# KNOWLEDGE AND PREVENTIVE PRACTICE REGARDING OSTEOPOROSIS AMONG WOMEN RESIDING IN BARAHAKSHETRA MUNICIPALITY, SUNSARI

by

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# Knowledge and preventive practice regarding osteoporosis among women residing in Barahakshetra Municipality, Sunsari

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

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## Approval Letter

This ***dissertation*** entitled ***knowledge and preventive practice regarding osteoporosis among women residing in Barahakshetra Municipality, Sunsari*** presented by **Ashmita Bhattarai** has been accepted as the partial fulfillment of the requirement for the **Bachelor degree in Nutrition and Dietetics.**

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# Abstract

A community based cross-sectional study was conducted with the objective to assess the knowledge and preventive practices regarding osteoporosis among women residing in Barahakshetra Municipality. This study involved 160 women aged 15-59 years, selected from two randomly chosen wards out of the 11 wards in the municipality. Data collection was conducted through face-to-face interviews using structured questionnaires, which included questions about socio-demographic characteristics, knowledge of osteoporosis, and preventive practices. Additionally, anthropometric measurements were taken to provide further context for the data.

The study revealed that 29% of the participants had poor knowledge of osteoporosis, 49% had moderate knowledge, and 22% had good knowledge. Practice scores indicated that 1% of the women had poor practices, 63% had moderate practices, and 36% had good practices in terms of osteoporosis prevention. A mild positive correlation was found between knowledge levels and preventive practices. Significant association was found between knowledge scores and variables such as education level, ethnicity, and menopausal history. Similarly, education level, occupation, ethnicity, religion, and menstruation history were significantly associated to the level of preventive practices. However, no significant correlation was identified between the knowledge or practice scores and the BMI of the participants. The findings highlight the need for targeted educational interventions to improve osteoporosis awareness and prevention practices among women in Barahakshetra Municipality.

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## List of Abbreviations

| Abbreviations | Full form |
|---|---|
| BHOF | Bone Health and Osteoporosis Foundation |
| BMD | Bone Mineral Density |
| BMI | Body Mass Index |
| BMSCs | Bone Marrow Stromal Cells |
| CBS | Central Bureau of Statistics |
| CI | Confidence Interval |
| DXA/DEXA | Dual-Energy X-ray Absorbtiometry |
| FRAX | Fracture Risk Assessment Tool |
| GCs | Glucocorticoids |
| IGF-I | Insulin like Growth Factor 1 |
| ISCD | International Society for Clinical Densitometry |
| NCDs | Non-Communicable Diseases |
| NHI | National Health Insurance |
| OKAT | Osteoporosis Knowledge Assessment Tool |
| OKT | Osteoporosis Knowledge Tool |
| OPG | Osteoprotegerin |
| PBM | Peak Bone Mass |
| PLaOs | Pregnancy and lactation-associated Osteoporosis |
| PTH | Parathyroid Hormone |
| RANKL | Receptor Activator of Nuclear Factor Kappa Beta |
| SD | Standard Deviation |
| WHO | World Health Organization |

# Part I

## Introduction

### 1.1 General Introduction

Throughout the world, osteoporosis is a serious health issue. A growing medical and social concern, osteoporosis is characterized by a systemic loss of bone mass, strength, and micro architecture, which raises the risk of fragility fractures. Osteoporosis is defined by the World Health Organization (2003) as a vertebral or hip bone mineral density (BMD) assessed by dual energy x-ray absorptiometry (DEXA) that is -2.5 standard deviations or more below the mean for young, healthy women (T-score of −2.5 or lower). The medical and social impact of osteoporosis, especially postmenopausal osteoporosis, will worsen as the population ages (Rachner *et al.*, 2011). A skeletal disorder called osteoporosis is defined by a reduction in the density of typically calcified bone. Because of its decreased density, bones are less mechanically strong and are therefore more prone to breaking. It is acknowledged in this definition that there is a direct correlation between bone mineral density and fracture risk (Glaser and Kaplan, 1997). Both the spongy and cortical bone tissues are impacted when the microarchitecture of the bone tissue deteriorates. There is a decline in bone mineral density. As a result, bone resistance to low-energy stress is compromised. The fragility of bones increases, leading to a higher risk of fractures (WHO, 2003). Because of its increasing financial burden, osteoporosis is a major concern for health care systems (Kuo and Chen, 2017).

The cost of osteoporosis fractures in the US was estimated to be $13.8 billion (O'Neill and Roy, 2005). Osteoporosis has also increased in frequency and increased health care costs in the Asian area as a result of the region's aging populations' growing percentages (De Silva *et al.*, 2014). Although osteoporosis is curable and preventative, many patients are not receiving a diagnosis in time to start effective medication during the early stages of the illness since there are no warning signals before a fracture (Cosman *et al.*, 2014). Since osteoporosis is a disease that goes unnoticed, it makes sense that primary preventive measures, such as early identification of risk factors, education of those at risk, and prompt treatment intervention, will lower treatment costs and reduce morbidity and mortality (Juby and Davis, 2001; Lee and Lai, 2006).

Primary and secondary osteoporosis are the two types of the disease. Age-related osteoporosis (Type II) and postmenopausal osteoporosis (Type I) are the two subtypes of primary osteoporosis. Osteoporosis that develops postmenopausal (Type I) in women who are deficient in oestrogen, while age-related osteoporosis (Type II) affects both men and women when their bone density deteriorates with age. Patients with recognized disease processes or causal factors are referred to as having secondary osteoporosis (Marcus and Bouxsein, 2008). The standard method for diagnosing osteoporosis is bone mineral density (BMD). One measurement tool for BMD, dual energy X-ray absorptiometry (DXA), is especially regarded as the appropriate tool applicable to WHO criteria, which define osteoporosis as a T-score of less than (-2.5) SDs below the mean of young adult women. FRAX, a new technique that the WHO just developed, allows us to more easily assess the risk of osteoporotic fractures (Kim and Moon, 2011).

Both sexes and all racial groups are affected by osteoporosis, which will become more common as the population ages (Cosman *et al.*, 2014). It was predicted that about 200 million patients globally suffer from osteoporotic hip fractures (Harvey *et al.*, 2014). According to Bone Health and Osteoporosis Foundation (BHOF) estimates, 44 million Americans are at high risk of developing osteoporosis owing to poor bone density and 10 million Americans currently have the disease. About 71 million persons worldwide are predicted to have poor bone density and osteoporosis by 2030 (Sarafrazi *et al.*, 2021). Despite these numbers, it is widely recognized that osteoporosis is preventable, and numerous studies have found clear associations between several health behaviors and a decreased risk of osteoporosis. For example, there is clear-cut evidence regarding the association between decreased risk of osteoporosis and participation in physical activity, cessation of smoking, and adequate intake of calcium and vitamin D in the diet (Wolf *et al.*, 2000).

According to a comprehensive systematic review and meta-analysis, it was estimated that 18.3 percent of people worldwide suffer from osteoporosis. According to this study's findings, it was discovered that, Africa has been found to have the greatest prevalence of osteoporosis (39.5%). In a similar way, osteoporosis is more common in the USA (12.4%), Australia (13.5%), Asia (16.7%), and Europe (18.6%). Compared to the USA and Australia, osteoporosis is more common in Asia. Similarly, compared to Europe and Africa, osteoporosis is less common in Asia (Salari *et al.*, 2021).

## 1.2 Statement of problem

Globally, osteoporosis is a prevalent condition. Among the 18.3 percent of people worldwide suffering from osteoporosis, the global prevalence of osteoporosis in women was reported to be 23.1, whilst the global prevalence in males was determined to be 11.7 (Salari *et al.,* 2021). Women are more likely than men to suffer from vertebral fractures (Conti *et al.,* 2015). Studies have indicated that if women are categorized into three groups: premenopausal (before menopause), menopausal beginning around the onset of menopause, and women who have gone through menopause for more than five years, post-menopausal women are more likely than premenopausal or menopausal beginning around the onset of menopause to experience bone fractures from osteoporosis (Jarupanich, 2007). A sample of 524 Indians aged 20 to 85 years was found to have 6.9% osteoporosis prevalence, with women accounting for 11.1% of the cases and males for 3.9% (Kaushal *et al.,* 2018).

The mean scores for health attitudes and general awareness of osteoporosis among middle aged women in Kathmandu Municipality were 146.18 ±11.58 and 9.39 ± 2.93, respectively. The majority of respondents (60.0%) had no idea what osteoporosis was (Panta *et al.,* 2021). According to the study's findings, 51% of the young adult women of selected community of Pokhara knew about osteoporosis at an average level and 49% knew very little about it. All of them lacked adequate knowledge about osteoporosis, though (Deepti *et al.,* 2021). It was found that the participants lacked sufficient knowledge regarding the definition and consequences of osteoporosis, risk factors, and strategies for prevention in India (Panda *et al.,* 2022). In general, osteoporosis prevention and treatment greatly benefit from a healthy diet. In addition to a healthy diet, maintaining a healthy lifestyle may help ensure bone health. This includes abstaining from high-risk behaviors like excessive alcohol and tobacco use and getting enough exercise (Hejazi *et al.,* 2020).

Despite a reasonably high level of general awareness of the disease's presence, there is a lack of understanding regarding its treatment, prevention, and the severity of its effects. Women are unlikely to be taking action to lower their chance of getting osteoporosis, based on their apparent lack of information about the severity of the condition and their lack of knowledge about preventative behaviors. Since osteoporosis is a disease that may be prevented, it is important to evaluate the general public's health beliefs and knowledge

about the condition. The results of these assessments could be used to develop effective ways to raise awareness and fight osteoporosis. The evaluation of women's awareness levels aids in identifying knowledge gaps and in promoting improved health-seeking behaviors. Few studies have been done in Nepal to evaluate young adult women's awareness of osteoporosis, however some have been done with postmenopausal women (Deepti *et al.*, 2021).

It is possible to change how patients prevent osteoporosis. By raising awareness, encouraging people to take preventative actions, and improving their general bone health, osteoporosis education can eventually lower the incidence of osteoporotic fractures. The purpose of this study was to ascertain awareness of osteoporosis risk factors and their osteoporosis prevention behaviors among rural women in Nepal. The study aims to assess the knowledge of osteoporosis and its prevention strategies among this population to design effective educational programs and promote lifestyle changes for osteoporosis control. By focusing on self-care and community support, the study seeks to gather valuable insights that can guide the development of comprehensive initiatives to address osteoporosis and its impacts. This research is crucial in understanding the awareness levels and behaviors related to osteoporosis in rural settings, highlighting the importance of preventive measures and lifestyle modifications in combating this bone disease.

## 1.3 Objectives

### 1.3.1 General Objective

The general objective of this study was to assess the knowledge and preventive practices regarding osteoporosis among women residing in Barahakshetra Municipality.

### 1.3.2 Specific Objectives

a) To assess knowledge of osteoporosis among women with the help of questionnaire.
b) To study the behavioral factors and preventive practices of osteoporosis.
c) To investigate correlation between knowledge levels and preventive practices about osteoporosis.
d) To examine the association between knowledge level and selected socio-demographic variables.

e) To examine the association between level of preventive practice and selected socio-demographic variables.

### 1.4 Research questions

a) What is the degree of knowledge of osteoporosis among women residing in Barahakshetra Municipality?
b) What are the preventive measures adopted by women residing in Barahakshetra Municipality to reduce prevalence of osteoporosis?
c) What association exists between the knowledge level and selected socio-demographic variables?
d) What association exists between the level of preventive practice and selected socio-demographic variables?

### 1.5 Significance

a) The study result will be helpful in highlighting the awareness of osteoporosis and the main contributing factor.
b) The study would enhance early detection and management of osteoporosis by assessing the knowledge and preventive health behaviors related to the disease among women aged 15 to 59, thereby addressing a critical gap in health promotion for a condition that is often overlooked.
c) The findings will be helpful in informing the health sector and the public health planners in mobilization and allocation of resources for the prevention and control of NCDs.
d) The result would be basis for the formulation of guideline and resources.
e) Findings of the study can also be used as baseline data by the researchers for future studies.

### 1.6 Limitations

a) Osteoporosis was not assessed due to limited resources.
b) Current data about the population, nutritional status and the knowledge of osteoporosis of village is not available so information through the communication may not be accurate.

c) Dietary assessment using validated food frequency questionnaire and 24-hour dietary recall was not done to evaluate dietary practices among women.

# PART II

## Literature Review

### 2.1 Introduction

According to the National Institutes of Health Consensus Development Panel on Osteoporosis (2015), osteoporosis is a skeletal disorder marked by weakening bones that puts a person at higher risk of fracture. The integration of bone density and bone quality is the primary indicator of bone strength. A fracture happens when stress or another force that causes failure is applied to an osteoporotic bone. Hence, a major risk factor for fracture is osteoporosis. The skeleton is a dynamic structure that constantly undergoes reabsorption and reconstruction, which is known as remodeling (Peck *et al.*, 1988). From birth to adulthood, bone mass is molded (grows and becomes its final shape). At puberty, bone mass reaches its peak, also known as peak bone mass (PBM), after which bone mass begins to decline. Reabsorption and formation rates become unbalanced as we age and enter menopause, with reabsorption surpassing absorption. This imbalance increases the likelihood of fracture (Sözen *et al.*, 2017).

As a serious public health concern, osteoporosis is the most frequent bone disease in humans. Older adults and women are more likely to experience this. As with hypertension increases the risk of stroke, osteoporosis increases the chance of fracture. With the aging of the population, osteoporosis will become more common in the vast majority of people, affecting all racial and gender identities. Up to fractures, which can result in serious secondary health issues or even death, the condition is silent (Cosman *et al.*, 2014). General variables related to age and sex steroid deficiency, as well as specific risk factors including the use of glucocorticoids (which cause decreased bone development and bone loss) and lower bone quality, are all linked to an increased risk of osteoporosis (Riggs *et al.*, 1982).

The gold standard for diagnosing osteoporosis is central dual-energy x-ray absorptiometry (DXA) of the hip (femoral neck or whole hip), notwithstanding the availability of several methods for BMD testing (Kanis *et al.*, 2000). According to WHO criteria, osteopenia defined as a BMD between 1.0 and 2.5 SD below that of a “young normal” adult (T-score between −1.0 and −2.5, whereas osteoporosis as a T score at −2.5 or lower). Osteopenia can also be referred to as "low bone density" or "decreased bone

density. Osteopenia is linked to vitamin D insufficiency, hyperparathyroidism, and osteoporosis, among other metabolic disorders (Karaguzel and Holick, 2010). Adolescence and childhood are crucial for promoting healthy bone growth and preventing osteoporosis as people mature. The formative years of 13 to 17 years old account for an estimated 50% of the calcium deposited in the adult skeleton. A progressive decrease in bone mass occurs naturally beyond the age of thirty (Noble *et al.*, 2001).

