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PREVALENCE AND CORRELATES OF OSTEOPOROSIS AMONG POSTMENOPAUSAL WOMEN IN ISLAMABAD AND RAWALPINDI, PAKISTAN: A FOCUS ON BONE MINERAL DENSITY

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ABSTRACT

Pakistan has an aging population, with an associated increase in the prevalence of chronic diseases. Postmenopausal osteoporosis is of particular concern because it leads to an increased risk of fractures, with subsequent negative impacts on health in older women. A descriptive cross-sectional study was designed to determine the prevalence of osteoporosis with BMD among post-menopausal women of twin cities. A total of 200 post-menopausal women of different age groups (40-70) were scanned using BMD data from DEXA scan. Out of 200 participants, 112 had Osteoporosis. The mean age of the participants was 55.09 years with S.D 6.688. Osteoporosis was present in 112 (56%) and osteopenia in 46 (23%) of the participants and only 42(21%) females had normal BMD. Study revealed that as age increases post-menopausal females had greater prevalence of osteoporosis due to low bone mineral density. Among all participants, samples of age group 60-70 years had higher prevalence of osteoporosis than any other age groups.
Keywords: *Osteoporosis, Estrogen, Osteopenia, Menopause, Primary health care*

INTRODUCTION

Health issues are opposed by mankind all over the world. The technologically advanced world, nonetheless, gives the impression of dealing with the disease and disease related problems in a deliberate way than the developing countries. Of course, a lot of it is to do with resource handiness and technical capacity, but the overall level of awareness, education and early diagnosis of the common people plays an important role in challenging, holding and handling the health threats and hazards. Quantification of disease burden caused by various risks and initial diagnosis of ailment informs prevention by providing an account of health loss different to that provided by a disease-by-disease analysis (Fatima, 2009). One specific disease that is required to be studied and diagnosed in that specific perspective is the metabolic disease called Osteoporosis that is distressing voluminous people around the world. With growing age, the prevalence of osteoporosis is increasing at an unending pace. Osteoporosis increases the fractures and leads to morbidity, mortality and diminished quality of life (Habib, 2015).

Osteoporosis, a multifactorial systemic skeletal disease, is caused by low bone mineral density (BMD) and micro-architectural worsening of bone tissue resulting in bone fragility (Sandhu &Hampson, 2011). It is a systemic skeletal disorder categorized by reduced bone mineral density and a micro architectural deteriorating of one tissue, with a increase in bone brittleness and susceptibility to fracture (Gass & Dawson-Hughes, 2006).

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World Health Organization (WHO) demarcated osteoporosis as the T-score of less or equal to -2.5 measured by DEXA (dual-energy x-ray absorptiometry) (Kanis, 2006; Shuler, Conjeski, Kendall, & Salava, 2012).

Examining the Link between Osteoporosis and Menopause

Research has established a direct correlation between the decline of estrogen levels after menopause and the development of osteoporosis. Following menopause, the breakdown of bone tissue surpasses the formation of new bone, leading to a net loss of bone mass. Premature menopause (before age 40) and prolonged periods of hormonal imbalance, characterized by infrequent or absent menstrual cycles, can exacerbate bone loss. As women age, multiple factors contribute to decreased bone mineral density (BMD) (Ahmadi, 2007). Inadequate calcium intake is a significant contributor to the rapid decline in bone mass post-menopause. Insufficient calcium consumption leads to demineralization and mobilization of calcium from bones, resulting in decreased bone mass and increased risk of osteoporosis (Peacock, 2008). Older adults, particularly women, are prone to decreased calcium intake and absorption. Estrogen plays a crucial role in regulating calcium levels by stimulating intestinal absorption and renal reabsorption. Furthermore, estrogen promotes bone mineralization, which is compromised after menopause, contributing to accelerated bone loss (Adachi, 1997).

TYPES OF OSTEOPOROSIS

There are three main types of osteoporosis:
- Primary Osteoporosis
- Secondary Osteoporosis
- Idiopathic Osteoporosis

Primary Osteoporosis

Osteoporosis can be categorized into two primary forms: primary and secondary. Primary osteoporosis occurs naturally, without any underlying medical condition or medication-induced cause. In contrast, secondary osteoporosis is triggered by an underlying disease, disorder, or medication. Interestingly, more than 95% of osteoporosis cases in women are primary, predominantly affecting postmenopausal women and older men. The primary cause of osteoporosis, particularly the rapid decline observed during menopause, is the decline in estrogen levels. Consequently, low estrogen levels are strongly associated with osteoporosis in both men and women. Estrogen deficiency accelerates bone breakdown, resulting in rapid bone loss. Furthermore, inadequate calcium intake or low vitamin D levels exacerbate bone loss, making estrogen deficiency even more detrimental (Bubshait, 2007).

