KNOWLEDGE REGARDING OSTEOPOROSIS AMONG HOUSEWIVES IN BANGLADESH

A dissertation submitted to the Department of Pharmacy,
East West University, Bangladesh for the partial fulfillment of the Degree
of Bachelor of Pharmacy

Submitted by

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Declaration

The research work entitled "A Project on Knowledge Regarding Osteoporosis Among Housewives in Bangladesh" is submitted as dissertation for the partial fulfillment of the Bachelor Degree of Pharmacy, under the supervision and guidance of Nafisa Tanjia, Senior Lecturer, Department of Pharmacy, East West University, Dhaka.

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Certification by the Supervisor

The under signed certify that the research work which is presented here was completely done by the author as well as to the style and contents. This thesis is therefore suitable for submission. No part or whole of this work was submitted before other degree. We further certify that the source of information has been availed of this connection is duly acknowledged.

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<u>Certification by the Chairperson</u>

This is to certify that the thesis entitled "A Project On Knowledge Regarding Osteoporosis Among Housewives In Bangladesh" submitted to the Department of Pharmacy, East West University for the partial fulfillment of the requirement for the award of the degree of Bachelor of Pharmacy is a record of original and genuine research work carried out by Tanjila Islam, ID: 2013-1-70-053 in 2016.

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<u>Acknowledgement</u>

Dedication

This research work is dedicated to My Beloved Parents,

Honorable Faculties and Loving Friends.

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List of Abbreviations

BMD	Bone Mineral Density
NF	Nuclear Factor
DEXA	Dual Energy X-ray Absorptiometry
HRT	Hormone Replacement Therapy
PTH	Para Thyroid Hormone
OP	Osteoporosis
CI	Confidence Interval
T1DM	Type 1 Diabetes Mellitus
BMI	Body Mass Index
OST	Osteoporosis Self-Assessment Tool
PPI	Proton Pump Inhibitor
PGE2	Prostaglandin E2
COX2	Cyclooxygenase 2
BMP	Bone Morphogenic Protein
LDL	Low Density Lipid
LRP5	Low Density Lipoprotein Receptor-related Protein
LHRH	Luteinizing Hormone Releasing Hormone
CT	Computerized Tomography
MRI	Magnetic Resonance Imaging
QUS	Quantitative Ultrasound Densitometry
BP	Biphosphonate
RANKL	Receptor Activator of Nuclear factor Kappa-B Ligand
CTX-I	C- Terminal Crosslinked Telopeptide of Type I
SERM	Serum Estrogen Receptor Modulator
IOM	Institute Of Medicine
OPQ	Osteoporosis Questionnaire
OAQ	Osteoporosis Awareness Questionnaire
CSIR	Central Drug Research Institute

OKAQ	Osteoporosis Knowledge Assessment Questionnaire
IOF	International Osteoporosis Foundation
BMC	Bone Mineral Content
HT	Hormone Therapy
FSH	Follicle Stimulating Hormone

Abstract

Osteoporosis is one of the most common physiological disorders among the people in Bangladesh and worldwide. The main objective of the study was to find out the level of knowledge related to osteoporosis including risk factors, diagnosis, treatment, prevention and their attitude regarding osteoporosis screening among housewives in different areas of Bangladesh. In this study, the data was collected from 270 housewives. Majority of them were undergraduate and graduate, a little portion was illiterate. In spite of having proper education, 11% among 270 housewives, did not even heard term osteoporosis. This may be due to their ignorance in health knowledge. Those who know about osteoporosis, 48% do not have any clear idea about the treatment and diagnosis procedure, 64% housewives are only concerned about getting osteoporosis. A portion of them (56%) mentioned few risk factors, but 38% of them are unable to say at least one frisk factor of osteoporosis, 77% have false believe about the prevention of osteoporosis. Majority of the people rarely discuss with family and never discuss with physician. But women take calcium supplement regularly, after the age of 40 mostly. Overall finding suggest that the knowledge about risk factors, protective factors and treatment among mass people concerning osteoporosis was relatively poor and need to be improved. So some steps should be taken wit the help of professionals to make them aware of this physiological disorder.

Keywords: *Osteoporosis, bone mass density, calcium, fracture, postmenopausal, DEXA.*

Chapter One

Introduction

1.1 What is Osteoporosis:

Osteoporosis, which literally means porous bone, is a disease in which the density and quality of bone are reduced. As bones become more porous and fragile, the risk of fracture is greatly increased. The loss of bone occurs silently and progressively. Often there are no symptoms until the first fracture occurs.

Osteoporosis (OP) is defined as a disease characterized by low bone mass and micro-architectural deterioration of bone tissue, leading to enhanced bone fragility and a consequent increase in fracture risk.

Bones are living tissue and constantly changing. From the moment of birth until young adulthood, bones are developing and strengthening. They are most dense in age like early 20s called peak bone mass. With aging some of the bone cells begin to dissolve bone matrix (resorption), while new bone cells deposit osteoid (formation). This process is known as remodeling. For people with osteoporosis, bone loss outpaces the growth of new bone. Bones become porous, brittle and prone to fracture (International Osteoporesis Foundation, 2015).

Osteoporotic Bone   Normal Bone
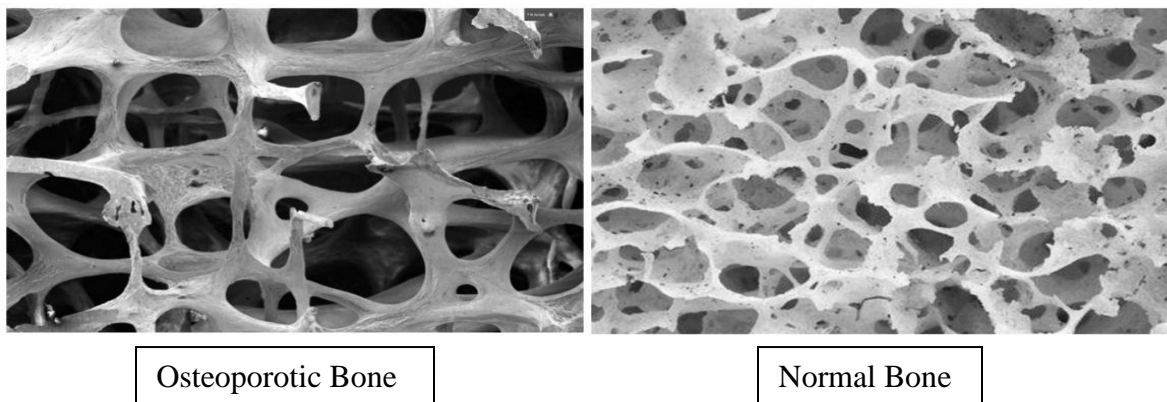
Fig 1.1: Condition of bone in osteoporosis (Dr. John, 2016)

Due to its prevalence worldwide, osteoporosis is considered a serious public health concern. Currently it is estimated that over 200 million people worldwide suffer from this disease. Approximately 30% of all postmenopausal women have osteoporosis in the United States and in Europe. At least 40% of these women and 15-30% of men will sustain one or more

fragility fractures in their remaining lifetime. Ageing of populations worldwide will be responsible for a major increase in the incidence of osteoporosis in postmenopausal women.

Wrist fractures are most likely to occur in women over 65 years old. An increase in age-adjusted incidence in white women between 45 and 60 years of age has been observed. Then the trend stabilises or slightly increases. Only 15% of wrist fractures occur in men and this rate does not increase much with age. (NHMRC, 2010)

1.2 Bone Remodeling:
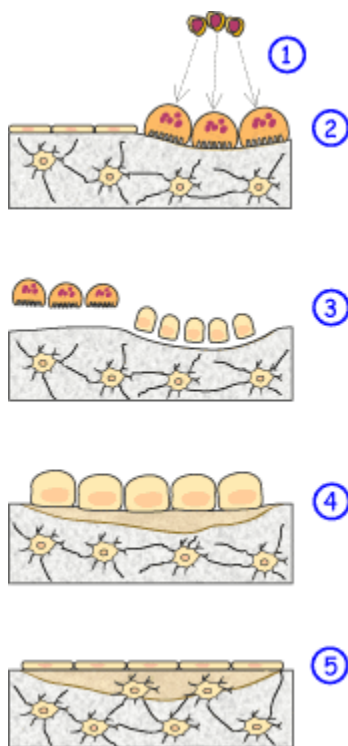
Remodeling is the replacement of old tissue by new bone tissue. This mainly occurs in the adult skeleton to maintain bone mass. This process involves the coupling of bone formation and bone resorption and consists of five phases:

1. Activation: preosteoclasts are stimulated and differentiate under the influence of cytokines and growth factors into mature active osteoclasts
2. Resorption: osteoclasts digest mineral matrix (old bone)
3. Reversal: end of resorption
4. Formation: osteoblasts synthesize new bone matrix
5. Quiescence: osteoblasts become resting bone lining cells on the newly formed bone surface (International Osteoporesis Foundation, 2015).

Fig 1.2: Remodeling of bone (NHMRC, 2010)

1.3 Pathophysiology of OP:

1.3.1 Bone framework

Bones have evolved to be light yet strong. The long bones are tubular in shape, with a strong outer shell, surrounding a softer, spongier core called trabecular bone. The combination

makes these bones strong and light, but flexible enough to absorb the stress, without breaking. With aging, daily remodeling leads to a gradual restructuring of the bone. Resorption of the minerals on the inside of the cortical layer and in the bone cavity itself leads to an inexorable loss of trabecular bone and a widening of the bone cavity. This is partly compensated for by the gradual addition of extra layers of mineral to the outside of the cortical layer. Overall the bones get slightly thicker but do not get any denser. In fact, peak bone mass, reached in early adulthood, gradually declines as people get older.

1.3.2 The cellular connection

The balance between bone resorption and bone deposition is determined by the activities of two principle cell types, osteoclasts and osteoblasts. Osteoclasts lower the pH in their own microenvironment. This drop in pH, in combination with enzyme action, dissolves the bone mineral. Osteoblasts lay down new bone mineral. The balance between the activities of these two cell types governs whether bone is made, maintained, or lost. In a typical bone remodeling cycle, osteoclasts are activated first, leading to bone resorption.

Then, after a brief "reversal" phase, during which the resorption "pit" is occupied by osteoblasts precursors, bone formation begins as progressive waves of osteoblasts form and lay down fresh bone matrix. Because the bone formation phase typically takes much longer than the resorption phase, any increase in remodeling activity tends to result in a net loss of bone.

1.3.3 Factors influencing osteoclasts and osteoblasts:

Hormones are possibly the most crucial modulators of bone formation. It is well established that estrogen, parathyroid hormone, and to a lesser extent testosterone, are essential for optimal bone development and maintenance. Of these, estrogen is now believed to have the most direct effect on bone cells, interacting with specific proteins, or receptors, on the surface of osteoblasts and osteoclasts.

Estrogen effects are mediated through the estrogen receptor alpha (ERα) cell, which binds and transports the hormone into the nucleus of the cell where the complex acts as a switch to turn on specific genes. ERα receptors are found on the surface of osteoblasts, which may play an auxillary role in regulating bone cells.

Prostaglandins, particularly progtaglandin E2 (PGE2), stimulate both resorption and formation of bone. PGE2 is a lipid that is formed in various bone cells from a precursor called arachidonic acid. The first step on PGE2 synthesis is carried out by an enzyme called cyclooxygenase 2 (COX2) and inhibitors of this enzyme can prevent bone formation in response to mechanical stress in animals. PGE2 may be required for exercise-induced bone formation. There is evidence that fracture risk is increased in people taking NSAID drugs that inhibit COX-2 may also increase. Leukotrienes, also derived from arachidonic acid, these have been found to reduce bone density in mice.

Bone morphogenic proteins, BMP receptors have been found on the surface of osteoblasts precursor cells. Another cell surface receptor called the low density lipoprotein (LDL)-related protein 5 receptor (LRP5) may also be important for bone formation because loss of LRP5 in animals leads to severe osteoporosis. BMP receptors and LRP5 may cooperate to stimulate osteoblasts into action, though exactly how this might occur has not been clarified (International Osteoporesis Foundation, 2015).

1.4 Sign and symptoms:

There typically are no symptoms in the early stages of bone loss. But once your bones have been weakened by osteoporosis, you may have signs and symptoms that include:

- Back pain, caused by a fractured or collapsed vertebra
- Loss of height over time
- A stooped posture
- A bone fracture that occurs much more easily than expected (Mayoclinic, 2016).

1.5 Types of osteoporosis:

As defined by the World Health Organization, osteoporosis is a generalized skeletal disorder of low bone mass (thinning of the bone) and deterioration in its architecture, causing susceptibility to fracture. People mostly do not know the types or classes of osteoporosis, resulting unawareness about the prevention of OP.

There are mainly 3 types of osteoporosis:

1. **Type I osteoporosis** (postmenopausal osteoporosis) generally develops in women after menopause when the amount of estrogen in the body greatly decreases. This process leads to an increase in the resorption of bone (the bones loses substance). Type 1 osteoporosis is far more common in women than in men, and typically develops between the ages of 50 and 70. The process usually results in a decrease in the amount of trabecular bone (the spongy bone inside of the hard cortical bone). The decrease in the overall strength of the bone leads primarily to wrist and vertebral body (in the spine) fractures.

2. **Type II osteoporosis** (senile osteoporosis) typically happens after the age of 70 and affects women twice as frequently as men. Type II osteoporosis involves a thinning of both the trabecular bone (the spongy bone inside of the hard cortical bone) and the hard cortical bone. This process often leads to hip and vertebral body fractures (Donald and Frisco, 2006).

3. **Secondary osteoporosis:** It is caused by certain medical conditions or treatments that interfere with the attainment of peak bone mass and may cause bone loss. With secondary osteoporosis, an increased rate of bone remodeling or an increase in the amount of bone being remodeled causes an overall increase in the rate of bone loss. Medical conditions resulting in secondary osteoporosis may include: serious kidney failure, cushing's disease, liver impairment, rheumatoid arthritis etc. (International Osteoporotic Foundation, 2015).

1.6 Risk factors

A risk factor is anything that increases your chance of getting a disease. More risk factors indicate the greater chance of developing a disease and also, the greater the level of each risk factor, the greater the risk.

Fixed risk factors determine whether an individual is at heightened risk of osteoporosis. Also, unlike modifiable risks, they are factors which can't be changed, including age, gender and family history. In addition, people may have secondary risk factors. These include disorders and medications that weaken bone and affect balance (heighten the risk of fracture due to falling). Read more about Secondary Osteoporosis.

Low bone mineral density, one of the most important indicators that a person is at risk of a fracture, is considered both fixed and modifiable since it is determined by a wide range of factors, including family history, age and lifestyle factors.

1.6.1 Fixed risks:

Although fixed risk factors cannot be changed, people need to be aware of them so that they can take steps to reduce bone mineral loss. Fixed risk factors also include what is termed 'secondary risk factors' disorders and medications that weaken bone and affect balance Fixed risk factors include:

- **Age:** The majority of hip fractures (90%) occur in people aged 50 and older. This is partly due to reduced bone mineral density as we age. But age can also be a risk factor independent of bone mineral density. In other words, even older adults with normal bone mineral density are more likely to suffer a fracture than younger people.