Estrogen deficiency increases bone turnover because it affects all types of bone cells. Therefore, the most common kind of osteoporosis is postmenopausal osteoporosis, which is brought on by an insufficient supply of the hormone oestrogen (Eastell *et al.*, 2016). Because older women are more likely than older males to sustain osteoporotic fractures, all menopausal women should get screened for osteoporosis (Aicale *et al.*, 2019). The first step in the prevention and treatment of disease is having the appropriate knowledge and the correct ideas about any health problem (Bilal *et al.*, 2017). There is increasing evidence that those who are more susceptible to osteoporosis are more likely to take preventative measures once they are knowledgeable of the illness (Senthilraja *et al.*, 2019). Factors such as age, marital status, level of education, family history of osteoporosis, personal history of osteoporosis, and information sources have a substantial impact on postmenopausal women's knowledge on osteoporosis prevention (Sava *et al.*, 2020; Rundasa *et al.*, 2022).

### 2.2 Pathophysiology

As new bone replaces older bone, the process of bone remodeling that keeps the skeleton in good condition can be thought of as a form of preventive maintenance. When this balance is thrown off, more bone is removed than is replaced, leading to bone loss. Menopause and growing older cause the imbalance. The pace of bone remodeling accelerates with the onset of menopause, exacerbating the effects of the remodeling imbalance. A disorganized skeletal architecture and an increased risk of fracture result from bone tissue loss (Cosman *et al.*, 2014).

The development of osteoporosis is influenced by mechanical stress on the skeleton. Osteoporosis can be caused by either excessive or insufficient stress on the bone or by disuse of the bone (Armas and Recker, 2012). Decrease in stiffness and strength is linked to an increase in unrepaired microdamage above the point at which focused remodeling may effectively repair it. If little cracks don't get fixed, they might combine to develop

bigger ones that show up as fractures (Burr *et al.*, 1998). Microdamage rises with age, but in women it does so at a faster rate, making them potentially more susceptible to fractures (Schaffler *et al.*, 1995).

After menopause, markers of bone resorption show a 90% increase in bone resorption, whereas markers of bone synthesis show a 45% increase in bone formation. The difference between the formation and resorption of bone promotes increased resorption of bone, resulting in faster bone loss in the first 8 to 10 years following menopause (Clarke and Khosla, 2010). Estrogen typically causes osteoblastic cells, T and B lymphocytes, and osteoblastic cells to produce less RANKL and more OPG, therefore when estrogen is deficient, the ratio of OPG to RANKL is altered in a way that promotes bone resorption (Khosla *et al.*, 2002; Clowes *et al.*, 2005). PTH production is somewhat suppressed during the fast phase of early postmenopausal bone loss, but it gradually increases during the slower phase of later postmenopausal bone loss, which is accompanied by an increase in bone resorption (Clarke and Khosla, 2010).

### 2.3 Classification

By taking into account the variables influencing bone metabolism, osteoporosis can be divided into two main groups:

a. Primary osteoporosis
b. Secondary osteoporosis

#### 2.3.1 Primary Osteoporosis

Typically, "primary" osteoporosis is a skeletal condition that affects older men and women or postmenopausal women. Hence primary osteoporosis can be further divided into:

- Type I Osteoporosis: It is also known as postmenopausal osteoporosis. In type I, there is a greater turnover of bones due to a decrease of testosterone and estrogen, with trabecular bone loss predominating over cortical bone development and bone resorption surpassing bone creation. a result, women are more prone to osteoporosis than males (Marcus and Majumder, 2001). Men and women lose bone at a rate of around 0.3% and 0.5% year, respectively, after reaching peak bone mass at age

thirty. During menopause, a woman's bone loss is further exacerbated by a 2% annual decrease in estrogen, which lasts for six years following menopause (Riggs *et al.*, 1982).

- Type II Osteoporosis: Another name for it is senile osteoporosis, and it is associated with a loss of bone mass brought on by the cortical and trabecular bones aging (Marcus and Majumder, 2001). Age is the cause of senile osteoporosis, which affects both men and women. People above the age of 70 are typically affected. Bone marrow stromal cells (BMSCs) have been demonstrated to undergo senescence and develop more into adipocytes than osteoblasts as people age. This process reduces bone production and is a contributing factor to senile osteoporosis (Qadir *et al.*, 2020).

However, idiopathic osteoporosis in adults and juveniles, pregnancy- and lactation-associated osteoporosis, and localized osteoporosis are less prevalent types of primary osteoporosis (Marcucci and Brandi, 2015). Juvenile idiopathic osteoporosis, is an extremely uncommon primary bone demineralization disorder (Kulkarni and Keshavamurthy, 2004). Although the exact cause of this illness is unknown, very low rates of bone production and reduced cancellous bone volume have been reported (Rauch *et al.*, 2002). Recurrent long-bone fractures, back discomfort, and trouble or incapacity walking are the major symptoms (Chlebna-Sokól *et al.*, 2001). An unusual and rare condition known as pregnancy and lactation-associated osteoporosis (PLaOs) is characterized by the development of fragility fracture(s), most frequently vertebral, in the latter stages of pregnancy or in the postpartum phase (Marcucci and Brandi, 2015). It's unclear what causes this illness or how it develops. Increased fetal demand for calcium for skeletal bone calcification appears to be the cause of the known substantial changes in calcium and bone homeostasis that occur during pregnancy and breastfeeding (Rizzoli and Bonjour, 1996).

### 2.3.2 Secondary Osteoporosis

When bone loss results from particular, well-defined clinical diseases, like thyrotoxicosis or hyperadrenocorticism, it is referred to as "secondary" osteoporosis (Marcus and Majumder, 2001). Secondary osteoporosis is nearly often caused by many factors, and it is typically discovered following an atraumatic fracture. It can be caused by a number of

endocrinopathies, systemic illnesses, malignant neoplasias, organ dysfunctions, a range of drugs, including corticosteroids, lifestyle factors and habits, as well as major depression (Polymeris *et al.*, 2013).

### 2.4 Diagnosis of osteoporosis

Bone quality (20%) and BMD (70%) can be used to quantify bone strength. BMD is easily measured; however bone quality is not yet quantifiable in clinical settings. Osteoporosis is diagnosed based on BMD measurement or the development of a hip or vertebral fragility fracture. Dual X-ray absorptiometry (DXA) is used to evaluate bone mineral density, which is the bone's true expression expressed in absolute terms in grams of mineral (mostly as g/cm2 of calcium) per square centimeter of the scanned bone. Bone mineral density (BMD) assessments of the hips and spine are used to diagnose or confirm osteoporosis, predict the risk of future fractures, and keep track of patients (Sözen *et al.*, 2017). Hip and spine DXA examinations are above to alternative bone densitometry techniques in multiple ways. These advantages include the consensus that BMD results can be interpreted using the World Health Organization T score definition of osteoporosis, the ability to assess treatment response, the ability to predict fracture risk, and the ability to target anti-fracture therapies (Celi *et al.*, 2013).

Table 2.1 WHO definitions of osteoporosis based on BMD

| **Classification** | **Bone Mineral Density** | **T Score** |
|---|---|---|
| **Normal** | Within 1 SD of the mean level for a young adult reference population | T score at −1.0 and above |
| **Low bone mass (Osteopenia)** | Between 1 and 2.5 SD below that of the mean level for a young adult reference population | T score between −1.0 and −2.5 |
| **Osteoporosis** | 2.5 or more below that of the mean level for a young adult reference population | T score at or below −2.5 |
| **Severe or established osteoporosis** | 2.5 or more below that of the mean level for a young adult reference population with fractures | T score at or below −2.5 with one or more fractures |

**Source: (Kanis, 2008)**

According to the International Society for Clinical Densitometry (ISCD), Z-scores adjusted for ethnicity or race should be used in place of T-scores. Z-scores below 2.0 are considered to be "low bone mineral density for chronological age" or "below the expected range for age," while those above 2.0 are considered to be "within the expected range for age" (ISfC and ISfC, 2015).

### 2.5 Risk Factors

Numerous factors, including age, gender, race, location, food, lifestyle, hormonal state, bone density, bone quality, body mass index, and medical comorbidities, increase the risk of osteoporotic fractures. Certain factors are inherently unmodifiable, while others can be prevented or changed in anticipation of a desired reduction in the frequency of fractures (Dontas and Yiannakopoulos, 2007).

#### 2.5.1 Age

The age-related rise in falls and the age-related decrease in proximal femur bone mineral density are thought to be the main causes of the increased fracture risk, which is also linked to the higher comorbidities of the elderly (Dontas and Yiannakopoulos, 2007). Bone loss is caused by hormonal changes that occur with aging; specifically, low levels of sexual steroids and a corresponding rise in cortisol have a detrimental effect on bone remodeling. The function of osteoblasts is diminished in the elderly, which leads to a reduction in bone production (D'Amelio and Isaia, 2015). While the prevalence of fractures varies widely between nations, up to 50% of women over 50 years are often at risk (Eastell *et al.*, 2016).

#### 2.5.2 Sex

Compared to men, women reach a lower maximal bone mass. The incidence of hip fractures in women of all ages in the USA and Europe is almost twice that of men at any age due to increasing bone loss in women after menopause and their greater propensity to fall than in men. Furthermore, as women often outlive men, over 75% of hip fractures occur in women (Dontas and Yiannakopoulos, 2007). For both sexes, hypogonadism is a significant risk factor for osteoporosis. In young women, chronic disease, exercise-induced amenorrhea, and anorexia nervosa can all cause hypogonadism, either as the primary cause or a secondary effect (Kanis, 2002).

### 2.5.3 BMI

The World Health Organization (WHO) suggests that the criteria of overweight and obese be based on BMI > 25 kg/m2 and BMI ≥ 30 kg/m2, respectively (WHO, 1995). These cutoff values are derived from research on the relationships between BMI and elevated risks of cardiovascular disease and type II diabetes in Western countries. BMI cut-off values of 23.0 to 24.9 kg/m2 for the categorization of overweight and of > 25.0 kg/m2 for obesity in Asians have been recommended by the WHO, International Association for the Study of Obesity, and International Obesity Task Force (WHO, 2000).

Lower body mass index (BMI) is a known risk factor for fractures in the future. A low body mass index (BMI < 21 kg/m2) increases the risk of hip fracture significantly (De Laet *et al.*, 2005). Bone mineral density influences the relationship between BMI and fracture risk. Obesity by itself does not increase the risk of hip fracture or osteoporotic fracture. On the other hand, compared to women with normal BMI, obese postmenopausal women seem to have an increased risk of humeral fractures (Johansson *et al.*, 2014). Theoretically, a higher weight loss (average 14% during 3-5 months) causes a considerable weakening of the bones, but a lower weight loss over a longer period of time (6 months) causes little to no bone loss (up to 1%) in premenopausal women (Fogelholm *et al.*, 2001; Riedt *et al.*, 2007).

### 2.5.4 Previous Fracture

When compared to people who had never fractured before, those who had a history of fractures were found to have a noticeably higher risk of fracture overall (Kanis *et al.*, 2004). Women who have already experienced a vertebral fracture are approximately four times more likely to experience another one in the future, and this risk rises as the number of previous fractures increases. Elderly individuals who exhibit fractures ought to be considered more likely to experience more fractures in the future, and they should be evaluated further for osteoporosis and fracture risk, including hip and other fractures (Klotzbuecher *et al.*, 2000).

### 2.5.5 Late menarch/Early menopause

Women who experience early menopause or late menarche, which reduces their exposure to typical reproductive hormones, may be at greater risk (Khosla and Bilezikian, 2003).

Among women in the 45–55 age range, those who experienced early menopause showed lower vertebral and femoral neck T-scores than those who experienced natural menopause (Faubion *et al.*, 2015). According to research by Francucci and colleagues women who go through menopause between the ages of 40 and 44 have lower vertebral bone mineral density than those who go through a natural menopause. Although both groups' BMD decreased over time, there was no difference in vertebral BMD between women who experienced an early or natural menopause after the age of 55 (Francucci *et al.*, 2008).

### 2.5.6 Family history

Osteoporosis risk is significantly influenced by inherited variables. The likelihood of hip fractures in women is around double that of women without a family history of the condition (Lane, 2006). According to research on twins (Howard *et al.*, 1998), genetic variables account for 70–80% of individual variations in BMD (measured at the lumbar spine and femoral neck). Variants of several important genes, such as the vitamin D receptor and collagen Ia1, have been linked to a doubled risk of osteoporotic fracture and have been identified as contributors to this inherited risk (Nguyen *et al.*, 2004).

### 2.5.7 Nutrition and Lifestyle factors

Physical exercise is a protective factor for bone mass retention in postmenopausal women, whereas smoking is an independent risk factor for osteoporosis (Bijelic *et al.*, 2017). While adequate dairy intake (>4 servings per day) had a beneficial influence on bone density in teenagers, alcohol and smoking had a significant unfavorable impact on the same (Korkor *et al.*, 2009). The distal radius in men who consume alcohol at low and moderate/high levels may suffer from poor bone health in the cortical and trabecular compartments. Women who consume alcohol at low and moderate levels also showed similar results in the trabecular and distal tibia compartments, indicating that avoiding alcohol may be good for bone health (Paccou *et al.*, 2015). Serum PTH levels among heavy smokers increased, but circulating levels of 1,25-dihydroxyvitamin D decreased by almost 10%.

Smoking is linked to higher levels of luteinizing and follicle stimulating hormone, which causes the estrogen levels to drop and causes fast bone loss (Kline *et al.*, 2016). The process of bone remodeling, osteoblastic proliferation, and activity are all negatively impacted by excessive alcohol use, which directly affects bone homeostasis (Zhang *et al.*, 2015). For postmenopausal women to retain bone density, physical activity or exercise

must supply the necessary voltage (Gómez-Cabello *et al.*, 2012). The National Osteoporosis Foundation states that walking is one of the best forms of exercise for postmenopausal women to maintain or increase their bone mineral density (Bassey and Dinan, 2002). Menopausal women may reduce their risk of osteoporosis and sarcopenia by engaging in exercise interventions that increase their muscular strength and physical activity levels (Yang *et al.*, 2017).