Secondary Osteoporosis

In contrast to primary osteoporosis, secondary osteoporosis accounts for a relatively small proportion of cases, affecting less than 5% of women and approximately 20% of men with osteoporosis. Various medical conditions can contribute to the development of secondary osteoporosis, including chronic kidney disease, hormonal disorders (such as Cushing's disease, hyperparathyroidism, and diabetes mellitus), and multiple myeloma. Additionally, chronic diseases like rheumatoid arthritis can also play a role. Certain medications can also increase the risk of osteoporosis, including progesterone, corticosteroids, thyroid hormones, chemotherapy agents, and antiseizure medications. Furthermore, lifestyle factors such as excessive alcohol or caffeine consumption and cigarette smoking can also contribute to osteoporosis (Bubshait, 2007).

Idiopathic Osteoporosis

Idiopathic osteoporosis is a rare and enigmatic form of the condition, characterized by an unknown cause. This type of osteoporosis affects individuals who would not typically be expected to develop the condition, including pre-menopausal women, men under the age of 50, and children and adolescents. Notably, these

individuals typically have normal hormone and vitamin D levels, with no apparent underlying reason for their weakened bones (Bubshait, 2007).

DIAGNOSTIC METHODS OF OSTEOPOROSIS

Osteoporosis can be diagnosed based on clinical history alone when a bone fracture occurs due to low-intensity trauma, presenting with characteristic symptoms (Kanis et al., 2004). However, in some cases, imaging tests may be necessary to confirm a decrease in bone mineral density (BMD) or to establish a definitive diagnosis. BMD is the standard measure for diagnosing osteoporosis (Johnson & Dawson-Hughes, 2011). Two commonly used diagnostic methods for osteoporosis are Dual-Energy X-ray Absorptiometry (DEXA scan) and ultrasonography.

MENO-PAUSE AND ITS IMPACT ON BONES

Increased risk of abrupt and unexpected fractures is caused by osteoporosis, a silent disease that weakens bones. The disease habitually progresses without any symptoms or pain. Primary osteoporosis mainly occurs in women 10–15 years after menopause and in elderly men around 75–80 years old as BMD decreases with age (Burge 2007). Normal menopause is at least 12 uninterrupted months of amenorrhea not due to physiological and pathologic causes as defines by WHO. The mean age of accepted menopause is 51 years in developed nations, compared to 48 years in poor and non-developed nations as shown in statistical data (Sapre & Thakur, 2004). In some countries menopause age is 45 years and in some countries of Asia the mean age of menopause is 40 years. With the average life span protracted to 70 years, most women will spend more than one third of their lifetime beyond the menopausal changeover. Besides, the proportion of menopausal women is rising since the aging population is expanding rapidly. Consequently, the menopausal women health becomes a leading concern worldwide. Menopause is a natural physiological phenomenon resulting from primary ovarian failure secondary to apoptosis or programmed cell death. Ovarian function decays with age. The beginning of menopause structures the decreasing production of estradiol, as well as increasing levels of follicle-stimulating hormone (FSH) (Bener 2009).

In menopausal women Osteoporosis is the most prevalent disease and is sturdily related with low quality of life and we concentrate on postmenopausal osteoporosis in this review. BMD decreases with age; thus, primary osteoporosis mainly occurs in women 10 to 15 years after menopause and elderly men around 75 to 80 years old. With fast aging population, osteoporosis and osteoporosis-related fractures are becoming important public health issues that result in a considerable economic burden on health service resources (Clark 2009).

In Pakistan, the overall prevalence of Osteoporosis was found to be 16%. Some studies in Pakistan have demonstrated that 75.3% of post-menopausal women are predisposed to osteoporosis with 55% within the age of 45-55year (Akhter, Baloch, Mohammad, Orfi & Ahmad, 2004).

METHODOLOGY

Measures and Methods

A cross-sectional study design is used to define the frequency of Osteoporosis with BMD (Bone Mineral Density) among post-menopausal womenof Rawalpindi, Islamabad, Pakistan. The study duration was six months from January 2023 to July 2023. The population under study was all the post-menopausal women in the Rawalpindi, Islamabad. The study population in the study included all the women (aged between 40-70 years) who meet the inclusion criteria of study and visited the Centre for DEXA scan within study duration of 6 months and agreed to participate in the study

The data that was used in our study was secondary data so there was no need to determine the sample size using any formula as it was stated by Linden, Ariel, (2015) in his article "Secondary analysis and national survey datasets" that "In the case of secondary data analysis, the sample size is pre-determined".

DEXA scan results for BMD and basic demographic details like name, age, weight and gender were collected in clinical history prior DEXA scan.