- **Female gender:** Women, particularly post-menopausal women, are more susceptible to bone loss than men, because their bodies produce less oestrogen. This hormone is an important component in bone formation. Women are more likely to sustain a osteoporotic fracture than men. Lifetime risk of any fracture ranges between 40-50% in women, compated to 13-22% in men.

- **Family history of osteoporosis:** A parental history of fracture (particularly a family history of hip fracture) is associated with an increased risk of fracture that is independent of bone mineral density.

- **Previous fracture:** A previous fracture increases the risk of any fracture by 86%, compared with people without a prior fracture. Both men and women are almost twice (1.86 times) as likely to have a second fracture compared to people who are fracture free.

- **Ethnicity:** Studies have found osteoporosis is more common in Caucasian and Asian populations, and the incidence of osteoporosis and fractures of the hip and spine is lower in black than in white people.

- **Menopause/hysterectomy:** Hysterectomy, if accompanied by removal of the ovaries, may also increase the risk for osteoporosis because of oestrogen loss. Post menopausal women, and those who have had their ovaries removed, must be particularly vigilant about their bone health.

- **Long term glucocorticoid therapy:** Long-term corticosteroids use is a very common cause of secondary osteoporosis and is associated with an increased risk of fracture.

- **Rheumatoid arthritis:** Rheumatoid arthritis and diseases of the endocrine system can take a heavy toll on bones. Hyperparathyroidism, for example, results in elevated levels of parathyroid hormone, which signals bone cells to release calcium from bone into the blood.

- **Primary/secondary hypogonadism in men:** Like estrogen deficiency in women (observed in case of primary or secondary amenorrhea and premature menopause), androgen deficiency in men (primary or secondary hypogonadism) increases the risk of fracture.

1.6.2 Modifiable risks:

Most modifiable risk factors directly impact bone biology and result in a decrease in bone mineral density (BMD), but some of them also increase the risk of fracture independently of their effect on bone itself. These include:

- **Alcohol:** People with excessive alcohol consumption (>2 units daily) have a 40% increased risk of sustaining any osteoporotic fracture, compared to people with moderate or no alcohol intake. High intakes of alcohol cause secondary osteoporosis due to direct adverse effects on bone-forming cells, on the hormone that regulates calcium metabolism and poor nutritional status (calcium, protein and vitamin D deficiency).

- **Smoking:** People with a past history of cigarette smoking and people who smoke are at increased risk of any fracture, compared to non-smokers.

- **Low body mass index:** Leanness (body mass index (BMI) <20 kg/m^2) regardless of age, sex and weight loss, is associated with greater bone loss and increased risk of fracture. People with a BMI of 20kg/m^2 have a two-fold increased risk of fracture compared to people with a BMI of 25 kg/m^2.

- **Poor nutrition:** When insufficient calcium is absorbed from dietary sources, the body produces more parathyroid hormone, which boosts bone remodeling, mobilizing osteoclasts in the bone to break down and sacrifice bone calcium to supply the nerves

and muscles with the mineral they need. There are indications that protein is also important in that it may act synergistically with vitamin D and calcium.

- **Vitamin D deficiency**: Vitamin D is also essential, since it helps calcium absorption from the intestines into the blood. Vitamin D is made in our skin with exposure to the sun's ultraviolet rays. In most people casual exposure to the sun for as little as 10-to-15 minutes a day is usually sufficient. However in elderly people, people who do not go outdoors, and during the winter months in northern latitudes, food or supplemental sources of vitamin D is of importance. At least 800 international units of vitamin D and 1,000 to 1,200 mg of calcium daily can protect against osteoporosis.

- **Eating disorders:** Osteoporosis can also be compounded by eating disorders such as anorexia nervosa and bulimia.

- **Insufficient exercise:** People with a more sedentary lifestyle are more likely to have a hip fracture than those who are more active. For example, women who sit for more than nine hours a day are 50% more likely to have a hip fracture than those who sit for less than six hours a day. Read more about the role of exercise in bone health.

- **Oestrogen deficiency:** Oestrogen deficiency in women afflicted by these disorders speeds up bone loss in a similar way to that which occurs in post-menopausal women, but to make matters worse, these diseases reduce the robust build up of bone mineral density that usually occurs in adolescence and early adulthood. This may be related to both hormone imbalance and nutritional factors.

- **Frequent falls:** Visual impairments, loss of balance, neuromuscular dysfunction, dementia, immobilization, and use of sleeping pills which are quite common conditions in elderly persons, significantly increase the risk of falling and accordingly increase the risk of fracture. Ninety percent of hip fractures result from falls (International Osteoporotic Foundation, 2015).

1.6.3 Secondary Risk Factors:

Secondary risk factors are less prevalent but they can have a significant impact on bone health and fracture incidence. These risk factors include other diseases that directly or indirectly affect bone remodelling and conditions that affect mobility and balance, which can contribute to the increased risk of falling and sustaining a fracture.

1.6.4 Disorders that affect the skeleton:

- **Asthma:** Asthma itself does not pose a threat to bone health. However, certain medications used to treat asthma and some behaviors triggered by concern over the disease can have a negative impact on the skeleton. For example, Anti-inflammatory medications, known as glucocorticoids, can decrease calcium absorbed from food, increase calcium lost from the kidneys, decrease bone formation, interfere with the production of sex hormones in both women and men, which can contribute to bone loss and they can cause muscle weakness, which can increase the risk of falling and related fractures (Center for Bone Reseacrh.com, n.d.).

  Many people with asthma think that milk and other dairy products trigger asthma attacks, this unnecessary avoidance of calcium-rich dairy products can be especially damaging for children with asthma who need calcium to build strong bones. Because exercise often can trigger an asthma attack, many people with asthma avoid weight bearing physical activities that are known to strengthen bone (National Institutes of Health Osteoporosis and Related Bone Diseases, 2014).

- **Nutritional/gastrointestinal problems (e.g. Crohn's or celiac disease):** Crohn's disease tends to affect any part of the digestive tract may be involved. People with Crohn's disease often treated with medications known as glucocorticoids (such as prednisone or cortisone) to reduce the inflammation caused by their disease, that is harmful for bone. In addition, people with severe inflammation of the small bowel or those who have parts of the small bowel surgically removed may have difficulty absorbing calcium and vitamin D.
  Celiac is clearly associated with abnormal intestinal permeability, which may contribute to osteoporosis by causing changes in bone metabolism and electrolyte balance. But the link may be even more direct: Celiac-associated auto-antibodies may actually attack bone and joint tissue (Goldman, 2013).

- **Rheumatoid arthritis:** Rheumatoid arthritis is an autoimmune disease, a disorder in which the body attacks its own healthy cells and tissues. When someone has rheumatoid arthritis, the membranes around his or her joints become inflamed and release enzymes that cause the surrounding cartilage and bone to wear away. The

glucocorticoid medications for the treatment of rheumatoid arthritis can trigger significant bone loss, pain and loss of joint function caused by the disease can result in inactivity, further increasing osteoporosis risk.

- **Haematological disorders/malignancy**: Any cancer treatment in women that lowers oestrogen levels can increase the risk of osteoporosis. Treatments include, chemotherapy that caused an early menopause, hormone therapy with LHRH analogue, aromatase inhibitor, radiotherapy to your ovaries to stop them working, surgery to remove your ovaries when you were premenopausal.

- **Some inherited disorders**

- **Hypogonadal states (e.g. Turner syndrome/Kleinfelter syndrome, amenorrhea):** The incidence of osteoporosis in men is indirectly correlated to the reduction in circulating testosterone. Because androgens may promote the proliferation and differentiation of osteoblasts, as well as inhibit osteoclast activity (recruitment and signaling), decreased bone density may ensue.

- **Endocrine disorders (e.g. Cushing's syndrome, hyperparathyroidism, diabetes**): Excess thyroid hormone, whether spontaneous or caused by overtreatment with thyroid hormone, may be associated with substantial bone loss, while bone turnover is increased in these patients, bone resorption is increased more than bone formation. Likewise, excess production of glucocorticoids caused by tumors of the pituitary or adrenal glands (Cushing's syndrome) can lead to rapidly progressive and severe osteoporosis, as can treatment with glucocorticoids. The relationship between diabetes and osteoporosis is more controversial. For example, hip fractures are increased in some studies of diabetic patients, but not in others. In general, patients with type 1 (insulin-dependent) diabetes, are at greater risk of osteoporosis than are those with type 2 (non-insulin dependent) diabetes.

- **Immobility**: Individuals who are immobile are limited or unable to participate in weight-bearing activities. Weight-bearing activity is any physical activity in which your body works against gravity, which builds bone mass in youth and maintains it in adulthood. When someone is immobile, the cells that make bone (osteoblasts) are not able to work as well. In addition, there is more activity of the cells that breakdown bone (NYSOPEP, 2016).

1.6.5 Medical treatments affecting bone health:

Some medications may have side effects that directly weaken bone or increase the risk of fracture due to fall or trauma. Patients taking any of the following medications should consult with their doctor about increased risk to bone health.

- **Glucocorticosteroids**: High levels of glucocorticoids (both natural and synthetic) are associated with reduced activity of the bone-forming cells and increased activity of the cells that break down bone, which may result in bone loss.

- **Certain immunosuppressant (calmodulin/calcineurine phosphatase inhibitors):** they are used after organ transplant may increase bone loss.

- **Thyroid hormone treatment (L-Thyroxine):** Excessive thyroid replacement in older adults has been associated with abnormal heart rhythms and muscle weakness, both of which increase the risk of falls and fractures. Excessive thyroid hormone replacement can also reduce bone mineral density and bone quality, which may also lead to fractures.

- **Certain steroid hormones**: Increase bone loss, especially during the first six months of treatment. Estrogens and androgens exert potent influences on the size and shape of the skeleton during growth. In addition, these hormones contribute to skeletal homeostasis during adulthood. The decline in estrogen levels associated with menopause causes bone loss in women, which occurs in both the trabecular (also known as cancellous) and the cortical bone compartments. Post-menopausal bone loss is associated with a high bone remodelling rate, as indicated by increased numbers of both osteoclasts and osteoblasts.

- **Aromatase inhibitors:** Aromatase inhibitors are used in the treatment of breast cancer. They prevent estrogen production, which results in extremely low blood levels of estrogen. These drugs have been shown to cause bone loss, and some studies have also shown increased risk of fractures, particularly at the spine and wrist.

- **Certain antipsychotics:** Drugs that act on the central nervous system can cause falls by causing drowsiness, confusion, a drop in blood pressure, abnormal heart rhythms or a change in the normal functioning of the nerves and/or muscles of the body. The risk of falling increases as more of these medications are taken, particularly during the start or the sudden discontinuation of these drugs.

- **Certain anticonvulsants:** The anti-seizure drugs carbamazepine and phenytoin have been associated with a reduction in bone density and this is believed to be due to low vitamin D and decreased intestinal absorption of calcium.

- **Certain antiepileptic drugs:** These drugs are thought to accelerate the metabolism of vitamin D, which lowers the availability of calcium for bone formation.

- **Lithium:** Lithium may be associated with hyperparathyroidism, a risk factor for osteoporosis. However, the data on the effect of lithium on bone mass are conflicting.

- **Methotrexate:** It may cause ovarian failure in women, resulting in premature menopause, or testicular failure in men, resulting in low testosterone levels, both of which lead to bone loss.

- **Antacids:** Aluminum-containing antacids may inhibit phosphate absorption from the intestine, which may reduce bone mineral density. In patients with impaired renal function, the aluminum may impair bone mineralization and this may be associated with fractures.

- **Proton pump inhibitors:** Proton pump inhibitors particularly at high doses, has been associated with an increased hip fracture risk in older adults. This may be due to less calcium absorption from foods in the presence of lower stomach acid (Osteoporosis Canada, 2016).

1.7 Diagnosis

Men and women over 60-years-old are at higher risk of osteoporosis than younger people. Nevertheless, it is possible to have osteopenia (low bone mass) or osteoporosis at a much earlier age. As osteoporosis has no obvious symptoms, it's important to go to doctor if any risk factors apply on someone.

Traditional X-rays can't measure bone density, but they can identify spine fractures. Bone mineral density (BMD) has to be measured by more specialised techniques.

- **Plain radiography:**

Conventional radiography is useful, both alone and in conjunction with CT or MRI, when detecting complications of osteopenia (e.g., fractures), for the differential diagnosis of osteopenia, or for follow-up examinations in specific clinical settings, such as progression of

soft tissue calcifications, or signs of secondary hyperparathyroidism and osteoporosis. It is relatively insensitive to the detection of early disease, though. A substantial amount of bone loss (~30%) must occur before it can be detected on x-ray images. Variations in radiographic exposure factors, film development, and patients' soft tissue thickness can also make it difficult to diagnose early signs of osteoporosis. The main radiographic features of generalized osteoporosis are cortical thinning and increased radiolucency **(Radiology Info.org , 2015).**

- **Qualitative CT scan imaging:**

CT scanning of the spine is performed to assess for alignment and fractures. It can be used to measure bone density and determine whether vertebral fractures are likely to occur. Bone-mineral density (BMD) measurements with a CT scanner have the major advantage that the trabecular component can be identified, and thus the measurements can be confined to these parts.

- **Quantitative ultrasound densitometry (QUS):**

QUS may be most useful in regions without access to DXA, but the same diagnostic criteria defined for DXA cannot be applied to this technique. QUS is, rather than a method for assessing BMD, a method to measure unknown elements of bone strength. QUS may be a good predictor of population-based fracture, but not individual fractures. Additionally, T-score has been tested only for DXA and cannot be applied to QUS. Standard parameters for diagnosis of osteoporosis by QUS have not yet been determined.

- **X-ray:**

X-ray may reveal osteopenia and/or fractures (e.g., vertebral fractures). However, x-ray is not useful diagnostically to define osteopenia, but rather is used to drive the need for DXA assessment when osteopenia is detected coincidentally. It should be considered in patients with pain in the thoraco-lumbar spine, height loss, or thoracic kyphosis. X-ray is also used in therapeutic trials to assess fracture incidence.

- **MRI:**

Magnetic resonance imaging of the spine is performed to evaluate vertebral fractures for evidence of underlying disease, such as cancer, and to assess the newness of the fracture. MRI of the spine uses radio waves, a magnetic field and a computer to produce detailed

pictures of the spine and surrounding tissues that are clearer and more detailed than other imaging methods (Gronholz, 2008).

1.7.1 Dual-Energy X-ray Absorptiometry (DEXA):

A number of different types of BMD tests are available, but the most commonly used is DEXA (dual-energy X-ray absorptiometry). DEXA is a low radiation X-ray capable of detecting quite small percentages of bone loss. It is used to measure spine and hip bone density, and can also measure bone density of the whole skeleton. A DEXA scan, which is used to measure spine and hip bone density, is the most common technique for assessing the risk of osteoporosis.

Osteopenia is diagnosed when the measurement is between 1 and 2.5 standard deviations below the young adult reference measurement.