### 2.5.8 Medications

Secondary osteoporosis is more likely to occur in those with chronic illnesses that need long-term medications. Drug-induced osteoporosis most commonly results from exposure to glucocorticoids (GCs). Exposure to GC has been linked to 20% of all instances of osteoporosis. GC increases total net bone resorption by stimulating osteoclast-mediated bone resorption and decreasing osteoblast-mediated bone creation (Mitra, 2011). In as little as three months of medication, glucocorticoids cause a 10%–20% quick early phase of bone loss, followed by a later period of 2%–5% annual bone loss (Ramsey-Goldman, 2002). In stromal and osteoblastic cells, they contribute to increased bone resorption by increasing the expression of receptor activator for nuclear factor κ-B ligand (RANKL) and inhibiting the expression of its soluble decoy receptor, osteoprotegerin (OPG). Glucocorticoids inhibit the transcription of the IGF-I gene, which is necessary for the production of type I collagen and the development of bones (Canalis, 2005). Anti-epileptic medications for epilepsy have been linked to decreased bone density in postmenopausal women and men over 65 (Ensrud *et al.*, 2004).

## 2.6 Prevention

Fracture rates can be decreased and quality of life can be increased by treating osteopenia and osteoporosis early on. Apart from the significant role played by genetic and hormonal factors, the diet (enough calcium and protein intake), normalized vitamin D stores maintained through sun exposure or supplementation, and regular weight-bearing exercise are the most important factors for the accumulation and maintenance of bone mass (Karaguzel and Holick, 2010).

### 2.6.1 Exercise

Osteoporosis can be prevented by engaging in proper exercise or physical activity. Exercise is known to have a number of physiological reactions, including the stimulation of growth hormone secretion, which can either directly or indirectly have anabolic effects through the action of insulin-like growth factor (Cariati *et al.*, 2021). Early postmenopausal women may benefit from a strength exercise program twice a week in addition to 30 minutes of moderate walking in one to three sessions per day to improve their bone density (Asikainen *et al.*, 2004). According to a meta-analysis of randomized clinical studies, walking significantly raises BMD in the hip and spine in postmenopausal women. Additionally, they discovered that postmenopausal women's BMD was positively impacted by resistance, weight-bearing, and aerobic activity (Bonaiuti *et al.*, 2002). Walking, running, Tai Chi, stair climbing, dance, and tennis are examples of weight-bearing exercises. For adults, walking three to five miles each week is the ideal guideline. In the hip and lumbar areas, this contributes to maintaining and maybe increasing BMD (Karaguzel and Holick, 2010).

### 2.6.2 Lifestyle changes

It should be promoted to abstain from excessive alcohol and soda use and to stop smoking. Due to the sequestration of dietary calcium in the digestive system and the requirement to dissolve bone mineral to neutralize acid, an excessive consumption of cola beverages high in phosphoric acid lowers the body's calcium level. This might lead to the development of moderate secondary hyperparathyroidism (Wyshak, 2000; Tucker *et al.*, 2006). Drugs like glucocorticoids and anticonvulsants that are known to be detrimental to bone health should not be administered or should only be used in small doses and for shorter periods of time (Karaguzel and Holick, 2010). Optimizing body mass index whether underweight or overweight is another way to enhance bone health (Compston *et al.*, 2017).

### 2.6.3 Diet

One of the most effective ways to avoid osteopenia and osteoporosis is through proper nutrition, as dietary risk factors are modifiable. The two most essential dietary elements in preventing osteopenia/osteoporosis are adequate consumption of calcium and vitamin D.

A reduced achievable peak bone mass is the consequence of inadequate calcium consumption throughout the formative adolescent and young adult years, which is between the ages of 20 and 30. Before the age of 50, 20 years of insufficient calcium consumption might cause a 5% to 15% decline in BMD. Skim milk is the simplest way to ensure that you are getting enough calcium (Noble, 2001). Supplementation should be targeted towards those, such as older adults and those with intestinal malabsorption, who do not consume enough calcium from their diet and who are at risk of developing osteoporosis and/or fragility fractures (Tang *et al.*, 2007).

From conception to death, vitamin D is vital for the growth and upkeep of healthy bones because it regulates the quantities of both calcium and phosphate in the blood. The prevalence of vitamin D insufficiency in osteoporosis patients is high. Vitamin D-containing foods include cod liver oil, irradiated mushrooms, egg yolks, and oily fish like salmon and mackerel (Noble, 2001). For most people, exposure to direct sunlight is the primary source of vitamin D. About 10–15% of the calcium in food can be passively absorbed by the small intestine when vitamin D levels are low (Holick, 2007). Meta-analyses regarding the combination of calcium and vitamin D supplements have demonstrated a decrease in hip and non-vertebral fractures, and perhaps in vertebral fractures as well (Tang *et al.*, 2007; Yao *et al.*, 2019).

Although protein is also necessary for healthy bones, there is ongoing discussion over the potential for excessive protein consumption to deplete calcium. An increased acid load from a high-protein diet causes the body to remove calcium from the skeleton, which damages the bones and excretes calcium in the urine in an attempt to balance the pH (Darling *et al.*, 2009). However, as long as calcium intakes are sufficient, dietary protein levels may help prevent hip fractures and bone loss. Greater consumption of protein in older individuals with osteoporosis is linked to increased bone mineral density (BMD), a slower pace of bone loss, and a lower risk of hip fracture (Rizzoli *et al.*, 2018).

### 2.7 Global Prevalence of osteoporosis

Even though there is some indication that fracture incidence rates are down in Western nations, the global burden of osteoporosis is rising as a result of an aging population and developing nations adopting a Western lifestyle (Clynes *et al.*, 2020). 19.7% of people

worldwide had osteoporosis. The prevalence varied significantly by continent (from Oceania, 8.0% to 26.9% in Africa) and country (from 4.1% in the Netherlands to 52.0% in Turkey). In developing nations, the prevalence was higher at 22.1% compared to 14.5% in developed nations (Xiao *et al.*, 2022). Osteoporosis and metabolic problems associated with lifestyle are becoming more common in Asian countries. In Asian males, metabolic syndrome may be linked to bone loss, and atherosclerosis is linked to a higher risk of fractures (Sugimoto *et al.*, 2016).

In 2006, data from the Taiwan National Health Insurance (NHI) database were randomly sampled, and the results showed that, based on BMD criteria, 1.63% of Taiwanese males over 50 had osteoporosis (Yang *et al.*, 2006). Although this incidence was reported to be 9.7% in a 2018 survey (Kazeminia *et al.*, 2020). According to another study conducted in Saudi Arabia, 24.1% of men between the ages of 30 and 90 had osteoporosis; of them, 19.2% had a correlation with the 30- to 50-year age range and 23.5% with the 50- to 90-year age range (El-Desouki and Sulimani, 2007).

As people age and adopt different lifestyles, chronic diseases like osteoporosis will become more common (Cauley *et al.*, 2014). The correlation between it and age-related fractures results in a significant clinical and public health burden (Black and Rosen, 2016). In the US, 10.2 million persons are predicted to have osteoporosis, with women accounting for 80% of cases (Wright *et al.*, 2014). Osteoporosis is most prevalent in Africa, where it makes up 26.9% of the global frequency (Xiao *et al.*, 2022). Osteoporosis causes osteoporotic fractures every three seconds, accounting for more than 8.9 million fractures globally each year (IOF, 2022). It has been estimated that 49% of women over 50 have osteoporosis (Lin *et al.*, 2015). Osteoporosis affects around one-tenth of women over 60, one-fifth of women over 70, two-fifths of women over 80, and two-thirds of women over 90 globally (Johnston and Dagar, 2020). Up to 21.3 million hip fractures will occur annually worldwide by 2050 as a result of an aging population (Neustadt).

### 2.8 Prevalence of osteoporosis in Nepal

Although official records are not yet available, osteoporosis is frequent in Nepalese women. In a research conducted to find out the prevalence of osteoporosis among middle aged women in Chitwan district, among the 200 participants, 65.5% exhibited low bone

mineral density. 26.2% of people met the WHO criterion for osteoporosis, 39.3% for osteopenia, and 34.40 percent for normal wrist BMD (Dhakal *et al.*, 2010).

Among 465 patients in Central Nepal, the prevalence of osteoporosis and osteopenia was 22.4% and 60.6%, respectively. Compared to other nations, the prevalence of osteoporosis and osteopenia is significant in the Nepalese population (Bagudai and Upadhayay, 2019). In a tertiary care hospital's orthopedics department, postmenopausal women had a significant prevalence of osteoporosis. 29 (32.58%) of the 89 postmenopausal women had osteoporosis (Panta *et al.*, 2021). A study conducted to assess prevalence of osteoporosis among adults showed that 38 individuals (8.2%) out of 464 participants had osteoporosis. At a 95% confidence interval (5.7–10.7), 38 (8.2%) of the 464 participants had osteoporosis overall. In those 60 years of age and above, the prevalence of osteoporosis was higher at 11.66 (30.7%). In comparison to men, women were found to be osteoporotic in 9.0% and 6.4% of cases, respectively (Shrestha *et al.*, 2019).

### 2.9 Knowledge towards osteoporosis prevention

According to a community-based cross-sectional survey conducted in the United States, just twenty-three percent of postmenopausal women knew enough about osteoporosis and its prevention (Bailey and Lin, 2021). A cross-sectional survey conducted in Lebanon showed that 52.7% of participants knew sufficient about osteoporosis (El Hage *et al.*, 2019). A study conducted in Egypt showed that about 59% of the participants showed inadequate knowledge and 70.7% had inadequate osteoporosis preventive behaviour (Mortada *et al.*, 2020). A similar study done in Malaysia revealed that only 33.3% of participants had adequate knowledge towards osteoporosis prevention (Abdulameer *et al.*, 2019). A study conducted in Kancheepuram city of India showed that 23% of the postmenopausal women enrolled in the research knew enough about preventing osteoporosis (Lavanya *et al.*, 2022).

According to a community-based cross-sectional survey conducted in southeast Nigeria, just 7% of participants had sufficient information (Njeze Ngozi *et al.*, 2017). An institutional cross-sectional research carried out in Mangalore, India, revealed that half of the participants knew enough about the prevention of osteoporosis (Thomas and Paul, 2023). In another study conducted in southern India, 302 postmenopausal women with a

mean age of 58.8 years were found to have a knowledge deficiency in nearly 60% of cases, and just 5.3 of participants had a satisfactory knowledge score (Senthilraja *et al.*, 2019). Furthermore, a research conducted in Riyadh, Saudi Arabia, found that 69% of participants knew a fair knowledge about preventing osteoporosis (AlHarthi *et al.*, 2017).

According to research done in the Egyptian cities of Tanta, Zagazig, and Cairo, respectively, 41.5%, 41%, and 29.4% of participants knew enough about osteoporosis (Mohamed *et al.*, 2018; Mortada *et al.*, 2020; Hussein and Wahdan, 2021). A similar survey was conducted in Mettu town, Ethiopia, reveals that 38.4% of the participants had sufficient understanding (Rundasa *et al.*, 2022). A comparable research conducted in Northeastern India found that only 37.85% of the 2000 postmenopausal women in the study had a high degree of knowledge (Shaki *et al.*, 2021).

A community based cross sectional study done in Pokhara shows 51 percent of the young adult women had an average level of knowledge and 49 percent had a poor level of knowledge regarding osteoporosis (Deepti *et al.*, 2021). A similar study conducted among women of 40 years and above in Nepalgunj city showed 61.3% women of 40 years and above had fair knowledge of osteoporosis (Neupane *et al.*, 2023). A similar study conducted among women in Lalitpur district showed majority (74.2%) of the respondents had an adequate level of awareness (Shakya, 2022).

# PART III

## Materials and Methods

### 3.1 Research design

A cross sectional descriptive study was conducted over a period to assess information on knowledge and preventive practice of osteoporosis among women residing in Barahakshetra municipality. Information was collected by administrating the standardized and pretested questionnaire. Anthropometric measurements were conducted using standardized instruments.

### 3.2 Study Area

The study was conducted in Barahakshetra Municipality, located in the Sunsari District of southeastern Nepal. It is a region renowned for its historical and religious significance, particularly as the site of the ancient Baraha Kshetra pilgrimage. Positioned along the fertile banks of the Koshi River, this municipality blends cultural richness with agricultural vitality. According to the Central Bureau of Statistics (CBS, 2021), Barahakshetra Municipality has a population of approximately 91,000 residents, encompassing around 21,000 households. The total area of the municipality spans 222 square kilometers, making it a significant region both in terms of its cultural heritage and its contemporary socio-economic activities.

### 3.3 Target population

The study population was women of 15-59 years of age residing in Barahakshetra Municipality. The diagnosis of osteoporosis was not a criterion for sample selection. Therefore, the included women may or may not have osteoporosis.

i. **Inclusion criteria**

Women residing in Barahakshetra municipality of age between 15-59 years of age were included in the study.

**ii. Exclusion criteria**

- ✓ Female who were below 15 years and above 59 years of age.

- ✓ Females who were seriously ill, mentally unfit, pregnant and lactating women.
- ✓ Females residing in hospital, prisons and nursing home.
- ✓ Females who were not available at household during the time of survey.
- ✓ Females who were temporarily residing in Barahakshetra.

### 3.4 Study variables

The different variables of the study are listed below:

1) Dependent variable: Knowledge and practice score of study participants.
2) Independent variables:

a) Socio-economic and demographic variables: Religion, ethnicity, income, occupation

b) Individual/sample characteristics: Age, sex, marital status, education level

c) BMI

### 3.5 Sampling technique

The cross sectional, population based study was carried out in Barahakshetra Municipality. Among total 11 wards of Barahakshetra, only 2 wards (i.e. 6, and 9) were selected by using Simple Random Sampling Technique and subjects of age group of 15-59 years was included for study from the selected wards. The basic criterion for the selection of household sample was that the household with at least one patient was included in the study. In households with more than one patient, patient was chosen by lottery method.

### 3.6 Sample size

Sample size was determined by literature review and by statistical calculation. The sample size was calculated to represent entire women aged 15-59 years residing in Barahakshetra. In order to achieve this statistical inference, the sample size was determined by using a single proportional formula assuming the prevalence rate of knowledge of osteoporosis to be 40% (Panta *et al.*, 2021) in the survey area, 95% confidence interval (CI), 8% margin of error (d) and 10% non-response rate is added to the total calculated sample size.

