgetfulness).....
8. Sexual problems (change in sexual desire, in sexual activity and satisfaction) ……
9. Bladder problems (difficulty in urinating, increased need to urinate, and bladder incontinence).....
10. Dryness of vagina (sensation of dryness or burning in the vagina, difficulty with sexual intercourse) .....
11. Joint and muscular discomfort (pain in the joints, rheumatoid complaints) .....

Appendix C

Study site

Biratnagar Municipality



Appendix D

Photo Gallery

Plate 1: Measurement of height

Plate 2: Measurement of weight

Plate 3: Asking survey questionnaire

Plate 4: Asking survey questionnaire