Table 1.1: Relation between T-score value and density (Nof. Org, 2016)

Status	Hip BMD
Normal	T-score of -1 or above
Osteopenia	T-score lower than -1 and greater than -2.5
Osteoporosis	T-score of -2.5 or lower
Severe osteoporosis	T-score of -2.5 or lower, and presence of at least one fragility fracture

If the results of BMD test show osteopenia or osteoporosis, it does not automatically mean of have a fracture. There are lifestyle changes and a number of available therapies that doctor might prescribe to slow down bone loss and help prevent fractures.

The test usually takes less than 15 minutes. Bone density tests are non-invasive and painless. This means that no needles or instruments are placed through the skin or body. A central DXA uses very little radiation. When repeating a bone density test, it is best to use the same testing equipment and have the test done at the same place each time. This provides a more accurate comparison with your last test result. Although it is not always possible to have your bone density test at the same place, it is still important to compare your current bone density scores to your previous scores. If you have a peripheral bone density test, you should follow

up with your healthcare provider. Discuss whether you need additional testing, such as a central DXA test of the hip and/or spine. The results of a peripheral test cannot be compared with the results of a central DXA.

Currently, DEXA is the most accurate and recommended method for BMD measurement. It is a sensitive technique and can detect changes in bone density only 6-12 months after a previous measurement is obtained. Density measurements of the spine or hip are used. The procedure takes approximately 20-30 minutes (Nof.org, 2016).

1.8 Treatment

A number of effective medications are approved for the prevention and treatment of osteoporosis. These medications must be tailored to a person's specific needs and used in conjugation with recommended lifestyle changes.

- **Bisphosphonates:** Bisphosphonates (BP) are potent inhibitors of bone resorption that inhibit the activity of osteoclasts. All approved bisphosphonates have been shown to reduce vertebral fracture risk and increase BMD, whereas some have demonstrated reductions in non-vertebral and hip fracture risk as well. Bisphosphponates bind to bone mineral, and consequently have a long skeletal retention. Examples include alendronate, risedronate, zoledronic acid etc.

- **Calcitonin**: This 32-amino-acid peptide secreted by the C-cells of the thyroid inhibits activity of osteoclasts, slows bone resorption, but induces only a mild increase in bone mineral density BMD. Nasal salmon calcitonin decreased the incidence of vertebral fractures by 33 % in older osteoporotic women, most of whom had prevalent vertebral fractures. Salmon calcitonin appears to reduce the pain associated with acute vertebral fractures.

- **Denosumab**: Denosumab prevents the binding of receptor activator of nuclear factor-kB ligand (RANKL) to receptor activator of nuclear factor-kB (RANK) on the cells of the osteoclastic lineage. RANKL binds to RANK and stimulates osteoclast differentiation, activation and survival. It inhibits bone resorption strongly and

rapidly, e.g. serum CTX-I decreases by more than 80 % one week after denosumab injection.

- **Selective Estrogen Receptor Modulators (SERM):** Selective estrogen receptor modulators (SERM) have the ability to bind to oestrogen receptors throughout the body and act as estrogen agonists or antagonists depending upon the target organ. Examples are raloxifene, bazedoxifene etc.

- **Strontium ranelate:** Strontium ranelate slightly inhibits bone resorption, slightly stimulates bone formation and progressively dose-dependently increases BMD, decreases the incidence of vertebral fractures.

- **Teriparatide:** Recombinant human parathyroid hormone teriparatide and recombinant human intact parathyroid hormone are effective stimulators of bone formation. They stimulate bone remodeling at the bone remodeling unit and bone modeling on quiescent bone surfaces. They induce a prompt increase in bone formation followed by a slower increase in bone resorption.

- **Hormone replacement therapy (HRT):** Hormone replacement therapy (HRT) may consist of oestrogens alone or in combination with progestin. HRT slows bone turnover and increases bone mineral density (BMD) at all skeletal sites in early and late postmenopausal women.

- **Vertebroplasty and Kyphoplasty**: Vertebroplasty and kyphoplasty are minimally invasive surgical procedures which aim to relieve symptoms associated with vertebral compression fractures (International Osteoporosis Foundation, 2015).

1.9 Prevention

Genetic factors play a significant role in determining whether an individual is at heightened risk of osteoporosis. However, lifestyle factors such as diet and physical activity also influence bone development in youth and the rate of bone loss later in life. After your mid-20s, bone thinning is a natural process and cannot be completely stopped. The thicker your bones, the less likely they are to become thin enough to break. Young women in particular need to be aware of their osteoporosis risk and take steps to slow its progress and prevent fractures. It can be prevented with proper calcium, vitamin D, nutrition intake and exercise. Children and adolescents should:

- Ensure a nutritious diet with adequate calcium intake

- Avoid protein malnutrition and under-nutrition

- Maintain an adequate supply of vitamin D

- Participate in regular physical activity

- Avoid the effects of second-hand smoking

It's estimated a 10% increase of peak bone mass in children reduces the risk of an osteoporotic fracture during adult life by 50%. Bone mass acquired during youth is an important determinant of the risk of osteoporotic fracture during later life. The higher the peak bone mass, the lower the risk of osteoporosis. Once peak bone mass has been reached, it is maintained by remodelling. This is a continuous process in which old bone is removed (resorption) and new bone is created (formation). The renewal of bone is responsible for bone strength throughout life. During childhood and the beginning of adulthood, bone formation is more important than bone resorption. Later in life, however, the rate of bone resorption is greater than the rate of bone formation and results in net bone loss. Any factor which causes a higher rate of bone remodelling will ultimately lead to a more rapid loss of bone mass and more fragile bones. The nutritional and lifestyle advice for building strong bones are applicable for both young and adult.

Adults should:

- Ensure a nutritious diet and adequate calcium intake
- Avoid under-nutrition, particularly the effects of severe weight-loss diets and eating disorders
- Maintain an adequate supply of vitamin D
- Participate in regular weight-bearing activity
- Avoid smoking and second-hand smoking
- Avoid heavy drinking

1.9.1 Calcium

Recommended daily calcium allowances for populations vary between countries. The IOM

2010 (Institute of Medicine of the US National Academy of Sciences) recommendations are as follows:

Table 1.2: Dietary Recommended Intake of calcium (International Osteoporosis Foundation, 2015).

INFANCY TO ADOLESCENCE	CALCIUM (MG/DAY)
0-6 months	200
6-12 months	260
1-3 years	700
4-8 years	1000
9-13 years	1300

WOMEN	CALCIUM (MG/DAY)
19 - 50 years	1000
Post-menopause (51+ years)	1200
During pregnancy/lactation 14-18 years old	1300
During pregnancy/lactation 19-50 years old	1000

MEN	CALCIUM (MG/DAY)
19-70 years	1000
70+ years	1200

Calcium rich foods

Milk and dairy products are the most readily available dietary sources of calcium. Dairy foods have the additional advantage of being good sources of protein and other micronutrients important for bone health.

Other sources of calcium include:

- Green vegetables like broccoli, curly kale
- Some fruits such as oranges, apricots and dried figs
- Canned fish with soft, edible bones (the calcium is in the bones) such as sardines, pilchards and salmon
- Nuts, especially Brazil nuts and almonds
- Calcium-set Tofu
- Some calcium-fortified breads, cereals, fruit juices, soy beverages and several brands of commercial mineral water also contain significant amounts of calcium. These foods provide a suitable alternative for people who are lactose-intolerant or vegan.
- Some leafy produce, like spinach and rhubarb, contain 'oxalates', which prevent the calcium present in these vegetables from being absorbed. However, they do not interfere with calcium absorption from other calcium-containing foods eaten at the same time. The same is true of 'phytates' in dried beans, cereal husks and seeds.

Foods to avoid

Caffeine and salt can increase calcium loss from the body and should not be taken in excessive amounts. Alcohol should also be taken in moderation as it detracts from bone health and is associated with falls and fractures. No conclusive evidence shows that fizzy soft drinks (e.g. cola drinks) weaken bones, but here too, it's best not to overdo it - especially as such drinks tend to 'displace' milk in the diets of children and teenagers.

1.9.2 Vitamin D

Vitamin D is essential for the development and maintenance of bone, both for its role in assisting calcium absorption from food in the intestine, and for ensuring the correct renewal and mineralization of bone tissue. The type of vitamin D made in the skin is referred to as vitamin D_3 (cholecalciferol), whereas the dietary form can be vitamin D_3 or a closely related molecule of plant origin known as vitamin D_2 (ergocalciferol). The main source of vitamin D is ultraviolet ray.

Sources of vitamin D

Vitamin D is made in the skin when it is exposed to ultraviolet B rays; in children and adults exposure of the hands, face and arms to the sun for 10 to 15 minutes per day is usually

sufficient for most individuals. However, how much vitamin D is produced from sunlight depends on the time of day, where you live in the world and the color of your skin. Vitamin D can also be obtained from food, and dietary supplements. Food sources are rather limited, and include oily fish such as salmon, sardines and mackerel, eggs, liver, and in some countries fortified foods such as margarine, dairy foods and cereals.

Table 1.3: Dietary Reference Intakes for Vitamin D (International Osteoporosis Foundation, 2015).

AGE GROUP	RECOMMENDED DIETARY ALLOWANCE (IU/DAY)
Infants 0-6 months	400
Infants 6-12 months	400
1-70 years	600
>70 years	800

1.9.3 Other nutrition

A healthy diet can help you prevent and manage osteoporosis and related musculoskeletal disorders by assisting in the production and maintenance of bone. Two of the most important nutrients are calcium and vitamin D. Calcium is a major building-block of bone tissue (the skeleton houses 99% of the body's calcium stores). Vitamin D is key at it assists your body to absorb calcium, the two go hand in hand.

<u>Protein</u>

Adequate dietary protein is essential for optimal bone mass gain during childhood and adolescence. It's also responsible for preserving bone mass with ageing. Lack of protein robs the muscles of strength, which heightens the risk of falls, and contributes to poor recovery in patients who have had a fracture. Lean red meat, poultry and fish, as well as eggs and dairy foods, are excellent sources of animal protein. Vegetable sources of protein include legumes (e.g. lentils, kidney beans), soya products (e.g. tofu), grains, nuts and seeds.

Fruits and Vegetables

Fruits and vegetables contain an array of vitamins, minerals, antioxidants and alkaline salts some or all of which can have a beneficial effect on bone. Studies have shown higher fruit and vegetable consumption is associated with beneficial effects on bone density in elderly men and women.

B Vitamins and Homocysteine

Some studies suggest high blood levels of the amino acid homocysteine may be linked to lower bone density and higher risk of hip fracture in the eldery. Vitamins B6 and B12, as well as folic acid, play a role in changing homocysteine into other amino acids for use by the body, so it is possible that they might play a protective role in osteoporosis.

Vitamin A

The role of vitamin A in osteoporosis is controversial. Vitamin A is present as a compound called retinol in foods of animal origin, such as liver and fish liver oils, dairy foods and egg yolk, green leafy vegetables, and red and yellow colored fruits and vegetables.

Vitamin K

Vitamin K is required for the correct mineralization of bone. Some evidence suggests low vitamin K levels lead to low bone density and increased risk of fracture in the elderly. Sources include leafy green vegetables such as lettuce, spinach and cabbage, liver and some fermented cheeses and soya bean products.

Zinc

This mineral is required for bone tissue renewal and mineralization. Severe deficiency is usually associated with calorie and protein malnutrition, and contributes to impaired bone growth in children. Milder degrees of zinc deficiency have been reported in the elderly and could potentially contribute to poor bone status. Sources of zinc include lean red meat, poultry, whole grain cereals, pulses and legumes.

1.9.4 Exercise

Exercise plays an important role in building and maintaining bone and muscle strength. It

also helps to reduce falls by improving balance and aids rehabilitation from fractures. Muscles and bones respond and strengthen when they are 'stressed'. This can be achieved by weight bearing or impact exercises.

- It builds strong bones in youth. It's estimated a 10 per cent increase of peak bone mass in children can reduce the risk of an osteoporotic fracture during adult life by 50 per cent.

- Exercise plays a key role in adults preventing bone loss and maintaining muscle strength.

- It helps prevent weak bones and falls in the elderly. One-third of people over 65 have a fall each year and the risk of falling increases as age rises.

- People who have suffered fractures can benefit from special exercises and training (under medical supervision) to improve muscle strength and muscle function for greater mobility and improved quality of life (International Osteoporosis Foundation, 2015).

Chapter Two

Literature Review

2.1 Relationship between Osteoporosis Knowledge, Beliefs and Dietary Calcium Intake among South Asian Women in Auckland.

Midi Tsai had conducted a thesis on osteoporosis knowledge and awareness on South Asian women in 2008. The purpose of this study was to determine osteoporosis knowledge, health beliefs and dietary calcium intake in a sample of South Asian women living in Auckland, New Zealand. Relationships between these variables and the predictors of dietary calcium intake were examined. According to this study, it was suggested that prevention of osteoporosis interventions may need to increase awareness, overcome perceived barriers to dietary calcium intake as well as maintain health motivation among these South Asia women to achieve sufficient dietary calcium intake (Tsai, 2008).

2.2 Awareness regarding the importance of calcium and vitamin D among the undergraduate pharmacy students in Bangladesh.

Riaz Uddin, Naz Hasan Huda and some others designed and conducted a research study to establish a basic understanding on the level of gap of knowledge and awareness among pharmacy students at undergraduate level in Bangladesh in 2013. Calcium and vitamin D are two important micronutrients required for maintaining proper bone health. Lack of awareness and insufficient knowledge of the essentiality of these two nutrients were assumed to cause this problem in Bangladesh. A total of 713 students of Bachelor of Pharmacy course participated in the study. The students were asked about basic idea related to calcium and vitamin D and the disorders due to their deficiency, name of common foods containing calcium and vitamin D, their perception regarding the essentiality of the said nutrients etc. The study indicated that the pharmacy students had lack of knowledge about calcium and vitamin D and thus it clearly predicted that the condition of general people may be worse (Uddin et al., 2013).

2.3 Low Awareness of Osteoporosis among Women Attending an Urban Health Centre in Mumbai, Western India.

Patil sapna, Hasamnis Ameya, Jena conducted research study on general awareness on osteoporosis among women in Mumbai in 2010 for eight months. The objective of this study was to evaluate knowledge about osteoporosis and its correlates among women aged ≥ 40

years attending an urban health centre in India and to identify their sources of information on osteoporosis. Knowledge about osteoporosis was assessed using the Osteoporosis Questionnaire (OPQ) in 243 women over 40 years of age, attending an urban health centre in the city of Mumbai located in the state of Maharashtra in western India. The study had identified deficiencies in the knowledge about osteoporosis particularly regarding the risk factors, treatment and consequences amongst Indian women staying in urban slums. The study reveals lack of knowledge about osteoporosis in the present sample, and the need for increased involvement of doctors in educating patients about osteoporosis (Patil et al., 2010)

2.4 Assessment of Awareness of Osteoporosis Amongst Unmarried Indian Girl Students Pursuing Undergraduate and Postgraduate Professional Courses.