N= sample size,

p= estimated proportion of an attribute present in the population, (40%)

z= confidence interval at 95% (standard value of z is 1.96)

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

$=1.96^2 \times 0.40 \times (1-0.40)/ (0.08)^2$

$= 144$

As per the data, total number of 15-59 years aged females residing in Barahakshetra municipality ward no 6 and 9 was 4,351 (CBS, 2021). So,

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

= 144 / [1+ (144-1) / 4351]

= 140

Thus, calculated sample size was adjusted for non-response. Considering non-response rate as 10%, the adjusted sample size was calculated to be 160.

### 3.7 Research instrument

The materials that were used for data collection are:

a) Questionnaire: A semi-structured questionnaire was used to obtain socio-demographic variables. The modified standard tools Osteoporosis knowledge assessment tool (OKAT) and Osteoporosis Knowledge tool (OKT) with Cronbach's alpha of 0.70 and 0.85 was used to assess the knowledge of participants (Winzenberg *et al.*, 2003; Gendler *et al.*, 2015). A well designed and pretested set of Likert scale questionnaire developed by (Shakya, 2022) with necessary modifications based on reviewing the literature, consulting with subject experts, and the objectives of the study was used to assess the level of preventive practice. For knowledge items, the participants were given 1 point for each correct answer and 0 for each incorrect answer. The responses of "Daily", "Often", "Rarely", and "Never" for positive practices were given the scores of 4, 3, 2, 1, and for the negative practice scores of 1, 2, 3, and 4 were given respectively. Knowledge scores could range from 0 to 20 and practice scores could range from 12 to 48. The classification of total score into good (≥ 80%), moderate (60-80%) and poor (< 60%) was based on Bloom's cut-off point.

The questionnaire had four sections:

Part 1: Demographic factors
Part 2: Questions related to behavioral factors
Part 3: Questions related to knowledge of osteoporosis
Part 4: Questions related to preventive practices of osteoporosis

The questionnaire was prepared in English and later it was translated to Nepali language. Pretesting was done to ensure that the questionnaire is accurate and clear.

b) Stadiometer: A well calibrated stadiometer to measure the height with minimum and maximum measuring capacity of 1 cm and 196 cm respectively was used.

c) Weighing balance: A digital weighing balance to measure the weight with minimum and maximum measuring capacity of 0.1 kg and 150 kg respectively was used.

### 3.8 Pre-testing

First of all, the prepared sets of questionnaire were pre-tested among 8 reproductive aged women respectively under the sampling plan. The pilot survey sample respondents were excluded after pretesting.

Pre-testing should be conducted in order to maintain accuracy and clarity of questionnaire, to check the consistency in interpretation of questions by respondents and to identify ambiguous item. When pre- testing was done all the ambiguous, misleading and wrongly interpreted questions were removed and questionnaire was revised in accordance with the findings of pre-testing.

### 3.9 Validity and Reliability

To improve the validity and the reliability of the collected data following methods were applied

- To increase the precision of the equipment especially weighing machine it was monitored 3 times a day by using the standard 1 kg measurement.
- I was regularly monitored by my guide teacher

To ascertain the degree to which the data collection instruments will measure what they purposed to measure, the instruments were validated at Central Campus of Technology, Central department of Nutrition and Dietetics. The expected testes in the questionnaire were also drawn according to the available literature in knowledge of osteoporosis. The questionnaire was also pre-tested prior to data collection to ascertain content and face validity.

Reliability refers to quality control measure of data collected. Before data collection, detailed study was done based on the objectives of the study and on data collection techniques. Questionnaire was checked daily for completeness, consistency and clarity as mentioned earlier.

### 3.10 Data Collection Techniques

#### 3.10.1 Questionnaire

Data was collected using a semi-structured questionnaire based on the objectives of the study. A face to face interview was conducted among women of 15-59 years age of Barahakshetra Municipality to fill the questionnaire. The information on demographic, socio-economic aspects and knowledge and preventive practice were collected.

#### 3.10.2 Height

Following steps were carried out for the measurement of height:

a) Stadiometer was placed on a smooth surface.

b) Participants were asked to stand straight on the base bare foot ensuring that the back of the head, shoulder, hips and legs touch the wall of stadiometer.

c) It was made sure that the head was held erect with their arms hanging loosely at their sides.

d) Head of the participant was positioned so that the line of sight is perpendicular to the horizontal surface.

e) The index was brought up to the head of the participant and height was then noted to the nearest 0.1mm (Bista *et al.*, 2021).

### 3.10.3 Weight

Following steps were carried out for the measurement of weight:

a) Weighing balance was placed on a smooth surface.

b) Participants were asked to step on the scale without their slipper and light clothes.

c) The measurement was noted (WHO, 2017).

### 3.11 Field Work

Data collection was carried out through door-to-door visits in selected areas. Prior to each interview, the objectives were explained to the participants individually, and informed written consent was obtained. The researcher conducted face-to-face interviews. Interviews were conducted with 10-12 respondents daily over a period of four weeks, starting from 25$^{th}$ of Magh to 25$^{th}$ of Falgun. Each interview session lasted approximately 20-30 minutes. To ensure the privacy of their information, interviews were conducted in a separate location, and respondents were assured that the research findings would be used solely for study purposes.

### 3.12 Data analysis

The data obtained in this study was checked for completeness and consistency. It was then coded and entered into IBM SPSS version 25 for statistical analysis. Descriptive analysis was done in the form of frequencies, percentages, mean, median and standard deviation. For inferential statistics, chi-square test was applied to test the association between knowledge/ practice scores and socio-demographic variables at 95% CI and level of significance as p = 0.05. Variables were subjected to Pearson's Correlation to find out the correlation between level of knowledge and level of preventive practice at 95% C.I and level of significance as p=0.05.

### 3.13 Logistical and Ethical Considerations

Permission to conduct survey in Barahakshetra Municipality was obtained from the Central Campus of technology administration, department of Nutrition and Dietetics and municipality office of Barahakshetra municipality on 25/10/2080. 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. Participants were assured that their information would be used solely for

research purposes, emphasizing that the study is purely academic and not for commercial use or personal gain. I emphasized the confidentiality of the data, explaining that findings would be presented in a manner that would not reveal individual identities.

### 3.14 Conceptual Framework of the Study

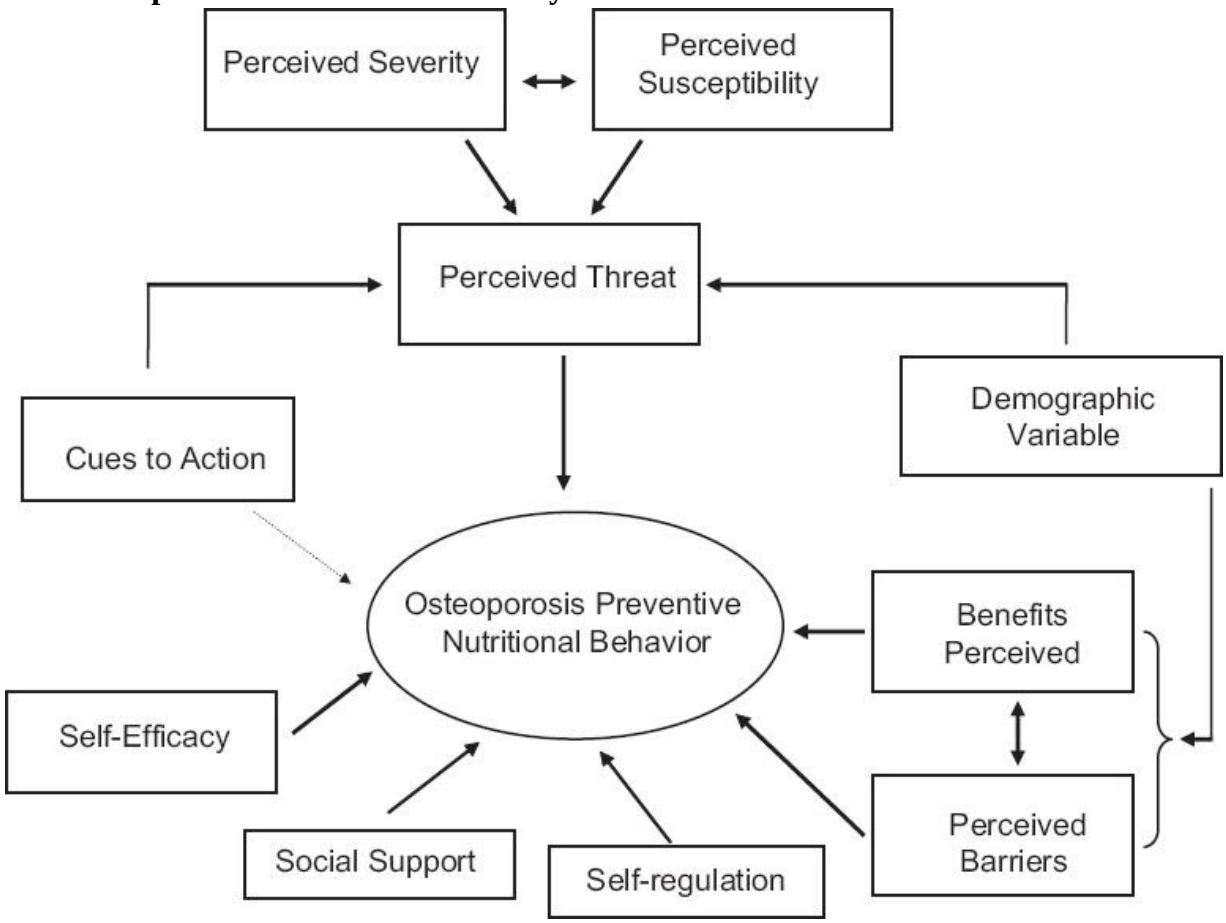


**Fig 3.1:** Conceptual Framework of Osteoporosis(Jeihooni *et al.*, 2016)

# Part IV

## Result and Discussion

The cross-sectional study was carried out to assess the knowledge and preventive practices regarding osteoporosis among women residing in Barahakshetra Municipality. The results and findings of the study are presented in following headings.

### 4.1 Demographic and socio-economic characteristics

In this heading, results are shown on the basis of participants' demographic and socio-economic characteristics like age, marital status, economic factors, family type etc. which are given below.

#### 4.1.1 Age distribution of the study population

The patients who were enrolled in the study were from the age group 18-59 years. The average age of the respondents was 35.98 ± 13.097 years, with 25% (40) of the total participants belonging to the 30-39 years age range, while 21.9% (35) participants were of age group 20-29 years, 20.6% (33) participants were of age group 40-49 years, 19.4% (31) participants were of age group 50-59 years and 13.1% (21) participants were of age group 15-19 years. The minimum and maximum age of the participant was 15 and 59 years. The distribution of the study population according to the age is shown below in Table 4.1:

Table 4.1 Distribution of surveyed population by Age (n=160)

| Variables | Frequency | Percent |
|---|---|---|
| **Age Group(Years)** | | |
| 15-19 | 21 | 13.1 |
| 20-29 | 35 | 21.9 |
| 30-39 | 40 | 25.0 |
| 40-49 | 33 | 20.6 |
| 50-59 | 31 | 19.4 |

### 4.1.2 Marital status of the study population

The study revealed that majority of the women were found to be married constituting of 73.8% (118) in total whereas 18.8% (30) of the women were unmarried, 5.6% (9) were widowed and 1.9% (3) were divorced. The distribution of the respondents according to the marital status and parity is shown below in Table 4.2:

Table 4.2 Distribution of surveyed population by Marital Status (n=160)

| Variables | Frequency | Percentage |
|---|---|---|
| **Marital Status** | | |
| Unmarried | 30 | 18.8 |
| Married | 118 | 73.8 |
| Divorced | 3 | 1.9 |
| Widowed | 9 | 5.6 |

### 4.1.3 Literacy and education level of the study population

According to the study, the majority of the respondents 91.9% (147) can read or write while 8.1% (13) cannot read or write. It was found that majority about 48.1% (77) had studied upto secondary level followed by 24.4% (39) upto basic, 21.9% (35) informal education and only 5.9% (9) has studied upto university level as shown in Table 4.3 below:

Table 4.3 Distribution of surveyed population by Education Level (n=160)

| Variables | Frequency | Percentage |
|---|---|---|
| **Read or Write** | | |
| Yes | 147 | 91.9 |
| No | 13 | 8.1 |
| **Education Level** | | |
| Informal | 35 | 21.9 |
| Basic | 39 | 24.4 |
| Secondary | 77 | 48.1 |
| University | 9 | 5.6 |

### 4.1.4 Occupation and economic status of the study population

More than half of the women were housewife comprising of 47.5% (76), followed by 18.1% (29) involved in agriculture, 15.6% (25) were students, 11.3% (18) were self-employed in business like shops and 7.5% (12) were employed in different sectors. These findings were supported by the study conducted in Singapore in which nearly 70% of participants were housewife (Lulla *et al.*, 2021). When examining income distribution, the majority 55% (88) of the respondents had economic status sufficient for one year and 19.45% (31) had economic status sufficient for more than one year. This suggests that a sizable section of the population is in a reasonably advantageous financial condition. While 22.5% (36) had annual income sufficient for six months only and 3.1% (5) had annual income sufficient for less than 6 months as shown in table 4.4 below:

Table 4.4 Distribution of surveyed population by occupation and economic status (n=160)

| Variables | Frequency | Percentage |
|---|---|---|
| **Occupation** | | |
| Housewife | 76 | 47.5 |
| Employed | 12 | 7.5 |
| Business | 18 | 11.3 |
| Agriculture | 29 | 18.1 |
| Student | 25 | 15.6 |
| **Economic Status** | | |
| Sufficient for < 6 months | 5 | 3.1 |
| Sufficient for 6 months | 36 | 22.5 |
| Sufficient for 1 year | 88 | 55.0 |
| Sufficient for > 1 year | 31 | 19.4 |

### 4.1.5 Religion and Ethnicity of the study population

From the table given below, the maximum numbers of participants residing in the study area were Hindus with 66.9% (107) which was nearly three times greater than that of Buddhists which had the 25% (40) of participants. Participants who follow other religion were 8.1% (13). On the other hand, Janjati had the greatest proportion of participants, accounting for 47.5% (76) followed by Brahmin/Chhetri with 43.8% (70), Madhesi 6.3%

(10) and finally Dalit with 2.5% (4).The distribution by religion and ethnicity is shown in Table 4.5.

Table 4.5 Distribution of surveyed population by religion and ethnicity (n=160)

| Variables | Frequency | Percentage |
|---|---|---|
| **Religion** | | |
| Hindu | 107 | 66.9 |
| Buddhists | 40 | 25.0 |
| Other | 13 | 8.1 |
| **Ethnicity** | | |
| Brahmin/Chhetri | 70 | 43.8 |
| Dalit | 4 | 2.5 |
| Janajati | 76 | 47.5 |
| Madhesi | 10 | 6.3 |

### 4.1.6 Type of family of the study population

According to the table, 52.5% (84) of females lived in nuclear family whereas 47.5% (76) of participants lived in joint family. The distribution by family type is shown in the table 4.6.

Table 4.6 Distribution of surveyed population by family type (n=160)

| Variable | Frequency | Percentage |
|---|---|---|
| **Type of family** | | |
| Joint | 76 | 47.5 |
| Nuclear | 84 | 52.5 |

### 4.1.7 Menstruation history and menopausal history of the study population

According to the study the majority of the respondents 81.3% (130) were menstruating as most of the respondents haven't reached menopausal age, while 18.8% (30) were

menopausal women. The mean age at menopause was found to be 44.37±4.612 years. The distribution of the respondents by their menstruation and menopausal history is shown in the Table 4.7 below

Table 4.7 Distribution of surveyed population by menstruation and menopausal history (n=160)

| Variables | Frequency | Percentage |
|---|---|---|
| **Menstruation History** | | |
| Yes | 130 | 81.3 |
| No | 30 | 18.8 |
| **Menopausal History** | | |
| < 5 year | 9 | 30.0 |
| ≥ 5 year | 21 | 70.0 |

### 4.1.8 Fracture history and family history of fracture in the study population

This study shows that a large percent of respondents i.e. 85.0% (136) did not have history of fracture while 15% (24) have the history of fracture. Also a majority of the respondents did not have family history of fractures accounting for 65.6% (105) whereas 34.4% (55) of them had the history of fracture in their families. The distribution of the respondents by their fracture history and family history of fracture is shown in the Table 4.8 below

Table 4.8 Distribution of surveyed population by fracture history and family history of fracture (n=160)

| Variables | Frequency | Percentage |
|---|---|---|
| **Fracture History** | | |
| Yes | 24 | 15.0 |
| No | 136 | 85.0 |
| **Family History of fracture** | | |
| Yes | 55 | 34.4 |
| No | 105 | 65.6 |

### 4.1.9 Source of information in the study population

The study revealed that majority of the respondents i.e 36.9% (59) primary source of information about bone health and osteoporosis were health workers, while 28.1% (45) obtained information from teachers or books, followed by 18.8% (30) respondents source of information was Family or relatives and 16.3% (26) respondents source of information was media. In a study conducted in India 30% of respondents source of information was medical staffs (Mohabey *et al.*, 2021). In contrast, only 6.7% participants identified health care professionals as their source of information in a study conducted among students of tertiary institution in Malaysia (Khan *et al.*, 2014). The distribution by source of information is shown in the table 4.9

Table 4.9 Distribution of surveyed population by the source of information of osteoporosis (n=160)

| Variables | Frequency | Percentage |
|---|---|---|
| **Source of information** | | |
| Health workers | 59 | 36.9 |
| Teacher/Books | 45 | 28.1 |
| Family/Relatives | 30 | 18.8 |
| Media | 26 | 16.3 |

## 4.2 Nutritional Assessment

In this heading, results are shown on the basis of participants' BMI categorization.

### 4.2.1 BMI of the study population

The result of this study was analyzed according to International BMI categorization as given by WHO. Table 4.10 illustrates the fact that significant percent of women of reproductive age in Barahakshetra Municipality are malnourished. Out of total population, 5.0% (8) were underweight, 54.4% (87) were normal, 26.9% (43) were overweight and 13.8% (22) of total population were obese. The average BMI of the respondents was 24.58±4.42. The distribution by BMI is shown in the table 4.10

Table 4.10 Distribution of surveyed population by BMI (n=160)

| Variables | Frequency | Percentage |
|---|---|---|
| **BMI** | | |
| Underweight | 8 | 5.0 |
| Normal | 87 | 54.4 |
| Overweight | 43 | 26.9 |
| Obese | 22 | 13.8 |

### 4.3 Behavioral Characteristics

In this heading, results are shown on the basis of participants' behavioral characteristics like- salt intake, usage of birth control pills, and proper lighting etc. which are given below.

#### 4.3.1 Behavioral Characteristics of the study population

The study found that most of the participants 92.5% (148) were non-vegetarian and 7.5% (12) of them followed vegetarian diet. Salt consumption pattern of the participants shows that only 15.0% (24) were having optimum salt intake i.e. < 5 gm as per recommendation given by WHO. 85.0% (136) of them were consuming excess amount i.e. ≥ 5gm of salt per day.

The survey results indicate that 9.4% (15) of individuals use birth control pills, while 90.6% (145) do not use them. This data suggests that the majority of individuals do not use this form of contraception, despite it being a widely used and accessible method. Similarly, 12.5% (20) of participants have checked their bone density, while 87.5% (140) have not checked. Likewise in the context of proper lighting and non slippery floor it was found that, very few participants of about 10% (16) didn't have proper lights and non slippery floor while majority of them comprising of 90% (144) have proper lights and non slippery floor in their house. The distribution of behavioral characteristics is shown in Table 4.11:

Table 4.11 Distribution of surveyed population by behavioral characteristics (n=160)

| Variables | Frequency | Percentage |
|---|---|---|
| **Food habits** | | |
| Vegetarian | 12 | 7.5 |
| Non-vegetarian | 148 | 92.5 |
| **Salt Intake** | | |
| < 5 gm | 24 | 15.0 |
| ≥ 5gm | 136 | 85.0 |
| **Birth Control Pills** | | |
| Yes | 15 | 9.4 |
| No | 145 | 90.6 |
| **Prior Bone Density Assessment** | | |
| Yes | 20 | 12.5 |
| No | 140 | 87.5 |
| **Proper light/Non slippery Floors** | | |
| Yes | 144 | 90.0 |
| No | 16 | 10.0 |

### 4.4 Knowledge and preventive practices

The knowledge and practice related scores of the respondents were determined individually.

### 4.4.1 Knowledge related score of the study population

Questionnaires about the knowledge of osteoporosis were asked to the study participants. There answers were analyzed based on the answer given by the participants to the questions related to the knowledge about osteoporosis. The classification of total score into good (≥ 80%), moderate (60-80%) and poor (< 60%) was based on Bloom's cut-off point (Cheng *et al.*, 2020).

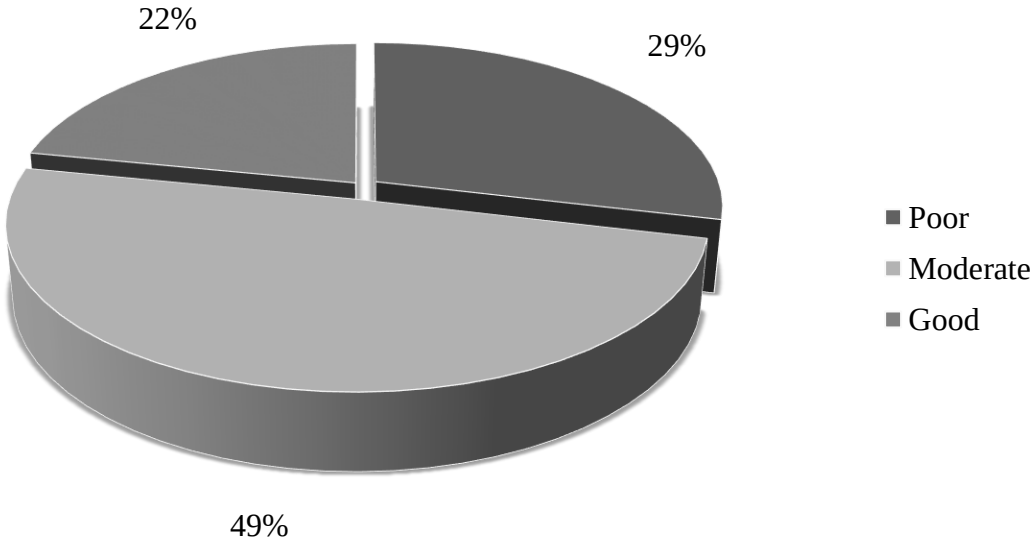


**Fig 4.1**: Knowledge related score of the study population

Figure 4.1 shows that out of 160 participants in the study, 22% (35) participants had good knowledge on osteoporosis related questions, 49% (79) had average knowledge whereas 29% (46) participants had poor knowledge. The mean ± SD of knowledge score was 13.15 ± 2.89.

According to this study, more than half of the patients who took part had a high level of knowledge and were thus aware of the condition and how to treat it. A social media based cross- sectional study among women aged ≥ 18 years age in Pakistan coincided with our study in which 22% had low knowledge, 44% had average knowledge, while 34% had good knowledge of osteoporosis (Ahmed *et al.*, 2023). Similarly, in a study conducted among female medical students of Saudi Arabia, 65.1% had adequate knowledge, 32.2% had poor knowledge, while only 2.3% had high knowledge (Shahi *et al.*, 2019).

A study conducted in Lebanon showed that about 14% of the women had high knowledge, 66% of the women had moderate knowledge and 20% had low knowledge of osteoporosis which was similar to our findings in the study (Nohra *et al.*, 2022).However, poor knowledge regarding osteoporosis have been reported in several other studies (Bilal *et al.*, 2017; Kadam *et al.*, 2019). Only 37.85% of the post menopausal women were aware about the osteoporosis in a study conducted Northeast part of India (Shaki *et al.*, 2021).

Table 4.12 Response to Knowledge Questions (n=160)

| **Questions** | **Frequency of correct answer** | **Percent -age** |
|---|---|---|
| Weakening or thinning of the bone (osteoporosis) is a serious disease like heart disease or cancer. | 67 | 41.9 |
| Osteoporosis is more common in men than women. | 93 | 58.1 |
| By age 50, the majority of women have a risk to develop OP. | 130 | 81.3 |
| Bone loss speeds up after menopause. | 100 | 62.5 |
| You are more likely to suffer from osteoporosis if your father or mother has had osteoporosis. | 98 | 61.3 |
| The risk factor for osteoporosis is cigarette smoking and caffeine. | 91 | 56.9 |
| An excessive amount of alcohol intake has no relationship with OP. | 87 | 54.4 |
| Less intake of calcium-containing diet in childhood and adolescence affects osteoporosis in later life. | 136 | 85 |
| You are likely to have osteoporosis if you have low body weight and small structure. | 96 | 60 |
| Knee pain, and back are the early symptoms of osteoporosis. | 5 | 3.1 |
| Losses of height, and humped spine are not symptom of OP. | 73 | 45.6 |
| Bone X-ray helps to diagnose osteoporosis. | 150 | 93.8 |
| There are effective treatments available for osteoporosis in Nepal. | 129 | 80.6 |
| Any type of physical activity is beneficial for osteoporosis. (Household chores, climbing stairs, etc.) | 27 | 16.9 |
| Brisk walking, yoga, Jumba dance like weight-bearing exercises are beneficial for the prevention of osteoporosis. | 152 | 95 |
| Milk and milk products are the best sources of calcium. | 148 | 92.5 |
| Soya bean, tofu, and green vegetables are also sources of calcium. | 134 | 83.8 |
| Calcium and Vitamin D supplements help to prevent bone loss. | 132 | 82.5 |
| Osteoporosis leads to easily breakdown of bones. | 128 | 80 |
| Avoiding cold drinks helps to prevent osteoporosis. | 128 | 80 |

Table 4.12 summarizes the responses of study participants to knowledge questions. Among 160 participants, only 41.9% (67) women recognized osteoporosis as a serious disease which was similar to the finding form a study among women of Lalitpur district in which 47.5% considered osteoporosis as a serious disease (Shakya, 2022). This may be due to the absence of osteoporosis awareness campaigns and the relative lack of emphasis and promotion placed on bone health in Nepal relative to other illnesses including cancer, cardiovascular, renal, and infectious disorders. 58.1 % (93) women were aware about the fact that osteoporosis is more common in women than in men and that was supported by the study conducted in India in which 465 of the study subjects had the misconception that osteoporosis was more common in men than in women (Senthilraja *et al.*, 2019). 81.3% (130) knew that by the age of 50, majority of women have a risk to develop osteoporosis and this result is supported by those reported in a study of (Tripathi *et al.*, 2019) indicated that elderly people (aged more than 50 years) increased the risk of osteoporosis by 30%. Only 62.5% (100) were aware of the fact that bone loss speeds after menopause. This contrast with the study among perimenopausal women in America which shows 88% of women knew to be menopausal increases the risk of getting osteoporosis (Endicott, 2013) and around 89% of participants recognizes older age as the risk factor of osteoporosis in the study among university students in UAE (Al-Hemyari *et al.*, 2018).

In the current study, 61.3% participants knew that genetic history is also a risk factor of osteoporosis which contrast with the findings in the study among university students in UAE (Al-Hemyari *et al.*, 2018). Around half of the participants were aware that smoking and drinking alcohol leads to osteoporosis. Similar findings were observed among study conducted in Sudan (Abdo and Idris, 2022). It is apparent from the study participant's responses, 85% of them indicated that childhood bone mass density can prevent osteoporosis occurrence. This is contrasted to a study conducted by (Khired *et al.*, 2022) in Jazan University that showed the limited knowledge regarding peak bone mass during childhood can prevent from osteoporosis.

Approximately, half of the participants knew underweight as risk factor of osteoporosis. This is supported by the study conducted among 18-35 years aged women in Kuwait in which 64.5% women were aware that being underweight increases the risk of osteoporosis (Al-Ayyadhi *et al.*, 2020). Regarding the symptoms, only 3.1% participants knew that knee pain and back pain are not the early symptoms of osteoporosis. Similarly, 45.6%

participants knew losses of height and humped spine are also the symptoms of osteoporosis which is contrasted to the study conducted among Singaporean women in which nearly 84% participants recognized humped spine as a symptom of osteoporosis (Lulla *et al.*, 2021). Nearly 90% and 80% participants were aware that OP can be diagnosed via X- ray and effective treatments are available in Nepal. 95% of the participants recognized weight bearing exercise as an osteoprotective exercise that contrasts with the findings from the study conducted among employees of Tanta University in Egypt (Elsabagh *et al.*, 2015).