Mukesh Srivastava, Gul Naz Fatima, Richa Srivastava and Man Mohan Singh had conducted research study to assess awareness of osteoporosis among unmarried Indian girl students pursuing undergraduate and post graduate professional courses in the city. This work was conducted at CSIR-Central Drug Research Institute, Lucknow, India. A 25-item multiple-choice cum 'Osteoporosis Awareness Questionnaire' (OAQ) was developed keeping in mind healthy participants and not patients. Osteoporotic fractures usually occur 10–20 years earlier in Indians than Caucasians. But relatively little is known about risk factors in women in Indian subcontinent (Srivastava et al., 2013)

2.5 Pakistani Women Knowledge, Beliefs and Attitudes towards Osteoporosis.

Sadia Shakeel, Safila Naveed, Wajiha Iffat, Faiza Nazeer and Yumna Nida Yousuf conducted survey study on risk factors, beliefs and attitudes towards osteoporosis on Pakistani women in 2015. Questionnaire was distributed to women between the age of 18 to 55 years, who had agreed and given consent to participate in the study. Descriptive statistics were used to demonstrate students' demographic information and their response to the questionnaire items. It identified a more standardized approach coupled with the well-structured health education programs pointing out such gaps between knowledge and practices (Shakeel et al., 2015).

2.6 Knowledge about Osteoporosis among healthy women attending a tertiary care hospital

Mehmood Riaz, Naushad Abid, Junaid Patel, Muhammad Tariq, Muhammad Shoaib Khan, Lubna Zuberi conducted research study on osteoporotic risk factors and disease in three age groups of Pakistani women. In this exploratory cross-sectional study, an osteoporosis knowledge assessment questionnaire (OKAT) was used to collect data and it was delivered through a face-to-face interview. Questions were asked about symptoms of osteoporosis, knowledge of risk factors, preventive factors and treatment. The knowledge on osteoporosis in younger women was very poor compared to relatively older females. However, women belonging to higher socioeconomic status and better education had slightly more knowledge about osteoporosis compared to those with a low education level, regardless of age. The majority of women had modest knowledge on osteoporosis. Younger women were at increased risk for low bone mass and premature osteoporosis (Riaz et al., (2008)

2.7 Vitamin D status in recently arrived immigrants from Africa and Asia: a cross-sectional study from Norway of children, adolescents and adults.

Åse R Eggemoen, Kirsten V Knutsen1, Ingvild Dalen1, Anne K Jenum conducted research study on vitamin D deficiency on immigrants from Africa and Asia in 2010. Objective was to estimate the prevalence of vitamin D deficiency <50 nmol/L among recently arrived immigrants from Africa and Asia in Oslo, and to explore D levels according to origin, gender and age. Setting was Primary healthcare unit in Oslo, Norway, offering family immigrants, asylum seekers, United Nations (UN) refugees or individuals granted asylum a free medical examination on arrival. All individuals from African and Asian countries (n=591) referred to the Centre of Migrant Health, Health Agency, Oslo, Norway in 2010, estimated to cover 60% of the targeted population.

The ethnic differences persisted after adjusting for the duration of residence, seasonality and residence status in multiple linear regression analyses. Female adolescents from South Asia, the Middle East and South Sahara Africa had the lowest levels of vitamin D. Further, country-specific median levels of vitamin D were low (24–38 nmol/L) among groups from

Somalia, Eritrea, Afghanistan and Iraq, the countries with the largest number of immigrants in study (Eggemoen et al., 2013).

2.8 Knowledge of Calcium and Vitamin D Intake on Risk of Fracture among General Physicians and General Population

Sanjay Damu Jadhav, Avishkar B Patil conducted research study on awareness about calcium and vitamin D needed to rduce the risk of fracture. The study was done to evaluate the knowledge of calcium and vitamin D intake on risk of fracture among the general physicians and general population.On comparison of the scores of the general physicians and general patients, it was found that the general practitioners were having more knowledge as compared to the group II and the difference was found to be statistically highly significant. Although the general medical practitioners were having good knowledge of the calcium and vitamin D supplements, their knowledge should be continuously updated as most of them were unaware of the facts added recently to the literature (Jadhav, 2016).

2.9 Comparative study of bone mineral density, calcium, and vitamin D status in the Gujarati and white populations of Leicester.

C Hamson, L Goh, P Sheldon, A Samanta conducted a comparative research study on BMD, calcium, vitamin D for observing their effects on Gujarati and white population **to** evaluate differences among the factors and to determine whether this was linked to their lifestyle factors, having influence on osteoporosis. An observational cross sectional study of randomly selected Gujarati and white volunteers aged from 20–40 years in the city of Leicester. The study was the first of its kind to note a low BMD in Gujarati subjects of South Asian origin compared with their white counterparts, living in Leicester. This study also confirmed the presence of low serum vitamin D levels in Gujaratis. There was a need for more research in South Asians with regard to the collection of normal BMD values. This could provide a more meaningful reference range for identifying South Asians at risk of osteoporotic fractures and may have public health implications of relevance to this ethnic group. (Hamson et al., 2002).

2.10 Osteoporosis: public awareness, commitment, and Perspectives

Margaret WM Fok, HB Leung, WM Lee conducted research study to explore public awareness of osteoporosis and willingness to manage the problem.

It included Cross-sectional questionnaire study carried out in a public hospital and a private health care clinic in Hong Kong. Two hundred and fifty postmenopausal women consisting of patients with fragile fracture, their next-of-kin, patients (without fragile fractures) from a government primary health care clinic, patients from a government orthopaedic clinic, and patients from a private primary health care clinic.

Only 81% of those interviewed had heard of the disease. Among these, 92% believed that the government was responsible for managing osteoporosis. Most (83%) were willing to self-finance treatment; a higher percentage were willing to do so among those with relatives having osteoporotic fractures. Most (87%) of the subjects underestimated the cost. Less than 40% expected to pay more than HK$1200 annually. Given the current market price, only 66% would still consider undertaking the treatment. Notably, 99% of interviewees would commence treatment provided the cost was lower (Fok, 2008).

2.11 Significance of the Study

As the average age of the world's population shifts upward, the incidence and prevalence of osteoporosis and its economic burden on society will increase further. Surveys based on data from developed countries show that the number of individuals aged 45 years and older increased from about 155 million in 1960 to 206 million in 1980. This number can be expected to rise to 257 million by the year 2000. This trend is true, not only for industrialized countries, but also in the developing countries. The world population of women older than 45 is therefore set to more than double in this time. More than 200 million women worldwide have osteoporosis. Estimates indicate that the number of osteoporotic hip fractures occurring in the world each year will rise from 1.66 million to 6.26 million by the year 2050, thereby implying an urgent need for preventive strategies.

In the United States, osteoporosis is a major public health threat for 24 million Americans, 80% of whom are women. Ten million individuals already have osteoporosis, and 14 million more have low bone mass, placing them at increased risk for this disease. Osteoporosis is responsible for more than 1.5 million fractures annually, among them more than half a million vertebral fractures, 300,000 hip fractures, 200,000 wrist fractures, and 300,000 fractures of other sites. Approximately 37,500 people die each year after complications related to osteoporotic fracture. Osteoporosis also caused more than 44 million patient-days in nursing homes and an estimated $13.8 billion in annual health care expenditures in 1995. The direct medical costs associated with hip fractures among men and women have been estimated to be between $5.4 billion and $7.4 billion. Costs will escalate as the proportion of elderly in the population increases; costs of hip fractures are projected to reach $62 billion in the United States by the year 2020. According to one projection, demographic changes alone could lead to an increase in the number of hip fractures annually to 840,000 by the year 2040 (Iqbal, 2000).

According to International Osteoporosis Foundation,

- Worldwide, osteoporosis causes more than 8.9 million fractures annually, resulting in an osteoporotic fracture every 3 seconds.

- Osteoporosis is estimated to affect 200 million women worldwide - approximately one-tenth of women aged 60, one-fifth of women aged 70, two-fifths of women aged 80 and two-thirds of women aged 90.

- Osteoporosis affects an estimated 75 million people in Europe, USA and Japan.

- For the year 2000, there were an estimated 9 million new osteoporotic fractures, of which 1.6 million were at the hip, 1.7 million were at the forearm and 1.4 million were clinical vertebral fractures. Europe and the Americas accounted for 51% of all these fractures, while most of the remainder occurred in the Western Pacific region and Southeast Asia.

- Worldwide, 1 in 3 women over age 50 will experience osteoporotic fractures, as will 1 in 5 men aged over 50.

- 80%, 75%, 70% and 58% of forearm, humerus, hip and spine fractures, respectively, occur in women. Overall, 61% of osteoporotic fractures occur in women, with a female-to-male ratio of 1.6.

- Nearly 75% of hip, spine and distal forearm fractures occur among patients 65 years old or over.

- A 10% loss of bone mass in the vertebrae can double the risk of vertebral fractures, and similarly, a 10% loss of bone mass in the hip can result in a 2.5 times greater risk of hip fracture .

- By 2050, the worldwide incidence of hip fracture in men is projected to increase by 310% and 240% in women, compared to rates in 1990.

- The combined lifetime risk for hip, forearm and vertebral fractures coming to clinical attention is around 40%, equivalent to the risk for cardiovascular disease.

- Osteoporosis takes a huge personal and economic toll. In Europe, the disability due to osteoporosis is greater than that caused by cancers (with the exception of lung cancer) and is comparable or greater than that lost to a variety of chronic non-communicable diseases, such as rheumatoid arthritis, asthma and high blood pressure related heart disease.

- A prior fracture is associated with an 86% increased risk of any fracture.

- Although low BMD confers increased risk for fracture, most fractures occur in postmenopausal women and elderly men at moderate risk.

- In women over 45 years of age, osteoporosis accounts for more days spent in hospital than many other diseases, including diabetes, myocardial infarction and breast cancer.

- Evidence suggests that many women who sustain a fragility fracture are not appropriately diagnosed and treated for probable osteoporosis.

- The great majority of individuals at high risk (possibly 80%), who have already had at least one osteoporotic fracture, are neither identified nor treated.

- An IOF survey, conducted in 11 countries, showed denial of personal risk by postmenopausal women, lack of dialogue about osteoporosis with their doctor, and restricted access to diagnosis and treatment before the first fracture result in under diagnosis and under treatment of the disease (IOF International, 2015).

2.12 Aim and Objective of the Study

1. To know the housewives knowledge of osteoporosis in Bangladesh.

2. To find out the presence of risk factors associated with osteoporosis among them.

3. To find out their habitual patterns that may influence the formation, early diagnosis and prevalence of osteoporosis.

Chapter Three

Methodology

3.1 Study area

The data was collected from different areas of Bangladesh, mainly from Dhaka, Chittagong, Comilla, Rajshahi including only housewives. The data includes the information from both rural and urban area of outside Dhaka. Uttora, Rampura, Mirpur, Shahbag, Bonani, Dhanmondi areas were covered in Dhaka, including the slum areas.

3.2 Total number of participants

- Data was collected from 270 housewives.

3.3 Inclusion criteria

- Only female
- Married
- Housewife

3.4 Exclusion criteria

- Unwilling to participate

3.5 Procedure

- For collecting data, a questionnaire was prepared according to required information.
- The collected data were analyzed with the help of Microsoft Office Excel 2007 and filtered out accordingly for Analysis.
- Some graphical representations were made from those analysis statuses.

Chapter Four

Result

4.1 Education Level of the Subjects
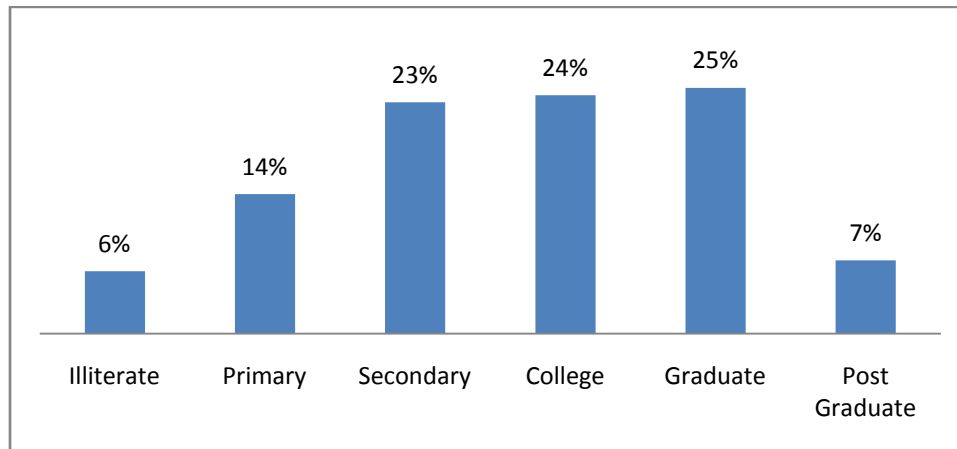
Fig 4.1: Education Level of the Subjects

Among all (270) the respondents, majority of the participants have studied up to secondary (23%), college (24%) and graduate (25%) level. There was also illiterate (6%), up to primary level (14%) and post graduate (7%).

4.2 Living with Family
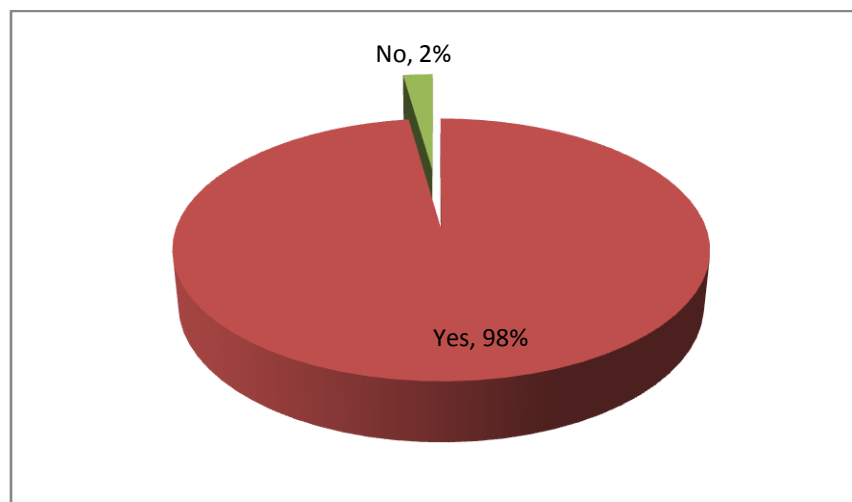
Fig 4.2: Living with Family

Majority of the participants are living with family (98%) and the rest of them don't live with family (2%).

4.3 Knowledge about Osteoporosis
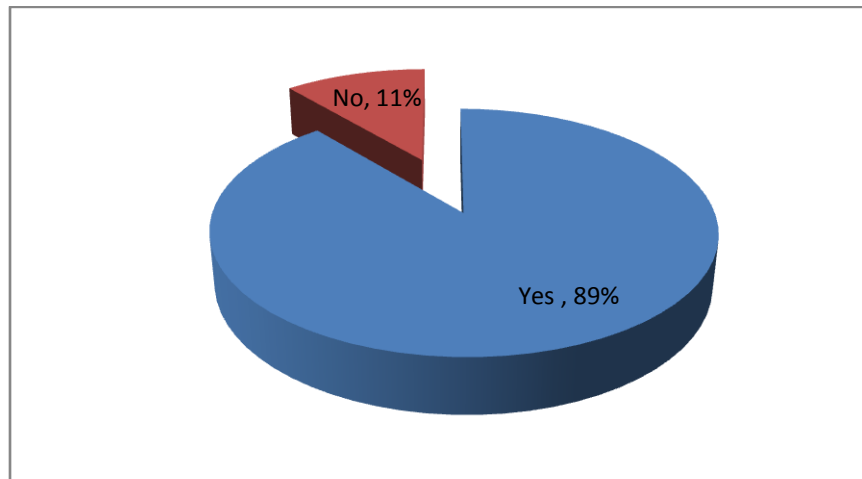
Fig 4.3: Knowledge about Osteoporosis

Among 270 participants 89% know about Osteoporosis and the rest of them 11% don't know even the term.