More than 80% participants were aware about the source of calcium and vitamin D and their role in bone health. A study conducted in Singapore had similar findings (Lulla *et al.*, 2021). In a study conducted among postmenopausal women in India nearly 80% women agreed that OP increases the risk of fractures which coincides the findings from our study (Mohabey *et al.*, 2021) . 80% of the study participants knew avoiding cold drinks helps to prevent from osteoporosis.

### 4.4.2 Preventive practices related score of the study population

There answers were analyzed based on the answer given by the participants to the questions related to the practice about osteoporosis. The classification of total score into good (≥ 80%), moderate (60-80%) and poor (< 60%) was based on Bloom's cut-off point (Cheng *et al.*, 2020).

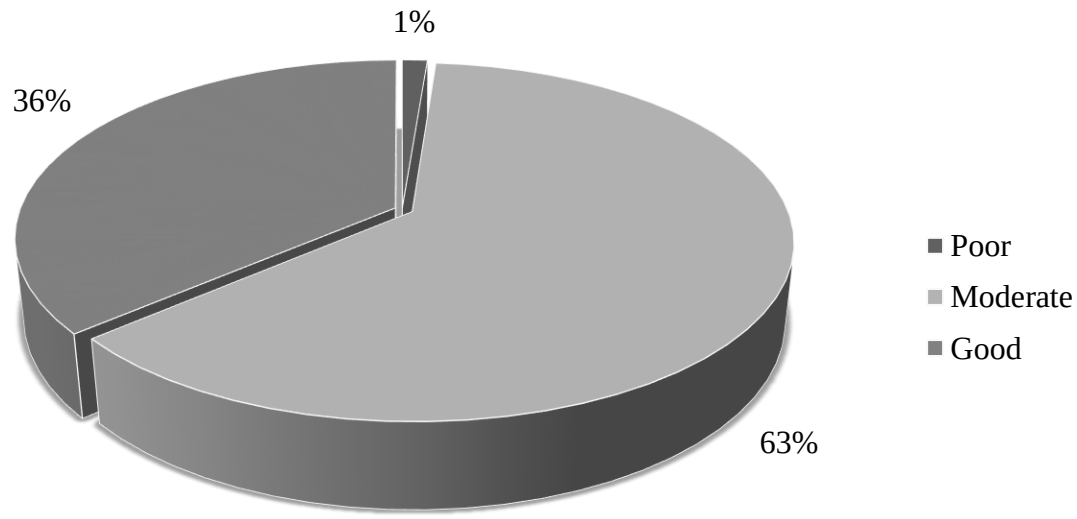


**Fig 4.2:** Preventive practice related score of the study population

Figure 4.2 shows that out of 160 participants in the study, 36% (58) participants had good preventive practice towards osteoporosis, 63% (100) had moderate practice whereas 1% (2) participants had poor preventive practice. The mean (SD) of osteoporosis preventive score was 36.41 ± 3.38. These findings were found to be consistent with studies conducted in Majmah city, Saudi Arabia and Bashair hospital, Sudan (ElTohami *et al.*, 2015; Abdo and Idris, 2022) but in contrasted with the another report that showed nearly 53% participants had poor preventive practice (Embong and Yew, 2021).

Table 4.13: Practice towards osteoporosis among participants (n=160)

| Items | Daily | Often (3-4 times/week) | Rarely (Once a week or less) | Never |
|---|---|---|---|---|
| Exposure to sun(before 10 A.M or after 2 P.M) for at least 15 min | 139(86.9%) | 13(8.1%) | 6(3.8%) | 2(1.3%) |
| Performing physical activities (household chores, climbing stairs) | 157(98.1%) | 2(1.3%) | 1(0.6%) | - |
| Performing weight bearing exercise for at least 30min ( yoga, jumba, running) | 25(15.6%) | 21(13.1%) | 22(13.8%) | 92(57.5%) |
| Consuming 2-3 cups of dairy | 42(26.3%) | 49(30.6%) | 63(39.4%) | 6(3.8%) |
| Consuming calcium rich foods ( Broccoli, almonds, tofu, figs) | 19(11.9%) | 54(33.8%) | 77(48.1%) | 10(6.3%) |
| Consuming Vit. D rich foods (Fish, mushroom, ghee) | 51(31.9%) | 64(40%) | 43(26.9%) | 2(1.3%) |
| Consuming protein rich foods (Meat, eggs, pulses) | 141(88.1%) | 14(8.8%) | 3(1.9%) | 2(1.3%) |
| Taking calcium/Vit. D supplements | 14(8.8%) | 15(9.4%) | 23(14.4%) | 108(67.5%) |
| Smoking cigarettes | 3(1.9%) | - | - | 157(98.1%) |
| Drinking Alcohol | 2(1.3%) | 3(1.9%) | 17(10.6%) | 138(86.3%) |
| Consuming coffee/tea of more than 3 cups/day | 45(28.1%) | 18(11.3%) | 21(13.1%) | 76(47.5%) |
| Consuming carbonated beverages e.g. cold drinks | 16(10%) | 66(41.3%) | 71(44.4%) | 7(4.4%) |

Table 4.13 depicts participants practice profile towards osteoporosis. Question wise, 86.9% women expose themselves to sun (before 10 A.M or after 2 P.M) for at least 15 minute. The (De Silva *et al.*, 2014) study also recorded 85% of the participants exposing themselves to sun for at least 30 minutes a week but this result disagree with (Shakya,

2022) which reported that 10.22% respondents exposing themselves to sunlight daily. This appears to be connected to the area's climate rather than a particular preventative measure. Almost all the participants (98.1%) participants do household activities by themselves which is consistent with the study results of (Embong and Yew, 2021). In the study, only 15.6% respondents performs weight bearing exercises daily which was similar to the findings of the study conducted in Lalitpur district (Shakya, 2022) whereas the study done in Saudi Arabia showed that only 12.8% performs such activities (Tripathi *et al.*, 2019). The findings showed that, only 26.3% respondents daily consumes dairy and only 11.9% respondents consumes calcium rich foods daily that contrasts with the findings from the study conducted among women in Malaysia in which 43.2% were consuming dairy products daily (Embong and Yew, 2021). Perhaps despite their awareness, many in Nepal are unable to afford the daily diet they follow due to the steadily rising cost of dairy products.

Nearly 32% participants daily consumed vitamin D rich foods such as mushroom and ghee. Almost 80% of the participants ate protein rich foods daily. Regarding consumption of calcium/vitamin D supplement, only 8.8% participants took supplements on daily basis. This is in contrast with the study conducted in Malaysia in which 38.7% took vitamin D supplement (Ramli *et al.*, 2018). Only 1.9% and 1.3% participants have the habit of smoking and drinking alcohol which is consistent with the findings from the studies conducted in Malaysia (Chan *et al.*, 2019; Embong and Yew, 2021). About 28% respondents regularly consumed more than 3 cups of tea/coffee per day and 10% respondents used to consume soft drinks daily. Similar findings were observed in a study conducted in Majmaah city where 21% respondents consumed soft drinks regularly but contrasts with the findings from a study conducted in Malaysia where 75% of respondents consumed tea/coffee daily (ElTohami *et al.*, 2015; Chan *et al.*, 2019).

### 4.5 Relationship between level of knowledge and level of preventive practice for osteoporosis

Table 4.14: Pearson correlation between level of knowledge and level of preventive practice for osteoporosis among study population (n=160)

| | | **Preventive practice** |
|---|---|---|
| **Level of awareness** | **Pearson correlation** | 0.312** |
| | **p-value** | < 0.001 |

** Correlation is significant at the 0.05 level (2-tailed).

Table 4.14 depicts moderate significant positive correlation between the level of awareness and level of preventive practice of osteoporosis with a 95% level of significance (r=0.312; p=<0.01), and that was supported by the study conducted in Lalitpur district in which a low but significant correlation was found between knowledge and practice level (Shakya, 2022). The study finding is in contrast with the study conducted in Pakistan where there was no significant correlation between knowledge and practice but strong positive correlation was observed between attitude and practice towards osteoporosis (Saeed *et al.*, 2024).

### 4.6 Association between the level of knowledge and socio-demographic characteristics

The chi square analysis showed that education level (p=0.034), ethnicity (p=0.041) and menopausal history (p=0.042) were significantly associated with the level of knowledge of osteoporosis among women residing in Barahakshetra Municipality as shown in table 4.15.

The study revealed that the majority of women 22 (19%) who had studied up to university level had the high level of knowledge. Individuals who have spent more time in educational settings are more likely to have been exposed to public health campaigns and educational programs about osteoporosis that might increase the knowledge of osteoporosis. The study result was aligned to other study results conducted among women in Vietnam (Hien *et al.*, 2009). Likewise, another study conducted in Southern India, reported that women with higher education levels demonstrated better knowledge about osteoporosis (Senthilraja *et al.*, 2019). A significant association was also found with the ethnicity where 22 (31.4%) of Brahmin/Chhetri women had high knowledge. Family and social networks might have played a crucial role in sharing health information and increased awareness. A similar type of study conducted by (Rosy and Sara, 2020) in Bharatpur, Nepal found significant association between the level of knowledge and ethnicity.

Our finding suggests association of menstrual history with the level of knowledge. Women who experienced menopause more than 5 years ago had significantly better knowledge of osteoporosis compared to those who experienced menopause less than 5 years ago. This might be due to postmenopausal women often experience various health changes that can prompt them to seek more information about their health. For instance, a study by (Hernandez-Rauda and Martinez-Garcia, 2004) found that women who had been post-menopausal for longer periods demonstrated greater awareness and understanding of osteoporosis-related issues, likely due to increased exposure to health information over time. There was no significant association between age, marital status, occupation, religion, economic status, menstruation history, fracture history and family history of fracture.

In study, the total knowledge score of study participants is categorized into poor, moderate or good.

Table 4.15 Association between level of knowledge and socio-demographic characteristics among study population (n=160)

| **Variables** | **Level of Awareness, N (%)** | | | **χ2** | **P-Value** |
|---|---|---|---|---|---|
| | **Poor** | **Moderate** | **Good** | | |
| **Age** | | | | 0.292 | 0.864[a] |
| ≤ 35 years | 24(28.2) | 41(48.2) | 20(23.5) | | |
| > 36 years | 22(29.3) | 38(50.7) | 15(20.0) | | |
| **Marital status** | | | | 0.668 | 0.716[a] |
| Single | 12(28.6) | 19(45.2) | 11(26.2) | | |
| Married | 34(28.8) | 60(50.8) | 24(20.3) | | |
| **Education Level** | | | | **9.728** | **0.034*[e]** |
| Informal | 11(31.4) | 17(48.6) | 7(20.0) | | |
| Basic/ Secondary | 35(30.2) | 59(50.9) | 22(19.0) | | |
| University | 0 | 3(33.3) | 6(66.7) | | |
| **Occupation** | | | | 8.048 | 0.100[a] |
| Housewife/Agriculture | 33(31.4) | 54(51.4) | 18(17.1) | | |
| Business/Employed | 4(13.3) | 15(50.0) | 11(36.7) | | |
| Student | 9(36.0) | 10(40.0) | 6(24.0) | | |
| **Ethnicity** | | | | **9.696** | **0.041*[e]** |
| Brahmin/Chhetri | 17(24.3) | 31(44.3) | 22(31.4) | | |
| Janajati | 24(31.6) | 43(56.6) | 9(11.8) | | |
| Others | 5(35.7) | 5(35.7) | 4(28.6) | | |

| | | | | | |
|---|---|---|---|---|---|
| **Religion** | | | | 6.913 | 0.133[e] |
| Hindu | 28(26.2) | 50(46.7) | 29(27.1) | | |
| Buddhist | 13(32.5) | 21(52.5) | 6( 15.0) | | |
| Other | 5(38.5) | 8(61.5) | 0 | | |
| **Economic Status** | | | | 1.805 | 0.405[a] |
| Sufficient for 6 months and less | 13(31.7) | 22(53.7) | 6(14.6) | | |
| Sufficient for 1 year and more | 33(27.7) | 57(47.9) | 29(24.4) | | |
| **Menstruation History** | | | | 0.768 | 0.681[a] |
| Yes | 39(30.0) | 64(49.2) | 27(20.8) | | |
| No | 7(23.3) | 15(50.0) | 8(26.7) | | |
| **Menopausal History** | | | | **5.940** | **0.042*[e]** |
| < 5 year | 4(44.4) | 5(55.6) | 0 | | |
| ≥ 5 year | 3(14.3) | 10(47.6) | 8(38.1) | | |
| **Fracture History** | | | | 1.305 | 0.521[a] |
| Yes | 5(20.8) | 12(50.0) | 7(29.2) | | |
| No | 41(30.1) | 67(49.3) | 28(20.6) | | |
| **Family History of fracture** | | | | 0.183 | 0.913[a] |
| Yes | 15(27.3) | 27(49.1) | 13(23.6) | | |
| No | 31(29.5) | 52(49.5) | 22(21.0) | | |

* p-value Statistically Significance at a level of 0.05
[a] Tested by Chi- square Test
[e] Tested by Fischer's Exact Test

### 4.7 Association between level of knowledge and BMI

Table 4.16 Association between level of knowledge and BMI among study population (n=160)

| Variables | Level of Knowledge, N (%) | | | $\chi 2$ | P-Value |
|---|---|---|---|---|---|
| | **Poor** | **Moderate** | **Good** | | |
| **BMI** | | | | 4.032 | 0.397 [e] |
| <18.5 | 0 | 5(62.5) | 3(37.5) | | |
| 18.5-25 | 27(31.0) | 42(48.3) | 18(20.7) | | |
| ≥ 25 | 19(29.2) | 32(49.2) | 20.7(21.5) | | |

* p-value Statistically Significance at a level of 0.05
[e] Tested by Fischer's Exact Test

Association between knowledge and BMI of study participants was not found statistically significant (p = 0.397). This suggests that a woman's knowledge about osteoporosis does not significantly influence her BMI. A similar type of study conducted by (Tan *et al.*, 2021) has also shown no association between BMI and osteoporosis knowledge. BMI may not be perceived as directly related to osteoporosis risk by the general public. Cultural attitudes and social norms regarding body weight and health could influence both BMI and osteoporosis knowledge. In some societies, there may be less emphasis on osteoporosis education, particularly in populations that do not perceive themselves at risk due to their body weight.

### 4.8 Association between the level of preventive practice and socio-demographic characteristics

As shown in table 4.17, women's education level, occupation, ethnicity, religion and menstruation history were found to be significantly associated with level of preventive practice of osteoporosis.

The study showed that women with university level education are more likely to engage in behaviors that prevent osteoporosis compared to those with lower education levels. A study conducted by (Elgzar *et al.*, 2023) reported that higher education was associated with better awareness and adoption of osteoporosis prevention measures. This aligns with the theory that education enhances health literacy and the ability to understand and act upon health information. The results indicate a significant association between occupation and the preventive practices of osteoporosis among women. Business and employed women are more likely to engage in osteoporosis preventive practices compared to women in other occupations. The study result was aligned to other study result conducted among women in Saudi Arabia (ElTohami *et al.*, 2015).

The results indicate a significant association between ethnicity and the preventive practices of osteoporosis among women. Brahmin/Chhetri women are more likely to engage in osteoporosis preventive practices compared to women from other ethnic group. Similar findings was also evident in the study conducted in Malaysia (Khan *et al.*, 2014). A significant association was also found with the religion where 48 (44.9%) of Hindu women had good preventive practice. Religious beliefs and practices can shape health behaviors that are beneficial for bone health. Likewise, majority of women of about 42 (32.3%) who were not menstruating had good preventive practices. The result was contrast to the findings of study conducted in Pakistan (Ahmed *et al.*, 2023).

Table 4.17 Association between level of preventive practice and socio-demographic characteristics among study population (n=160)

| **Variables** | **Level of Preventive practice,N (%)** | | | **χ2** | **P-Value** |
|---|---|---|---|---|---|
| | **Poor** | **Moderate** | **Good** | | |
| **Age** | | | | 4.861 | 0.051$_e$ |
| ≤ 35 years | 0 | 59(69.4) | 26(30.6) | | |
| > 36 years | 2(2.7) | 41(54.7) | 32(42.7) | | |
| **Marital status** | | | | 1.137 | 0.648$_e$ |
| Single | 0 | 29(69.0) | 13(31.0) | | |
| Married | 2(1.7) | 71(60.2) | 45(38.1) | | |
| **Education Level** | | | | **11.371** | **0.017*$_e$** |
| Informal | 2(5.7) | 18(51.4) | 15(42.9) | | |
| Basic/ Secondary | 0 | 79(68.1) | 37(31.9) | | |
| University | 0 | 3(33.3) | 6(66.7) | | |
| **Occupation** | | | | **10.197** | **0.020*$_e$** |
| Housewife/Agriculture | 2(1.9) | 63(60) | 40(38.1) | | |
| Business/Employed | 0 | 15(50.0) | 15(50.0) | | |
| Student | 0 | 22(88.0) | 3(12.0) | | |
| **Ethnicity** | | | | **16.196** | **<0.001*$_e$** |
| Brahmin/Chhetri | 0 | 34(48.6) | 36(51.4) | | |
| Janajati | 2(2.6) | 58(76.3) | 16(21.1) | | |
| Others | 0 | 8(57.1) | 6(42.9) | | |

| | | | | | |
|---|---|---|---|---|---|
| **Religion** | | | | **14.457** | **0.003*$_e$** |
| Hindu | 0 | 59(55.1) | 48(44.9) | | |
| Buddhist | 2(5.0) | 31(77.5) | 7(17.5) | | |
| Other | 0 | 10(76.9) | 3(23.1) | | |
| **Economic Status** | | | | 1.613 | 0.384$_e$ |
| Sufficient for 6 months and less | 0 | 29(70.7) | 12(29.3) | | |
| Sufficient for 1 year and more | 2(1.7) | 71(59.7) | 46(38.7) | | |
| **Menstruation History** | | | | **11.990** | **<0.001*$_e$** |
| Yes | 0 | 88(67.7) | 42(32.3) | | |
| No | 2(6.7) | 12(40.0) | 16(53.3) | | |
| **Menopausal History** | | | | 0.675 | 1.000$_e$ |
| < 5 year | 0 | 4(44.4) | 5(56.6) | | |
| ≥ 5 year | 2(9.5) | 8(38.1) | 11(52.4) | | |
| **Fracture History** | | | | 0.242 | 1.000$_e$ |
| Yes | 0 | 15(62.5) | 9(37.5) | | |
| No | 2(1.5) | 85(62.5) | 49(36.0) | | |
| **Family History of fracture** | | | | 0.836 | 0.704$_e$ |
| Yes | 0 | 36(65.5) | 19(34.5) | | |
| No | 2(1.3) | 64(62.5) | 39(37.1) | | |

* p-value Statistically Significance at a level of 0.05
$_e$ Tested by Fischer's Exact Test

### 4.9 Association between level of preventive practice and BMI

Table 4.18 Association between level of preventive practice and BMI among study population (n=160)

| Variables | Level of Preventive practice, N (%) | | | $\chi 2$ | P-Value |
|---|---|---|---|---|---|
| | **Poor** | **Moderate** | **Good** | | |
| **BMI** | | | | 2.725 | $0.658_e$ |
| <18.5 | 0 | 4(50.0) | 4(50.0) | | |
| 18.5-25 | 2(2.3) | 55(63.2) | 30(34.5) | | |
| ≥ 25 | 0 | 41(63.1) | 24(36.9) | | |

* p-value Statistically Significance at a level of 0.05
$_e$ Tested by Fischer's Exact Test

The survey results indicate that there is no significant association between Body Mass Index (BMI) and the preventive practices of osteoporosis among the surveyed women. Preventive health behaviors related to osteoporosis might be influenced more by general health awareness and education rather than BMI. Women with varying BMI might share similar levels of knowledge and attitudes towards osteoporosis prevention if they have had similar exposure to health information. Individuals might not perceive a direct link between their BMI and osteoporosis risk. The World Health Organization's Asian overweight categorization range of 23.0 to 24.9 kg/m2 was found to be the best range for reducing the risk of both type 2 diabetes and osteoporosis in Korean men over 50 and postmenopausal women (Lee *et al.*, 2020).

# Part V

## Conclusions and Recommendations

### 5.1 Conclusions

This study assessed the knowledge and preventive practice regarding osteoporosis among women residing in Barahakshetra municipality. The followings are the conclusions drawn from this study:

i. The study revealed that 22% of the participants had a good level of knowledge, 49% had a moderate level, and 29% had a poor level of knowledge about osteoporosis. While in terms of preventive practices among women in the Barahakshetra municipality, 36% practiced good preventive measures, 63% had moderate practices, and 1% had poor preventive practices.
ii. Only 42% participants were aware about the seriousness of disease and more than half of the participants recognized all the risk factors of osteoporosis.
iii. The study revealed that factors like education level, ethnicity and menopausal history were associated with level of knowledge whereas education level, occupation, ethnicity, religion and menstruation history were associated with level of preventive practice.
iv. There was no significant association between BMI and level of knowledge and BMI and level of preventive practice.
v. The study's findings showed moderate significant positive correlation between the level of knowledge and level of preventive practice.

## 5.2 Recommendations

Based on the study results, following recommendations can be practiced in order to improve the overall knowledge and preventive practices of women regarding osteoporosis:

i. Advocate for routine screening for osteoporosis usually at 2 year interval, especially for women over the age of 50, to ensure early detection and management.
ii. Health promotion activities regarding osteoporosis prevention at the community level should be customized to increase the knowledge level towards osteoporosis prevention.
iii. Comparative study of knowledge and preventive practice among osteoporotic and non-osteoporotic patients can be done.
iv. To validate results and investigate relevant factors, larger sample sizes and a broader area of research are advised.
v. Dietary assessment using validated food frequency questionnaire and 24-hour dietary recall would enhance studies evaluating dietary practices among women.

# Part VI

## Summary

Osteoporotic fractures are a significant global health concern, particularly as the population ages and lifestyles vary. While osteoporosis cannot be cured, its consequences can largely be prevented through healthy behaviors and awareness of risk factors. This cross-sectional study assessed knowledge and preventive practices related to lifestyle modifications among 160 women in Barahakshetra municipality. Two wards were selected randomly from 11, focusing on women aged 15-59. Data was collected through face-to-face interviews using structured questionnaires and anthropometric measurements. The participants' socio-demographic characteristics were also recorded. Analysis was conducted using IBM SPSS version 25, employing chi-square tests and Pearson's correlation to identify factors linked to knowledge and preventive practices.

The study evaluated participants' knowledge levels, with 29% having poor knowledge, 49% moderate, and 22% good knowledge. In terms of practice scores, 1% had poor, 63% moderate, and 36% good scores. The majority of participants were menstruating women (81.3%), while 18.8% were postmenopausal. Health workers were the primary source of information for most participants, with 48.1% having education up to the secondary level, and 47.5% being housewives. There was a mild positive correlation between knowledge level and preventive practices among participants. Significant relationships were observed between knowledge scores and education level, ethnicity, and menopausal history. Education level, occupation, ethnicity, religion, and menstruation history were statistically significant factors related to the level of preventive practices. However, there was no significant relationship between knowledge/practice scores and the BMI of the participants.

In conclusion, the study reveals a significant lack of knowledge about osteoporosis and only moderate adherence to preventive practices. Comprehensive intervention programs should focus on educating the public on risk factors, disease severity, the importance of early screening, and encourage lifestyle changes, including better diet and physical activity.

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# Appendices

## Appendix A: Informed Consent

Namaste!

I am Ashmita Bhattarai, graduate student in Department of Nutrition and Dietetics conducting a dissertation work for award of bachelor's degree in Nutrition and Dietetics. The topic for the study is "**KNOWLEDGE AND PREVENTIVE PRACTICE REGARDING OSTEOPOROSIS AMONG WOMEN RESIDING IN BARAHAKSHETRA MUNICIPALITY, SUNSARI".**

I have been told in a language that I understand about the study. I have been told that this is for a dissertation procedure, that my participation is voluntary and he/she reserve the full right to withdraw from the study at my own initiative at any time without having to give reason and that refresh to participate or withdraw from the study at any stage will not prejudice my/his/her rights and welfare. Confidentiality will be maintained and only be shared for academic purposes.

I hereby give consent to participate in the above study. I am also aware that I can withdraw this consent at any later date, if I wish to. This consent form being signed voluntarily indicates participate in the study until I decide otherwise. I understand that I will receive a signed and dated copy of this form. I have signed this consent forms before my participation in the study.

Signature of Participant: _____ Signature of Witness: _____

Date: Date:

Place: Place:

I hereby state the study procedures were explained in the detail and all questions were fully and clearly answered to the above mentioned participant /his/her relative.

Investigator's sign: _____

Date:

Contact Address:

## Appendix B: Questionnaire

**Section A: Socio-demographic information** Date:

Name: _____ Age: _____

1. What is your marital status?

   a. Unmarried b. Married c. Divorced d. Widowed

2. Can you read or write?

   a. Yes b. No

3. If yes, What is your education level?

   a. Informal b. Basic (upto 8) c. Secondary (9-12) d. University

4. What is your occupation?

   a. Housewife b. Employed c. Business d. Agriculture e. Student

5. Which ethnicity do you belong to?

   a. Brahmin/Chhetri b. Dalit c. Janajati d. Madhesi e. Other

6. What is your religion?

   a. Hindu b. Budhists c. Christian d. Muslim e. Other

7. What is the economic status of your family?

   a. Sufficient for less than 6 months c. Sufficient for 1 year

   b. Sufficient for 6 months d. Sufficient for more than 1 year

8. What is your type of family?

   a. Joint b. Nuclear

9. Are you menstruating?

   a. Yes b. No

10. If no, When did your menstruation stop? _____

11. Have you ever had fracture?

   a. Yes b. No

12. Is there any history of fractures in your family?

a. Yes b. No

13. What is your main source of information?

a. Health workers b. Teacher/Books c. Family/Relatives d. Media

**Section B: Anthropometric assessment**

| Height (cm) | Weight (kg) | BMI |
|---|---|---|
| | | |

**Section C: Behavioral Factors**

14. Are you vegetarian?

a. Yes b. No

15. How much salt do you take?

a. < 5gm b. ≥ 5gm

16. Do you use birth control pills?

a. Yes b. No

17. Have you checked your bone density?

a. Yes b. No

18. Do you have proper lighting and non slippery floor in your house?

a. Yes b. No

**Section D: Osteoporosis Knowledge Assessment Tool**

| S.N | Items | True | False | Don't Know |
|---|---|---|---|---|
| 1. | Weakening or thinning of the bone (osteoporosis) is a serious disease like heart disease or cancer. | | | |
| 2. | Osteoporosis is more common in men than women. | | | |
| 3. | By age 50, the majority of women have a risk to develop osteoporosis. | | | |
| 4. | Bone loss speeds up after menopause. | | | |
| 5. | You are more likely to suffer from osteoporosis if your father or mother has had osteoporosis. | | | |
| 6. | The risk factor for osteoporosis is cigarette smoking and caffeine. | | | |
| 7. | An excessive amount of alcohol intake has no relationship with osteoporosis. | | | |
| 8. | Less intake of calcium-containing diet in childhood and adolescence affects osteoporosis in later life. | | | |
| 9. | You are likely to have osteoporosis if you have low body weight and small structure. | | | |
| 10. | Knee pain, and back are the early symptoms of osteoporosis. | | | |
| 11. | Losses of height, and humped spine are not symptom of osteoporosis. | | | |
| 12. | Bone X-ray helps to diagnose osteoporosis. | | | |
| 13. | There are effective treatments available for osteoporosis in Nepal. | | | |
| 14. | Any type of physical activity is beneficial for osteoporosis. (Household chores, climbing stairs, etc.) | | | |
| 15. | Brisk walking, yoga, Jumba dance like weight-bearing exercises are beneficial for the prevention of osteoporosis. | | | |
| 16. | Milk and milk products are the best sources of calcium. | | | |
| 17. | Soya bean, tofu, and green vegetables are also sources of calcium. | | | |
| 18. | Calcium and Vitamin D supplements help to prevent bone loss. | | | |
| 19. | Osteoporosis leads to easily breakdown of bones. | | | |
| 20. | Avoiding cold drinks helps to prevent osteoporosis. | | | |

**Section E: Respondents preventive practices**

| S.N | Items | Daily | Often (3-4 times/week) | Rarely (Once a week or less) | Never |
|---|---|---|---|---|---|
| 1. | Exposure to sun(before 10 a.m or after 2 p.m) for atleast 15 min | | | | |
| 2. | Performing physical activities (household chores, climbing stairs) | | | | |
| 3. | Performing weight bearing exercise for atleast 30min ( yoga, jumba, running) | | | | |
| 4. | Consuming 2-3 cups of dairy | | | | |
| 5. | Consuming calcium rich foods ( Broccoli, almonds, tofu, figs) | | | | |
| 6. | Consuming VitD rich foods (Fish, mushroom, ghee) | | | | |
| 7. | Consuming protein rich foods (Meat, eggs, pulses) | | | | |
| 8. | Smoking cigarettes | | | | |
| 9. | Drinking Alcohol | | | | |
| 10. | Taking calcium/Vit D supplements | | | | |
| 11. | Consuming coffee/tea of more than 3 cups/day | | | | |
| 12. | Consuming carbonated beverages e.g. cold drinks | | | | |

**ओस्टियोपोरोसिस ज्ञान मूल्याङ्कन प्रश्नावली** कोड नम्बर:

**खण्ड क : सामाजिक-जनसांख्यिकीय जानकारी** मिति:

नाम: उमेर:

१. तपाईको वैवाहिक अवस्था कस्तो छ?