4.4 Family History of Osteoporosis
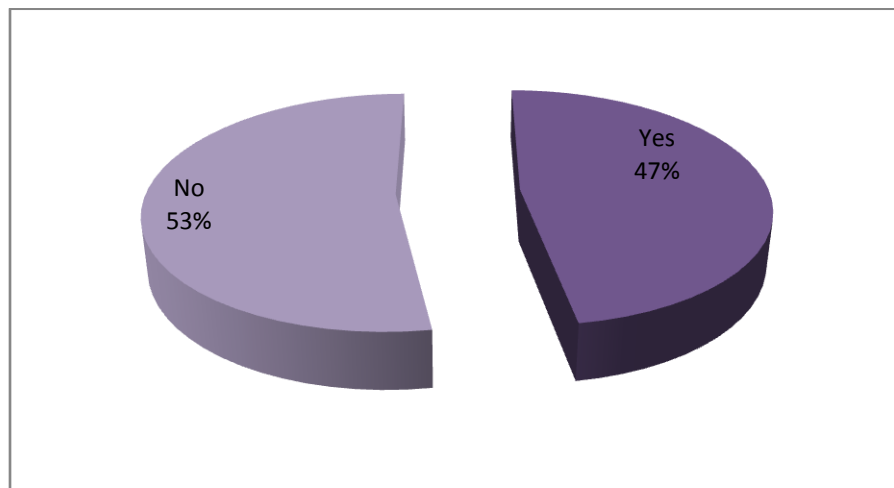
Fig 4.4: Family History of Osteoporosis

In this study, total 251 housewives participated and among them 47% of housewives have a family history of OP and 53% do not have that history, non participants (19) do not know if they have family history of osteoporosis or not.

4.5 Maternal History of Osteoporosis
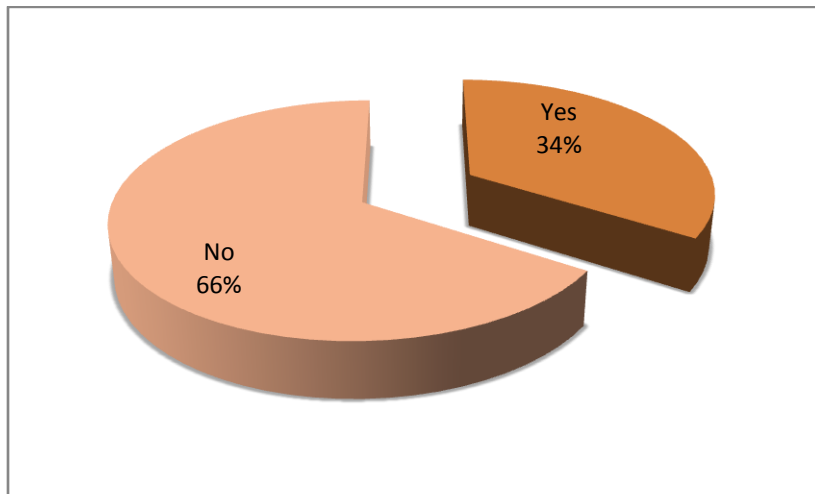
Fig 4.5: Maternal History of Osteoporosis

In this study 250 housewives took part and among them 34% having maternal history of osteoporosis and 66% are not having maternal history of OP, non participants (20) do not have any idea.

4.6 Maternal History of Fracture
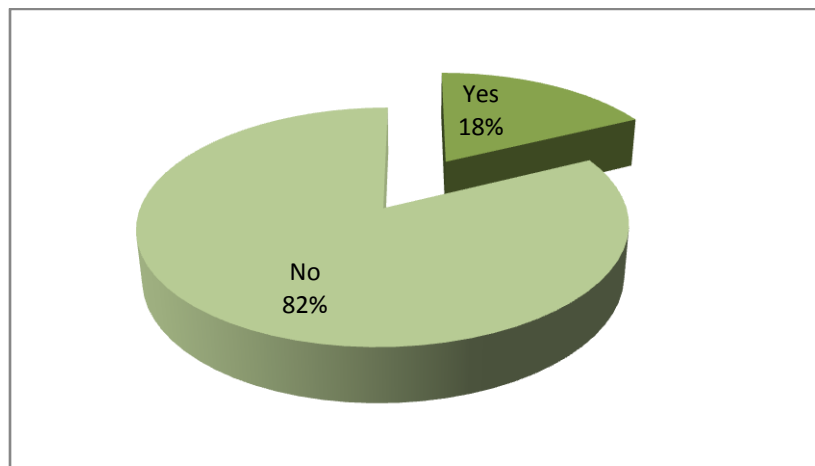
Fig 4.6: Maternal History of Fracture

Total 248 housewives responded on this question and among them, 18% having a maternal history of fracture, 82% are not having maternal history of fracture and non respondents are not aware about this.

4.7 Knowledge about Major Types of Osteoporosis
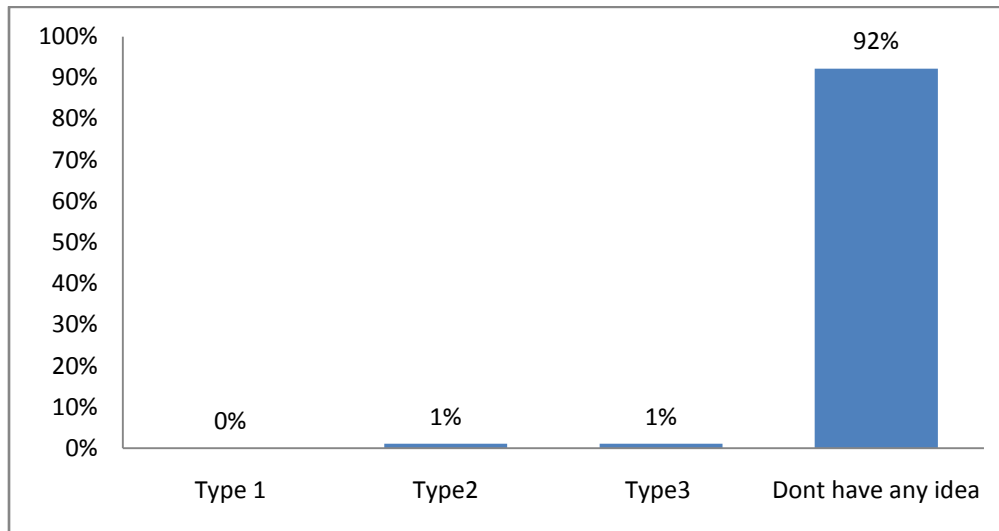
Fig 4.7: Knowledge about Major Types of Osteoporosis

Among all, 92% have no idea about the types of osteoporosis, 1% know about type 2 and 1% know about type 3 osteoporosis.

4.8 Diagnosed with Bone Problem
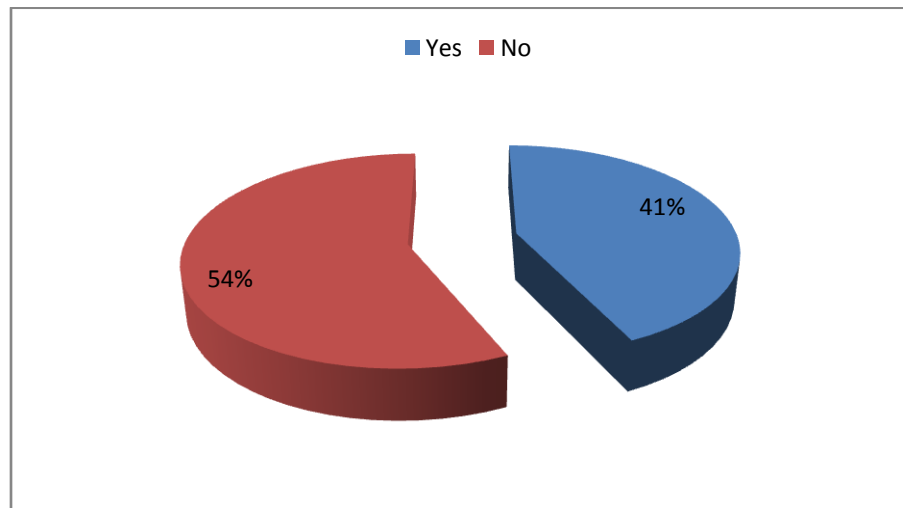
Fig 4.8: Diagnosed with Bone Problem

Among the participants, 41% have diagnosed with bone problem, 54% have not diagnosed yet with bone problem.
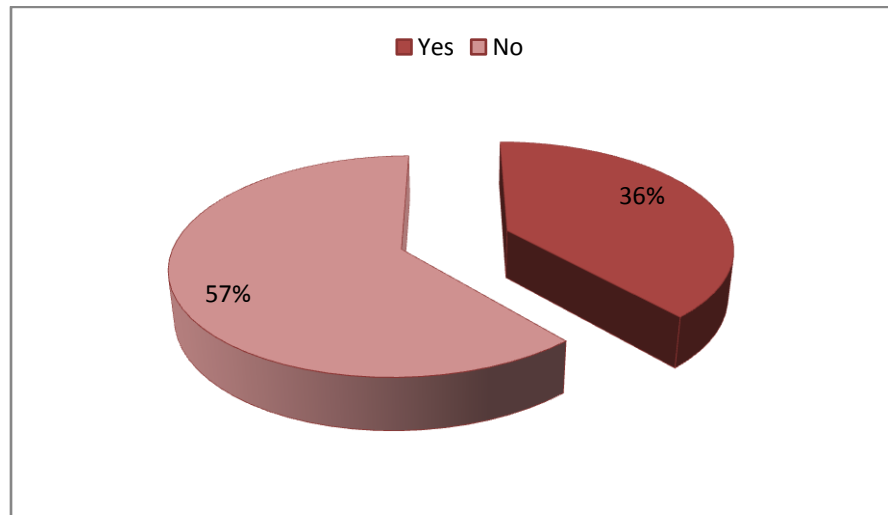
4.9 Postmenopausal graph

Fig 4.9: Postmenopausal graph

Among all the participants, 36% are postmenopausal and 57% are not.

4.10 Years since Menopause
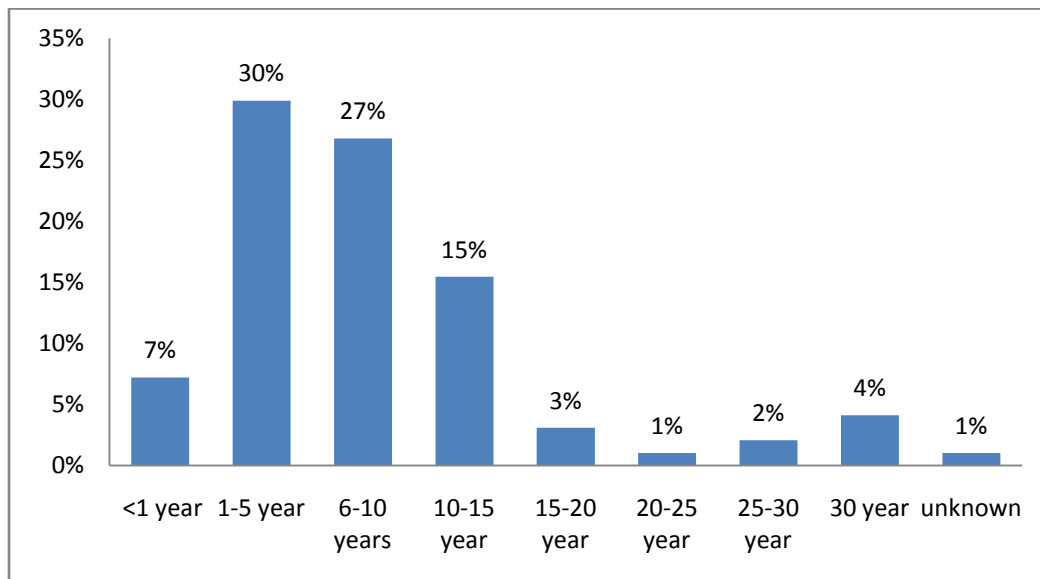
Fig 4.10: Years since Menopause

Among all 270 housewives, 97 were postmenopausal, where 30% are in postmenopausal condition for 1-5 years, 27% are in same condition for 6-10 years, 15% are for 10-15 years.

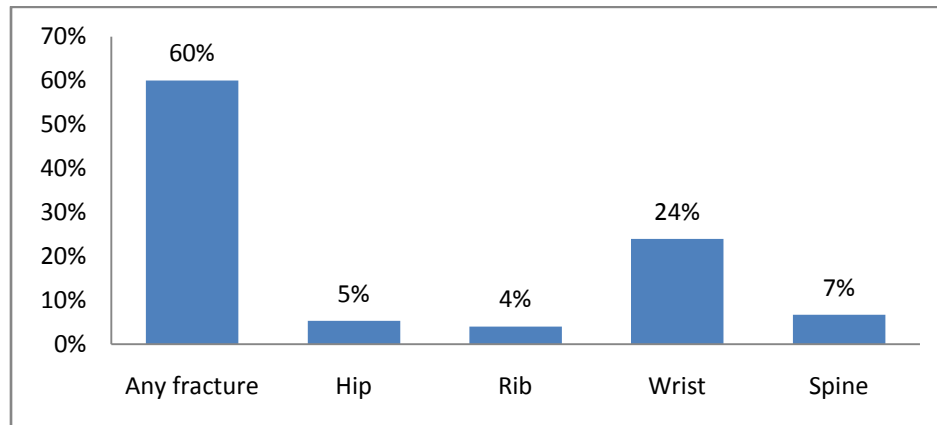## 4.11 History of fractures since age of 45

Fig 4.11: History of fractures since age of 45

Among the participants (75), aged above 45, 60% participants have any fracture. Among others, 24% have wrist fracture, 5% have hip fracture. Nonparticipants were 195 and did not have any fracture since age of 45.
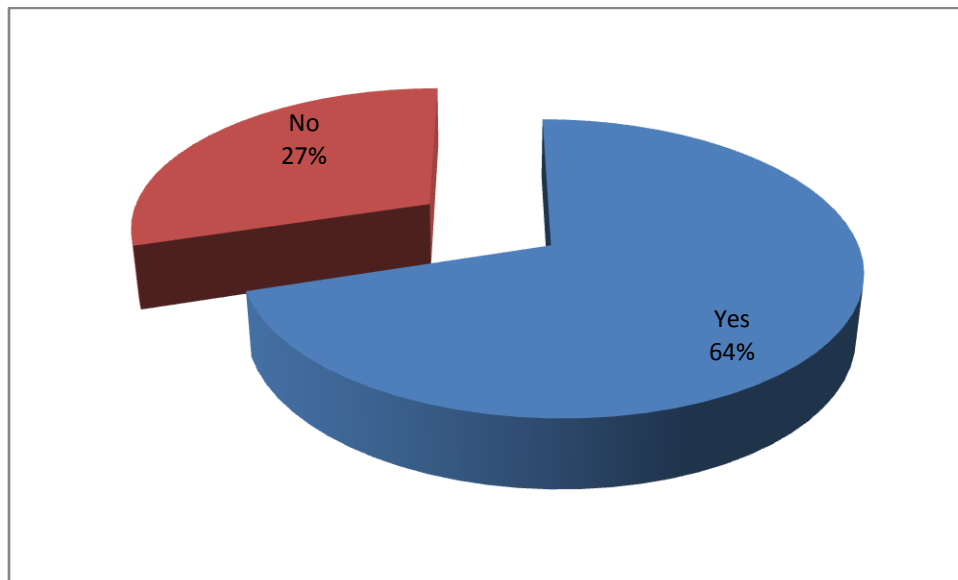
4.12 Concerned about Getting Osteoporosis

Fig 4.12: Concerned about Getting Osteoporosis

It was seen in our study that among the participants 64% are concerned about osteoporosis and 27% are not concerned.

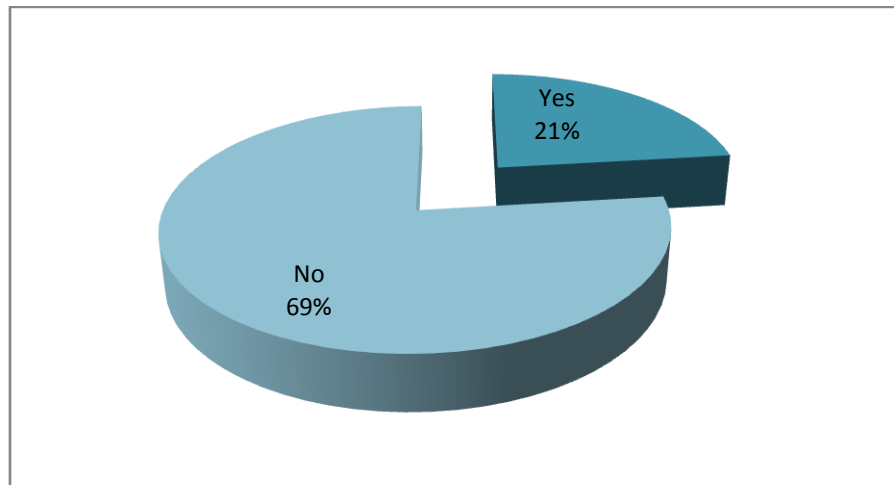**4.13 Patients suffering from Osteoporosis**

Fig 4.13: Patients suffering from Osteoporosis

Among all, 21% suffering from osteoporosis, 69% are not suffering from Osteoporosis.

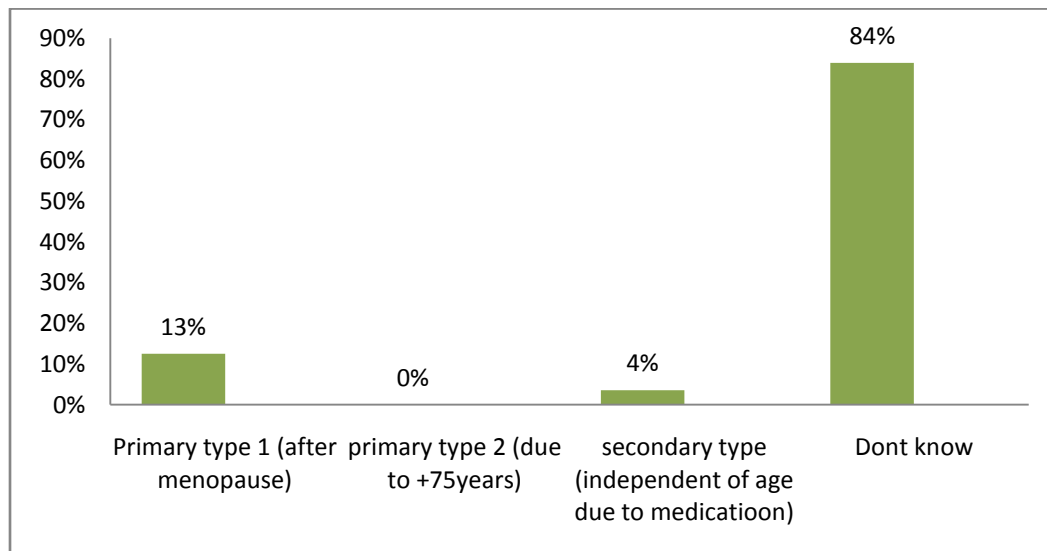**4.14 Type of Osteoporosis study subjects**

Fig 4.14: Type of the osteoporosis

Among all 56 participants suffering from osteoporosis, 84% have no idea about types of osteoporosis, they are suffering from.

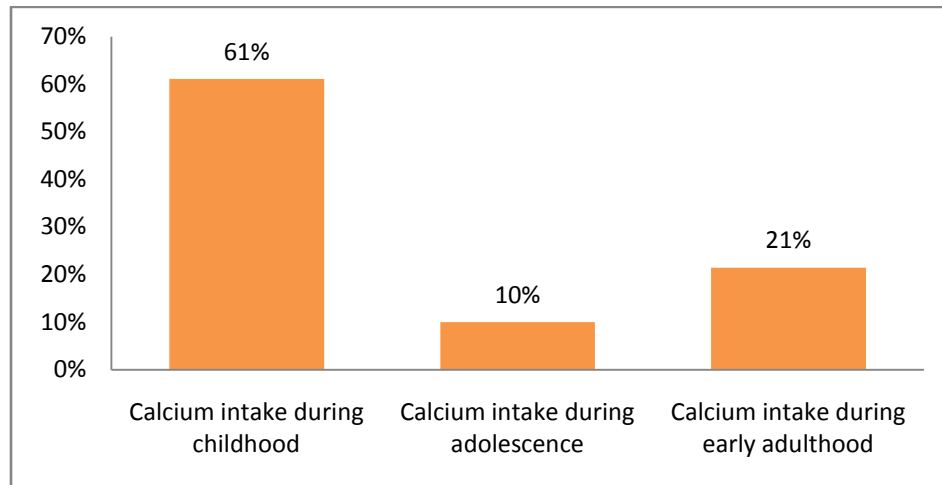**4.15 Knowledge about Main Factors That Influence Bone density**

Fig 4.15: Main factor that Influence Bone Density

Among all, most participants, 61% people think that calcium is mostly needed in childhood for preventing Osteoporosis. Only 10% think that calcium is highly needed in adolescent.

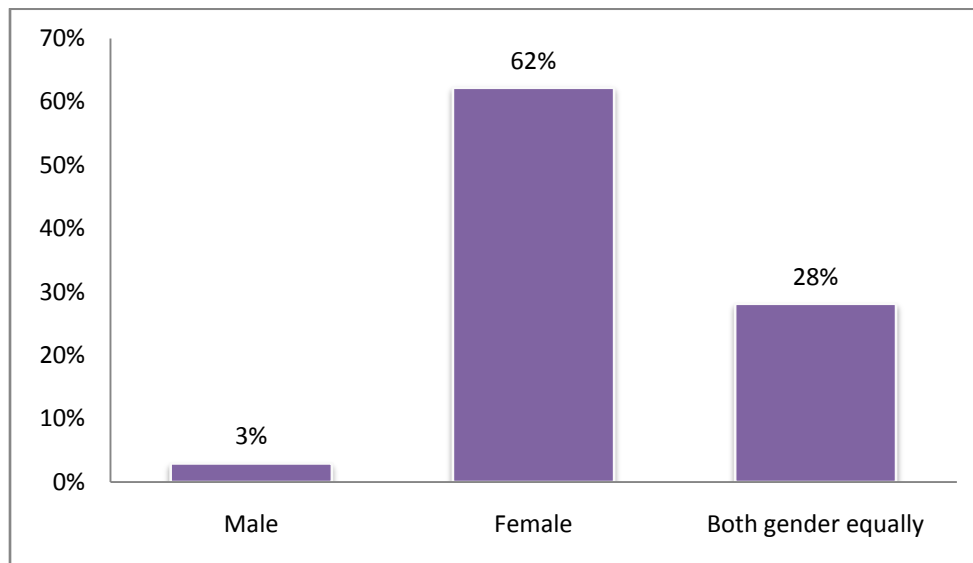**4.16 Chances of having osteoporosis Believed by the Subjective**

Fig 4.16 Chances of having osteoporosis Believed by the Subjects

Among the population, 62% think that osteoporosis is more prone to female and 28% think that both genders equally are prone to osteoporosis.

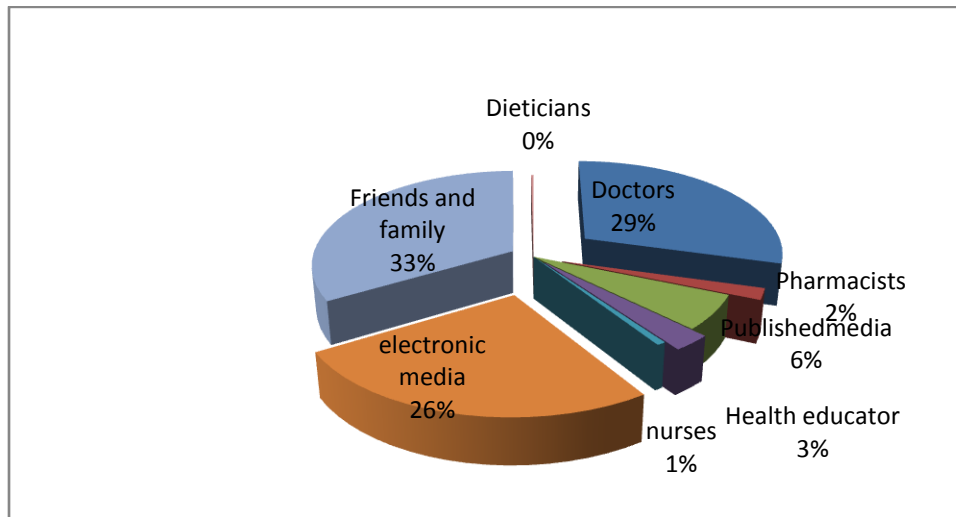**4.17 Sources of Knowledge of Osteoporosis**

Fig 4.17: Sources of Knowledge of Osteoporosis

Among the participants 29% have known about osteoporosis from doctors, 33% from friends and family, 26% from electronic media, 6% from published media and so on.

Table 4.1: General Knowledge about healthy bones

General Knowledge	Yes (%)	No (%)
Bones are living tissue that need physical activity to be healthy and happy.	80	14
Regular physical activity helps body to use calcium more efficiently.	76	19
Physical activity can help keep one from loosing muscle during diabetic to loose weight.	23	69
It is difficult to get the needed calcium from vegetable alone.	79	16
Adolescents need more calcium than children age 6.	21	34
Drinking too much cola beverage can be harmful to bone.	35	58
Drinking to much coffee can be harmful for bones.	66	27
Cigarette smoking can lead to osteoporosis.	42	51
Osteoporosis is a preventable disease.	71	23
Knowledge about the risk factors of osteoporosis.	56	38

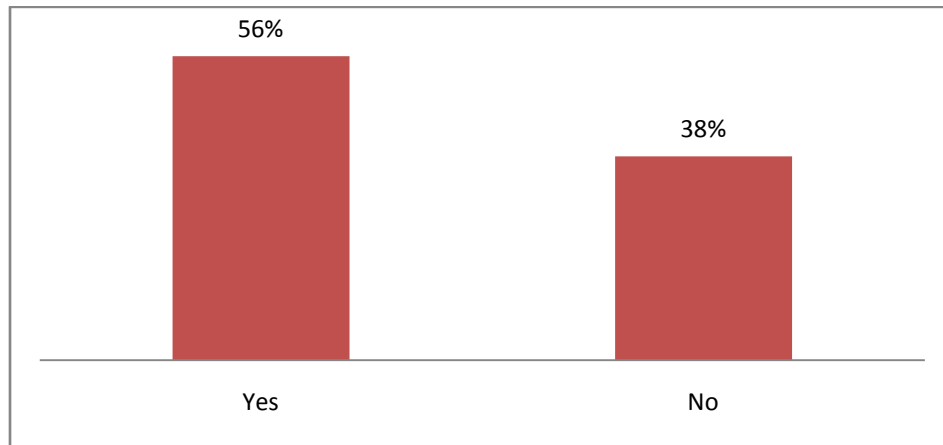**4.18 Knowledge about Risk Factors of Osteoporosis**

Fig 4.18: knowledge about Risk Factors of Osteoporosis

In the survey, it was found that 56% participants know one or more risk factors of osteoporosis. Remaining 38% do not know even a single risk factor.

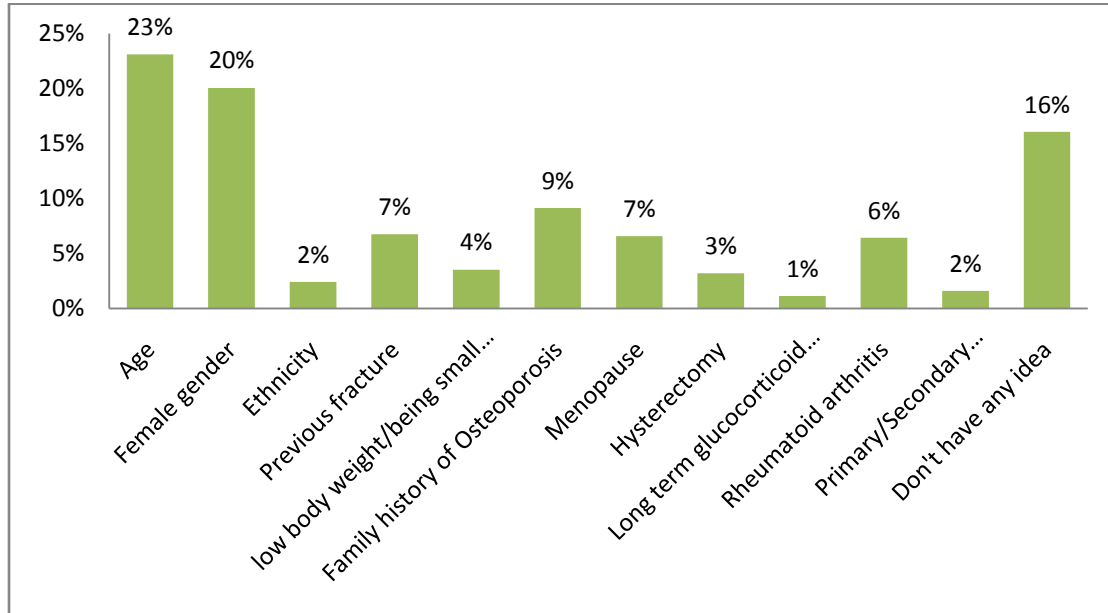**4.18.1 Knowledge about Uncontrollable Risk Factors of Osteoporosis**

Fig 4.18.1: Uncontrollable Risk Factors of Osteoporosis

In the survey it was seen that among the uncontrollable risk factors most of the patients had selected age (23%), female gender (20%) as the uncontrollable risk factor among all options.