क. अविवाहित ख. विवाहित ग. सम्बन्ध विच्छेद भएको घ. विधवा

२. तपाईं पढ्न वा लेख्न सक्नुहुन्छ?

क. सक्छु ख. सक्दिन

३. यदि सक्नुहुन्छ भने, तपाईको शिक्षा स्तर के हो?

क. अनौपचारिक ख. आधारभूत (८ सम्म) ग. माध्यमिक (९-१२) घ. विश्वविद्यालय

४. तपाईको पेशा के हो?

क. गृहिणी ख. कार्यरत ग. व्यापार घ. कृषि ङ. विद्यार्थी

5. तपाईं कुन जातिको हुनुहुन्छ?

क. ब्राह्मण/क्षेत्री ख. दलित ग. जनजाति घ. मधेसी ङ. अन्य

६. तपाईको धर्म के हो?

क. हिन्दू ख. बौद्ध ग. क्रिस्चियन घ. मुस्लिम ङ. अन्य

७. तपाईको परिवारको आर्थिक अवस्था कस्तो छ ?

क. ६ महिनाभन्दा कमको लागि पर्याप्त ग. १ वर्षको लागि पर्याप्त

ख. ६ महिनाको लागि पर्याप्त घ. १ बर्ष भन्दा बढीको लागि पर्याप्त

८. तपाईंको परिवार कस्तो छ?

क. संयुक्त ख. आणविक

९. के तपाई महिनावारी भइरहेको छ ?

क. छ ख. छैन

१०. यदि छैन भने, तपाईंको महिनावारी कहिले रोकियो ? ……

११. के तपाईलाई कहिल्यै फ्रयाक्चर भएको छ?

क. छ ख. छैन

१२. तपाईंको परिवारमा भाँचिएको कुनै इतिहास छ?

क. छ  ख. छैन

१३ . तपाईको जानकारीको मुख्य स्रोत के हो?

क. स्वास्थ्यकर्मी  ख. शिक्षक/पुस्तकहरू  ग. परिवार/आफन्तहरू  घ. मिडिया

**खण्ड ख: एन्थ्रोपोमेट्रिक मूल्याङ्कन**

| उचाइ (सेमी) | वजन (केजी) | BMI |
|---|---|---|
| | | |

**खण्ड C: व्यवहार कारक**

१४. के तपाई शाकाहारी हुनुहुन्छ?

क. हो  ख. होइन

१५. तपाईं कति नुन लिनुहुन्छ?

क. <५ ग्राम  ख. ≥ ५ ग्राम

१६. के तपाइँ गर्भनिरोधक चक्कीहरू प्रयोग गर्नुहुन्छ?

क. छु  ख. छैन

१७. के तपाईंले आफ्नो हड्डीको घनत्व जाँच गर्नुभयो?

क. छु  ख. छैन

१८. के तपाईको घरमा उचित प्रकाश र चिप्लो भुइँ छैन?

क. छ  ख. छैन

## खण्ड D: ओस्टियोपोरोसिस ज्ञान मूल्याङ्कन उपकरण

| क्र.म. | वस्तुहरू | सहि | गलत | थाहा छैन |
|---|---|---|---|---|
| १. | हड्डी कमजोर हुनु वा पातलो (अस्टियोपोरोसिस) हुनु मुटुरोग वा क्यान्सरजस्ता गम्भीर रोग हो। | | | |
| २. | ओस्टियोपोरोसिस महिलाको तुलनामा पुरुषमा बढी हुने गर्छ । | | | |
| ३. | ५० वर्षको उमेरमा, अधिकांश महिलाहरूलाई ओस्टियोपोरोसिस हुने जोखिम हुन्छ। | | | |
| ४. | रजोनिवृत्ति पछि हड्डी पातलो हुने गति बढ्छ। | | | |
| ५. | यदि तपाईको बुबा वा आमालाई ओस्टियोपोरोसिस भएको छ भने तपाईलाई ओस्टियोपोरोसिस हुने सम्भावना बढी हुन्छ। | | | |
| ६. | ओस्टियोपोरोसिसको लागि जोखिम कारक सिगरेट धूम्रपान र क्याफिन हो। | | | |
| ७. | अत्यधिक मात्रामा मदिरा सेवनको ओस्टियोपोरोसिससँग कुनै सम्बन्ध छैन। | | | |
| ८. | बाल्यकाल र किशोरावस्थामा क्याल्सियम युक्त आहारको कम सेवनले पछिको जीवनमा ओस्टियोपोरोसिसलाई असर गर्छ। | | | |
| ९. | यदि तपाईको शरीरको तौल कम र सानो संरचना छ भने तपाईलाई ओस्टियोपोरोसिस हुने सम्भावना हुन्छ। | | | |
| १०. | घुँडा र ढाड दुख्नु ओस्टियोपोरोसिसका प्रारम्भिक लक्षण हुन्। | | | |
| ११. | उचाइ घट्नु र मेरुदण्डको हम्प्ड हुनु अस्टियोपोरोसिसको लक्षण होइन। | | | |
| १२. | हड्डीको एक्स-रेले ओस्टियोपोरोसिसको निदान गर्न मद्दत गर्छ। | | | |
| १३. | नेपालमा ओस्टियोपोरोसिसको प्रभावकारी उपचार उपलब्ध छ। | | | |
| १४. | कुनै पनि प्रकारको शारीरिक गतिविधि ओस्टियोपोरोसिसको लागि लाभदायक हुन्छ। (घरको काम, सीढी चढ्ने, आदि) | | | |
| १५. | तीव्र हिड्ने, योग, जुम्बा नृत्य जस्ता तौल बोक्ने अभ्यासहरू ओस्टियोपोरोसिसको रोकथामका लागि लाभदायक हुन्छन्। | | | |
| १६. | दूध र दुग्धजन्य पदार्थ क्याल्सियमको उत्तम स्रोत हुन्। | | | |
| १७. | सोयाबीन, टोफु र हरियो सागसब्जी पनि क्याल्सियमका स्रोत हुन्। | | | |
| १८. | क्याल्सियम र भिटामिन डी सप्लिमेन्टले हड्डी पातलो हुन देखि रोक्छ । | | | |
| १९. | ओस्टियोपोरोसिसले हड्डी सजिलै भाँचिन्छ। | | | |
| २०. | चिसो पेय पदार्थ सेवन नगर्दा अस्टियोपोरोसिसबाट बच्न मद्दत गर्छ। | | | |

## खण्ड E: उत्तरदायी निवारक अभ्यासहरू

| क्र.म. | वस्तुहरू | दैनिक | अक्सर (3-4 पटक / हप्ता) | विरलै (हप्तामा एक पटक वा कम) | कहिल्यै |
|---|---|---|---|---|---|
| १. | कम्तिमा 15 मिनेटको लागि (बिहान 10 बजे वा दिउँसो 2 बजे पछि) सूर्यको सम्पर्कमा | | | | |
| २. | शारीरिक गतिविधिहरू प्रदर्शन गर्दै (घरको काम, सीढी चढ्ने) | | | | |
| ३. | कम्तिमा ३० मिनेट (योग, जुम्बा, दौड) तौल बोक्ने व्यायाम गर्ने | | | | |
| ४. | 2-3 कप दुध तथा दुग्धपदार्थ खपत | | | | |
| ५. | क्याल्सियम युक्त खानेकुराहरू (ब्रोकाउली, बदाम, टोफु, नेभारा) सेवन गर्ने | | | | |
| ६. | भिटामिनयुक्त खानेकुरा (माछा, च्याउ, घिउ) सेवन गर्ने | | | | |
| ७. | प्रोटिनयुक्त खानेकुराको सेवन (मासु, अण्डा, दाल) | | | | |
| ८. | चुरोट तान्ने | | | | |
| ९. | रक्सी पिउने | | | | |
| १०. | क्याल्सियम/भिट डी सप्लिमेन्टहरू लिने | | | | |
| ११. | ३ कप/दिनभन्दा बढी कफी/चिया उपभोग गर्ने | | | | |
| १२. | कार्बोनेटेड पेय पदार्थहरू जस्तै चिसो पेय पदार्थहरू खपत | | | | |

## Appendic C: Approval Letter

# बराहक्षेत्र नगरपालिका
# नगर कार्यपालिकाको कार्यालय

चक्रघट्टी, सुनसरी
कोशी प्रदेश, नेपाल

पत्र संख्याः ०८०/८१ ( प्रशासन शाखा )
च. नं: १७००

मितिः २०८०।१०।२५
ने.सं.: ११४४ पोहेलागा, १३ विहीवार

बिषय : अनुमति प्रदान गरिएको बारे ।

यो जो जससँग सम्बन्धित छ ।

प्रस्तुत बिषयमा त्रिभुवन विश्वविद्यालय, विज्ञान तथा प्रविधि अध्ययन संस्थान, केन्द्रीय प्रविधि क्याम्पस, धरानको च.नं. ७७३/०८० मिति २०८०।१०।२४ को पत्रबाट क्याम्पसमा सञ्चालन भइरहेको वि.एस्सी. न्यूट्रिशन एण्ड डाइटेक्टिस बिषयको पाठ्यक्रममा समाविष्ट भए बमोजिम चौथो वर्ष आठौं सेमेष्टरमा अध्ययनरत विद्यार्थी अस्मिता भट्टराईलाई ३०० पूर्णाङ्कको डिजर्टेशन कार्य अन्तर्गत "Knowledge and preventive practice regarding osteoporosis among women residing in Barahakshetra Municipality, sunsari." बिषयमा शोध कार्यका लागि आवश्यक सर्भेक्षण गर्न अनुमति माग भई आएकोमा निज शोधकर्ता अस्मिता भट्टराईलाई उल्लिखित बिषयमा शोध कार्यका लागि सर्भेक्षण गर्न अनुमति प्रदान गरिएको छ ।

रमेश कार्की
नगर प्रमुख

रमेश कार्की
नगर प्रमुख

बोधार्थ :
श्री केन्द्रीय प्रविधि क्याम्पस, धरान

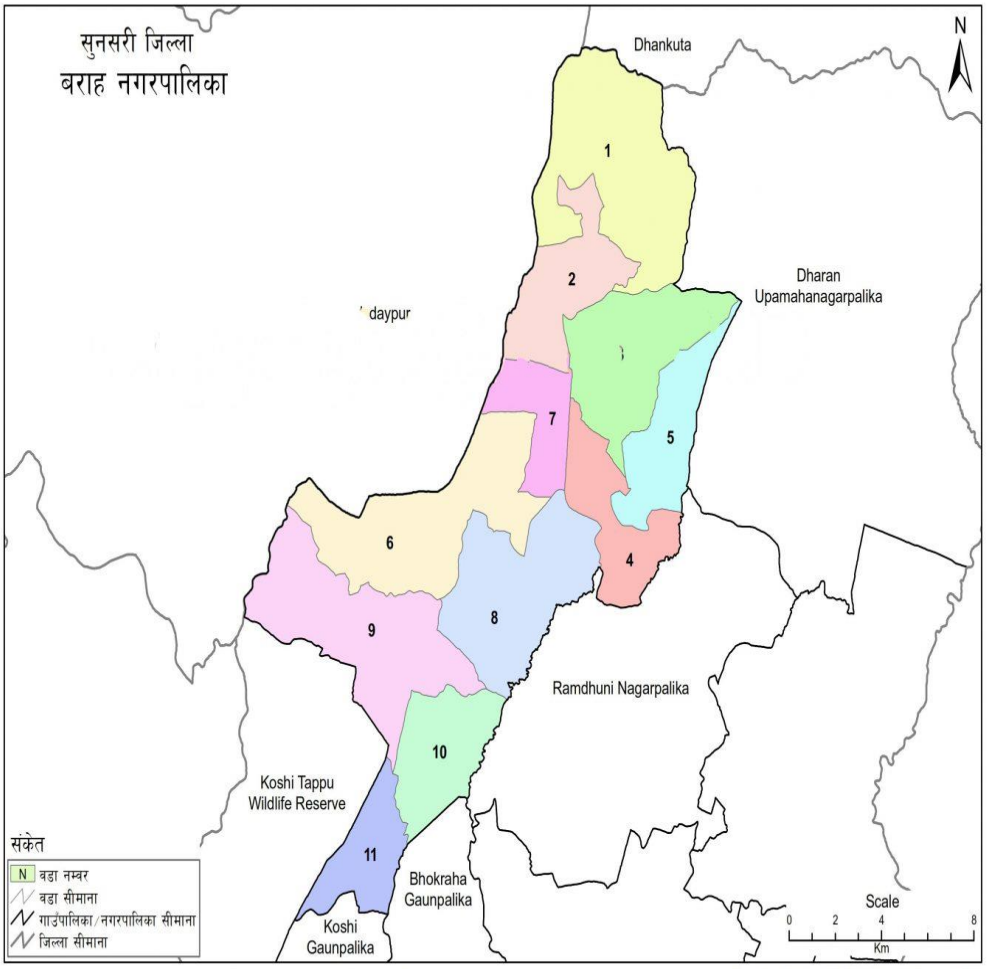
## Appendix D: Photo Gallery

Plate 1: Asking survey questionnaire

Plate 2: Measurement of weight

Plate 3: Measurement of height

# Appendix E: Map of the study area




स्रोत: स्थलरुप नक्सा (स्केल १:२५०००/१:५००००), नापी विभाग र जनगणना २०६८, केन्द्रिय तथ्यांक विभाग
तयार पार्ने: गाउँपालिका, नगरपालिका तथा विशेष, संरक्षित वा स्वायत्त क्षेत्रको संख्या तथा सीमाना निर्धारण आयोग

Projection System: MUTM, Spheroid - Everest 1830
LLRC, 2016