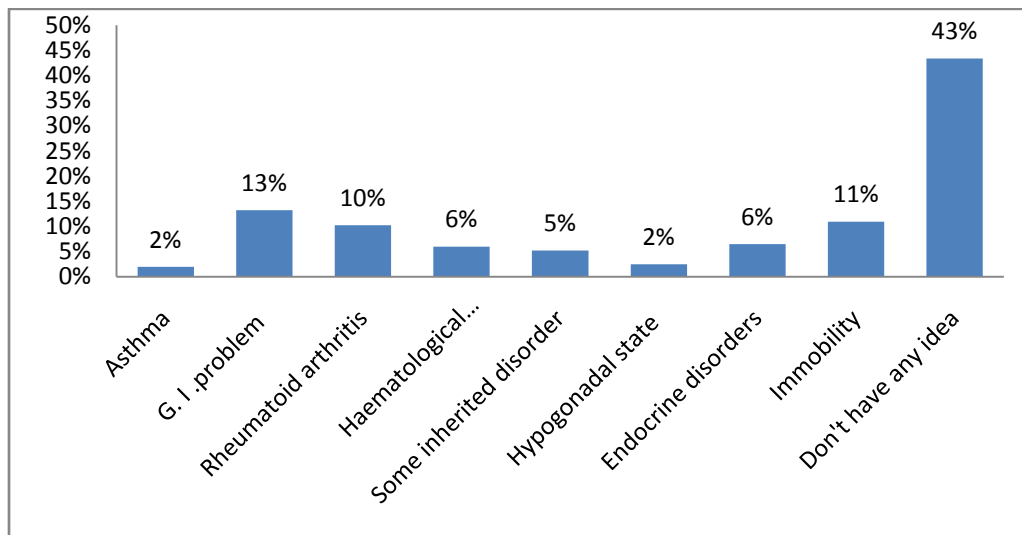**4.18.2 Knowledge about Disorder that Affect the Skeleton**

Fig 4.18.2: Knowledge about Disorders that Affect the Skeleton

Among the population most of them round 42% do not have any idea about the disorders that affect the skeleton.

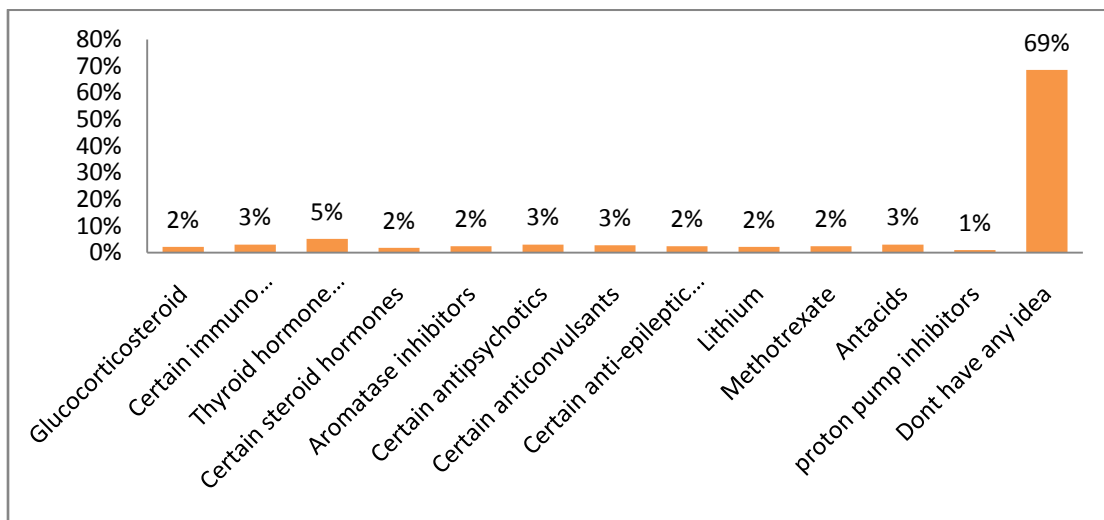**4.18.3 Knowledge about Medical Treatment Affecting Bone Health**

Fig 4.18.3: Knowledge about Medical Treatment Affecting Bone Health

It was seen that most of the patients 69% do not have any idea about the medical treatment affecting bone health.

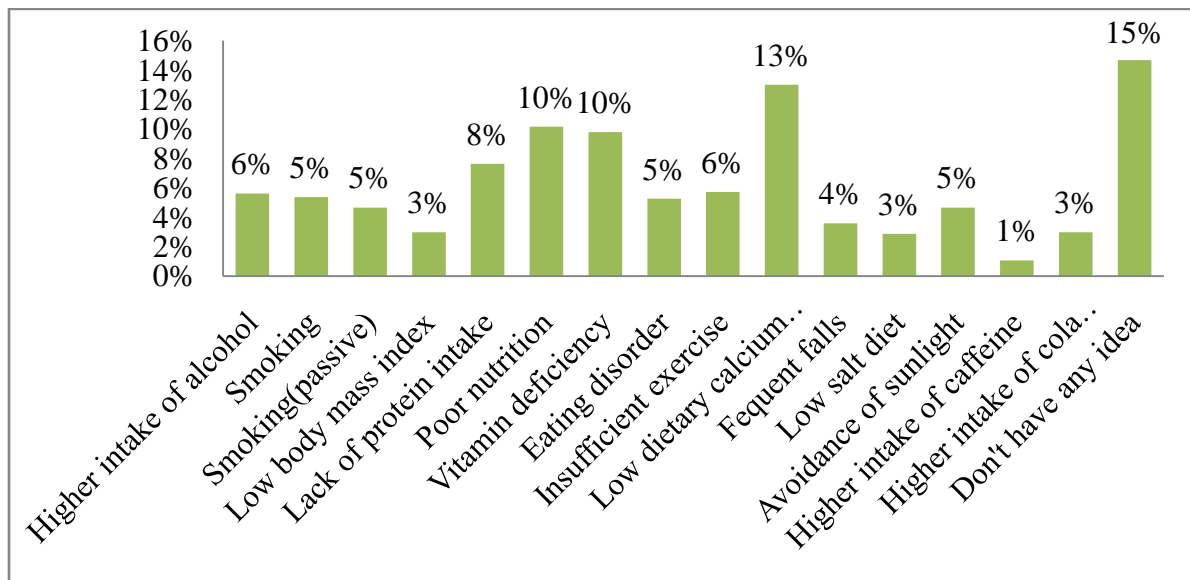**4.18.4 Knowledge about Controllable Risk Factors**

Fig 4.18.4: Knowledge about Controllable Risk Factors

Among all the participants, 13% thought that low dietary calcium intake, poor nutrition (10%), vitamin deficiency (10%) are the controllable risk factors mostly of osteoporosis. 15% had no clear idea about them.

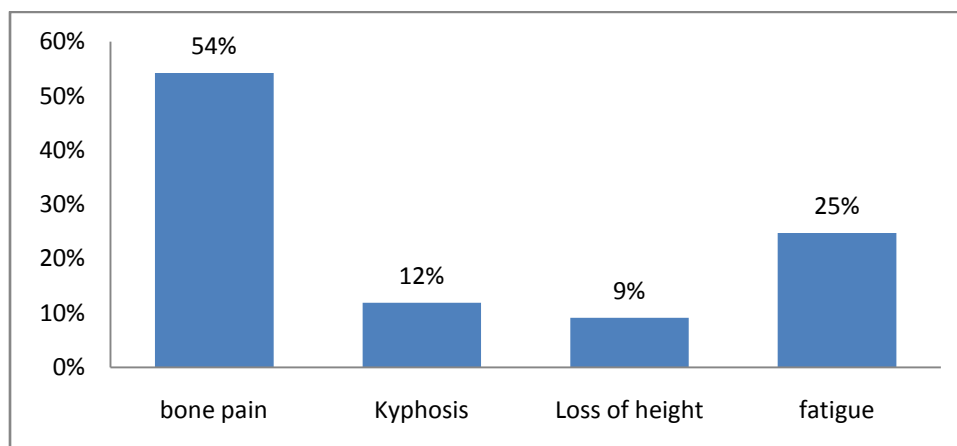**4.19 Knowledge about Osteoporosis Sign and Symptoms**

Fig 4.19: Knowledge about Osteoporosis Sign and Symptoms

Among the housewives, 54% picked up bone pain as the sign and symptom of osteoporosis and only 9% picked up loss of height.

4.20 Knowledge about Complications of Osteoporosis
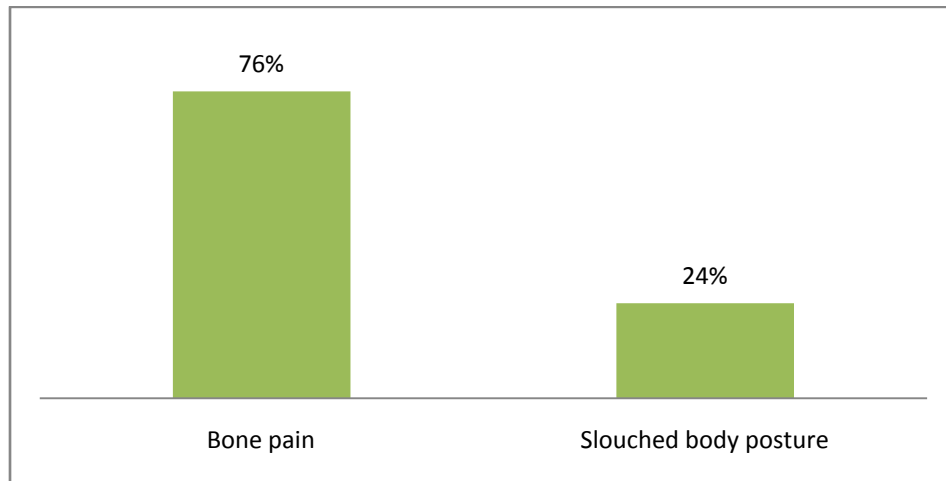

Fig 4.20: Knowledge about Complications of Osteoporosis

Among the population 76% thought bone pain as the major complication of osteoporosis.

4.21 False Belief regarding the Prevention of Osteoporosis
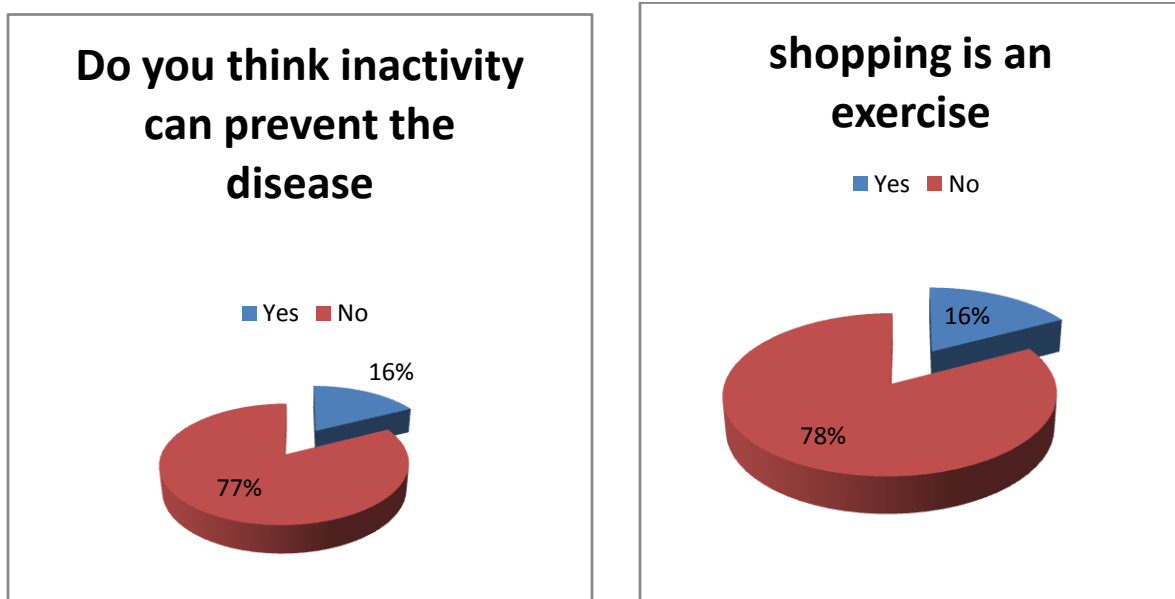

Fig 4.21: False Belief regarding the Prevention of Osteoporosis

Among the population 77% thought inactivity can't prevent the disease and 78% didn't consider shopping as an exercise.

Table 4.2: Preventive Measures of Osteoporosis

Preventive Measures	Never (%)	Sometimes (%)	Always (%)
Direct exposure to sunlight for more than 30 minutes a week.	75	15	3
Reading materials about osteoporosis	62	20	1
Checking bone mass density	65	21	6
Adequate calcium consumption (more than 1200 mg)	15	51	28
Adequate osteoporotic exercise (more than 90 minutess a day)	40	25	10
Ensure appropriate intake of protein in the diet	4	35	56
Appropriate supply of vitamin C	5	25	62
Appropriate supply of vitamin D	5	30	60
Reasonable physical exercise	3	46	9

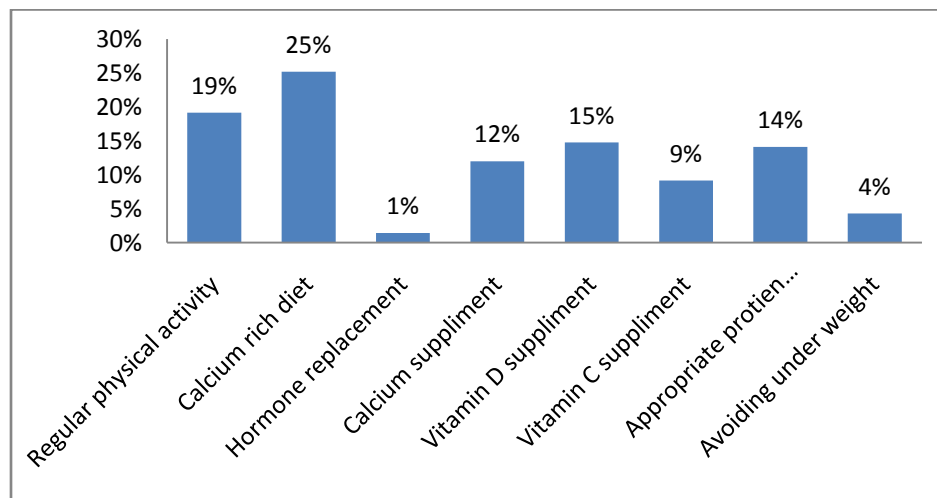**4.22 Knowledge about tools that can prevent osteoporosis**

Fig 4.23: Knowledge about tools that can prevent osteoporosis

Among population majority 25% states that calcium supplement is the main tool that can prevent osteoporosis.

4.23 Frequency of Discussion about Osteoporosis with Family
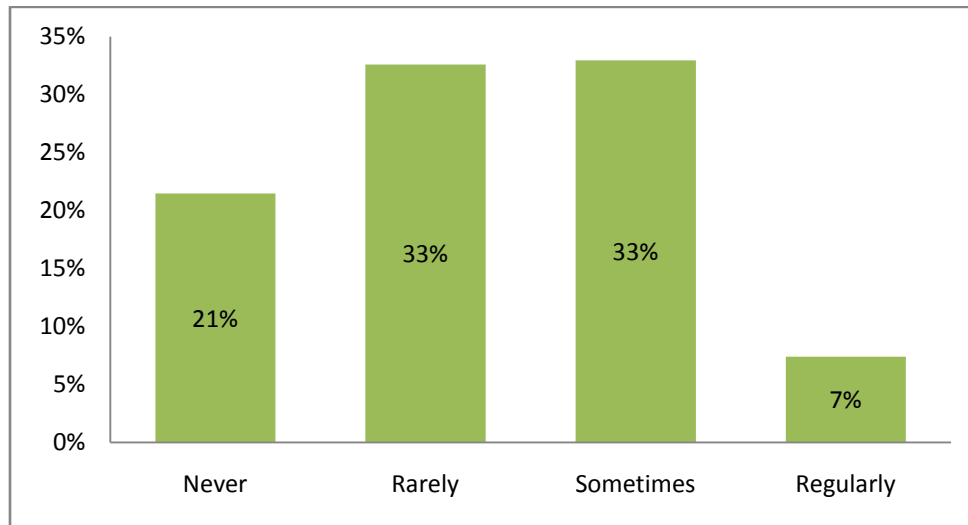
Fig 4.23: Frequency of Discussion about Osteoporosis with Family

Among 270 housewives majority of them around 33% sometimes and 33% rarely discuss with family about osteoporosis, only 7% discuss regularly.

4.24 Frequency of Discussion about Osteoporosis with Health Care Professional
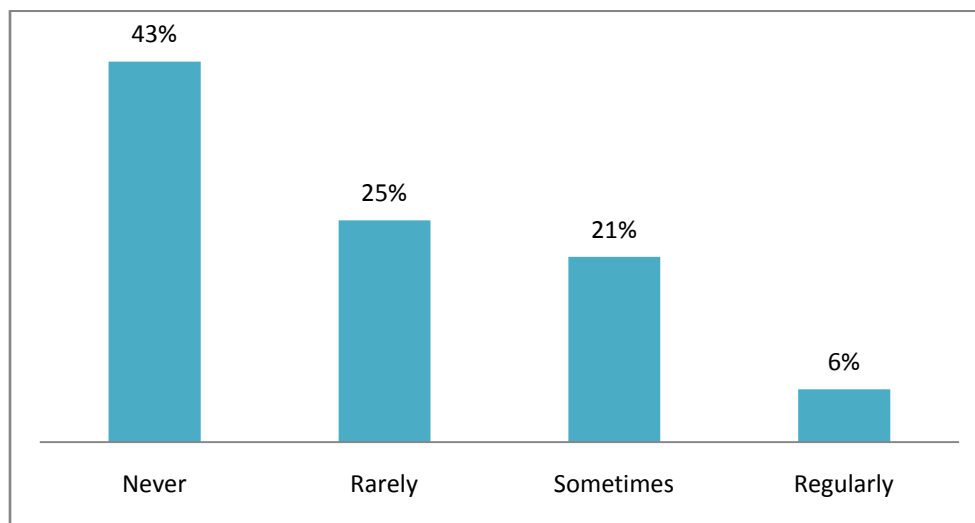
Fig 4.24: Frequency of Discussion about Osteoporosis with Health Care Professional

Among the participants, around 43% never discuss about osteoporosis with health care professionals, only 6% discuss regularly.

4.25 Knowledge about Diagnostic Procedure of Osteoporosis

Fig 4.25: Knowledge about Diagnostic Procedure of Osteoporosis

Among the population 48% do not know how to diagnose osteoporosis. Only 45% having the knowledge about diagnosis and from them 96% selected X-ray as diagnostic procedure.

4.26 Percent of Population Using Estrogen
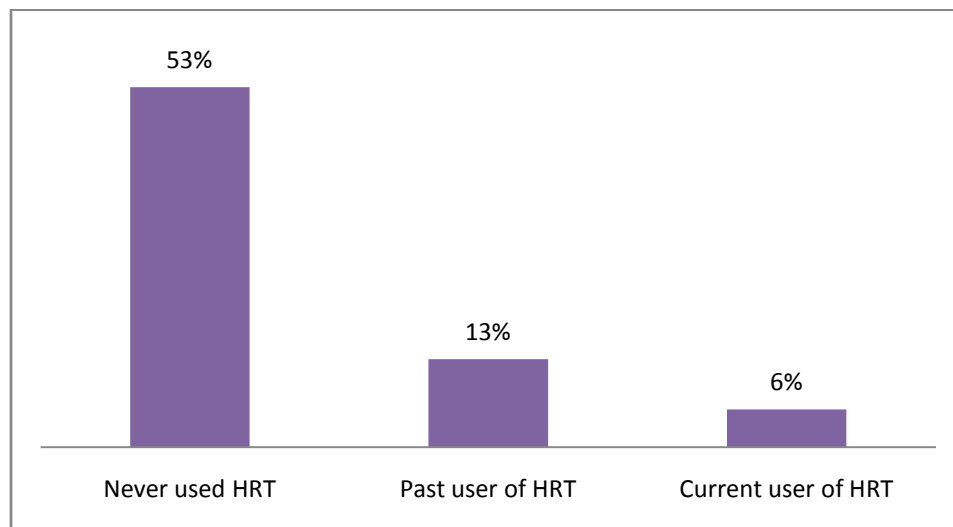
Fig 4.26: Percent of Population Using Estrogen

Among the population 53% never used HRT, 13% were past user and 6% are current user of HRT.

4.27 Types of Medications Currently Using for Osteoporosis

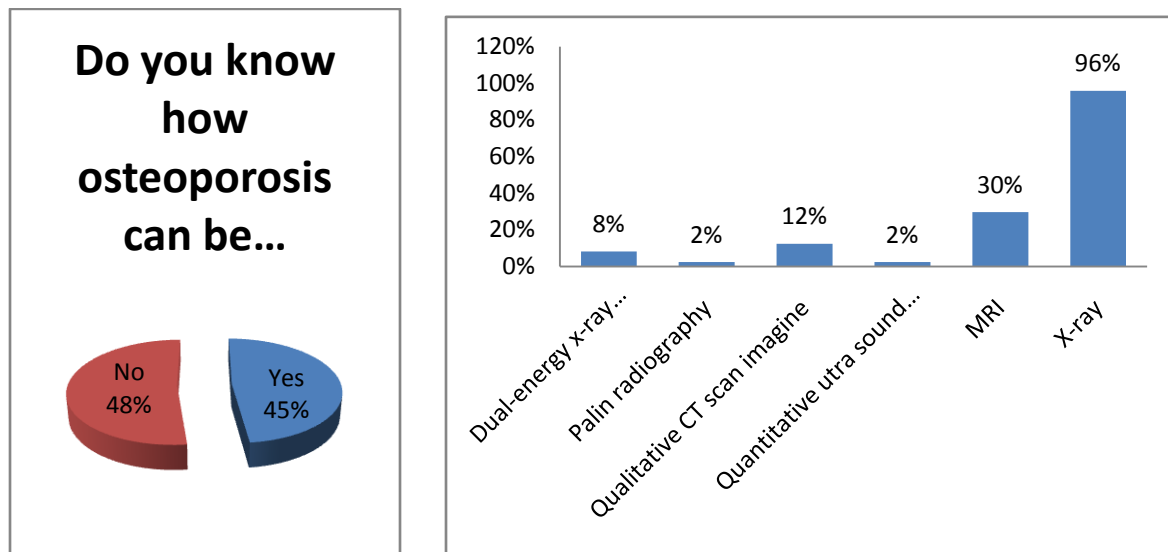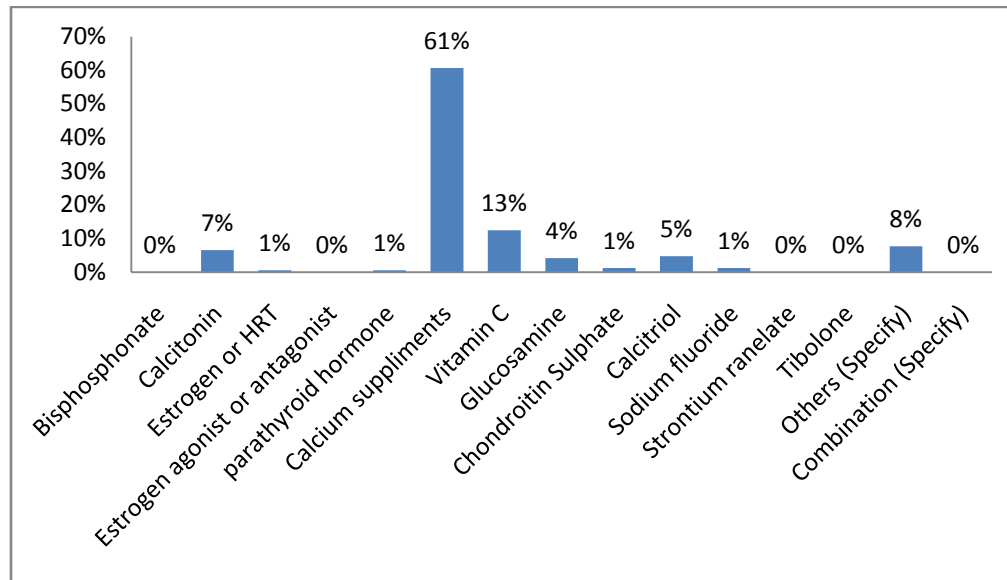

Fig 4.27: Types of Medications Currently Using for Osteoporosis

Among all, 61 % are using calcium supplement currently on osteoporosis. Vitamin C is also used by 13% respondents.

4.28 Types of Medications Currently Using by Subjects
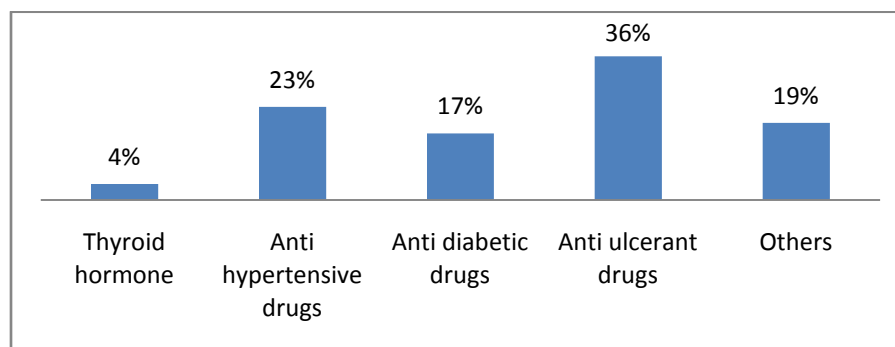
Fig 4.28: Types of Medications Currently Using by Subjects

Among the respondents, 36% are using anti ulcerant. 23% antihypertensive, 17% anti diabetic and 19% are taking other medications. Other medication includes vitamin complex, antihistamin, NSAIDs, steroids etc.

Chapter Five

Discussion & Conclusion

5.1 Discussion

Osteoporosis is most common physiological disorder of elderly people mostly women in Bangladesh. The basic level of osteoporosis knowledge of the population about diagnostic tool, screening, prevention, diagnosis, treatment modalities are important for controlling osteoporosis. Fractures are major risks of osteoporosis. The study was performed on 270 housewives. Among them 6% were illiterate, 25% will be there in the graduate. Among them majority 25% were graduate, 24% were up to college level, 23% were up to secondary level. Only few of them were illiterate.

Most of them only know the term Osteoporosis (89%), but they do not have clear concepts about risk factors, diagnosis, treatments, factors influencing disease etc. 92% respondents do not know the types of osteoporosis. Thought 43% have diagnosed with bone problem, they have lack of knowledge about diagnosis procedure. About 64% housewives are concerned about getting osteoporosis, which is higher than compared to the South Asian women by Midi Tsai (Tsai, 2008).

Only 10% participants said that calcium is needed the most for adolescent. About 90% of them, know the influence of calcium in bone homeostasis, which is similar to the result of study conducted on undergraduate pharmacy students in Bangladesh in 2013 by Riaz Uddin, Naz Hasan (Uddin et al., 2013). This is a preventable disease, said by 71% respondents. Among the risk factors, respondents mostly are familiar with age (23%) and female gender (20%). Other risk factors are not considered by them as risk factors, this result is similar with the research study conducted in Mumbai in 2010 among women by Patill, 2015). Most of them have no clue about other disorders affecting bone health. Some are also unknown about the medical treatments affecting bone, unaware of the seriousness of the disease. But the research study on Pakistani women revealed they considered osteoporosis as a serious disease in 2015, which differs from our result (Sadia, 2015).

Those who have standard knowledge about osteoporosis, get their knowledge from different sources. The result of the study indicates that among the population, 33% get the knowledge from friends and family, 29% from doctors, 26% from electronic media. The age range of the respondents are mostly between 30-55. Their knowledge were irrespective to their age, which

does not signify with the result of study on Pakistani women in tertiary care hospital, conducted by Mehmood Riaz, where young girls had poor knowledge than the older women (Riaz et al., 2008).

In the following study, most people had not experienced fracture, only 17% had small fractures since age of 45. Calcium rich diet and vitamin D is very important for preventing fracture. Calcium and vitamin D combination is very effective and 61% participants take calcium supplement as a preventive measure of osteoporosis. This result signifies with the study on general population (male and female) of India conducted by Sanjay Damu, which stated that older people take calcium and vitamin D after certain age (Jadhav, 2016). Our study also shows that, 51% take adequate calcium sometimes, 28% take it regularly. They do not go for osteoporotic exercise, 56% takes protein regularly. 62% take vitamin C regularly, 58% take vitamin D regularly.

Only 30% housewives discuss about the disease with family regularly, 6% with physician regularly. DEXA in spite of being the most effective diagnostic tool for osteoporosis, 24% know about this, 49% have marked X-ray as the most common method for diagnosis. Calcium supplement was found the most common medication (61%).

Physical activity helps maintain mobility, physical functioning, BMD, muscle strength, resulting prevention of falls and fractures in elderly. In our study, 16% people thinks that inactivity can prevent the disease.

Smoking and alcohol are one of the major causes of hip fracture. But in our study, housewives were not sure about the bad impacts of smoking, alcohol or cola beverage on bone. In Addition, all housewives were non-smoker. 42% assume that smoking can lead to bone damage.

5.2 Conclusion

In the conclusion, the results of present study revealed low levels of awareness regarding osteoporosis risk factors, its screening, diagnosis, therapeutic approaches among people at higher risk. The knowledge is very low among educated people also. Some are even unware about the term osteoporosis. Due to their educational lacking, unconsciously they remain inactive for reducing pain rather than practicing physical activities. Among the huge population of Bangladesh, collected data are not adequate to represent the whole county. So the result may not be fully appropriate. But awareness would lead to early detection of disease and enhance their knowledge. So training programs, increasing public awareness are needed to help them preventing osteoporosis. Efforts should be made by both government and non-government agencies to improve knowledge.

Chapter Six

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