Inclusion Criteria

1. All post-menopausal females reporting to IDC for DEXA scan

2. All women with age group 40 to 70 years

Exclusion Criteria

1. All premenopausal women and above age 70 years.

2. Women with hysterectomy and bilateral oophorectomy.

 3. All diagnosed cases of Osteoporosis that were already under treatment

4. All women on anti-epileptics and steroid therapy.

RESULTS

Results of the current study determined the prevalence of osteoporosis with BMD among post-menopausal women of Rawalpindi, Islamabad. After data collection from DEXA scan reports, results shows that Osteoporosis was present in 112 (56%) females, osteopenia was present in 46 (23%) females and 42 (21%) was normal. Among 200 participants, the average age of participants is 55.08 years with S.D of 6.688. Median age is 55.0 years and Mode is 60 years. Results of this study revealed that the risk of osteoporosis prevalence increases with age. The BMD results were further categorized into three types, Osteoporosis, Osteopenia and Normal. Age is categorized into 3 groups, one group has age range of 40-49 years, and second group includes all women with age 50-59 years and last group with age 60-69 years. The results are shown in the forms of tables and graphs.

Out of all samples, Frequencies were calculated for osteoporosis and for osteopenia and included participants with normal bone mineral density. Our results show that osteoporosis was present in 56% of the postmenopausal women.

Table 1.1: Frequency Distribution of Disease

	Frequency	Percent	Valid Percent	Cumulative Percent
Osteoporosis	112	56.0	56.0	56.0
Osteopenia	46	23.0	23.0	23.0
Normal	42	21.0	21.0	21.0
Total	200	100.0	100.0	100.0

Age Group Categories:

Age was further categorized into three groups 40-49, 50-59, 60-70. The mean age of participants of study is 55.09 with an S.D of 6.688. From 200 females, Age group 40-49 years comprised 38(19%) participants of the sample. Age group 50-59 years comprised 95 (47.5%) participants of the study. 67 (33.5%) of participants were aged 60-69 years.

Table.1.2: Cross tabulation of age group and disease type

Age- group (years)	Disease			Total
	Osteoporosis	Osteopenia	Normal	
40-49	13	7	18	38
50-59	48	24	23	95
60-69	51	15	1	67
Total	112	46	42	200

Table 1.2 shows that age group 40-49 years comprised a total of 38 participants, out of these 13 (34.21%) had osteoporosis, 7 (18.24%) participants had osteopenia, and 18 (47.36%) participants had normal BMD values. 50-59 years age group contained 95 participants of the study , among these 95 participants, 48 (50.52%) had osteoporosis, 24 (25.26%) had osteopenia, while 23 (24.21%) were normal . Similarly, participants with age group 60-69 occupied higher prevalence of osteoporosis than other age groups. Among 67 participants of age 60-69 years, 1 (1.49%) woman had normal BMD, 15 (22.38%) women had osteopenia, and 51 (76.11%) women had osteoporosis. Overall total 112 (56%) participants of study sample had osteoporosis. With aging, the prevalence of osteoporosis also increased because of low estrogen level and other risk factors. The result of cross tabulation is further elaborated and presented separately with age groups.

Weight distribution:
Out of 200 females, we distributed weight of female into 4 groups. Among 200 females, about 77 were falling in weight group 50-60 kg, 48 females have osteoporosis highest numbers among all weight groups. Weight group from 61-70 kg comprised of 45 participants, out of these 19 females were osteoporotic. 36 females out of 47 were osteoporotic in 71-80 kg weight group, whereas among 31 females from weight group of 81-90 kg, total 09 females were osteoporotic.

Table.1.3: Cross tabulation of weight and disease type

Weight of the participants (Kg)	Osteoporosis	Osteopenia	Total
50-60	48	29	77
61-70	19	26	45
71-80	36	11	47
81-90	09	22	31
Total	**112**	88	**200**

MENOPAUSE AGE:
There is a direct relationship between early menopause and osteoporosis. Out of 200 females, we distributed female into 2 groups based on menopause age. 45-50 years and 51 55 years. Total 111 women were comprised in 1st group, 67 women among 111 were diagnosed with osteoporosis and among group 2nd 51-55 years, and 45 were diagnosed with disease among 89. This shows that early menopause is also a risk factor of this disease and there is a strong positive association between early menopause and osteoporosis.

Distribution of patients according to menopause age
Table.1.4: Cross tabulation of menopause age and disease

Menopause Age (Yrs)	Osteoporosis	Normal	Total
45-50	67	44	111
51-55	45	44	89
Total	**112**	88	**200**

FAMILY HISTORY
One risk factor of osteoporosis is family history. Osteoporosis runs in families, probably because there are inherited factors that affect bone development. We are at higher risk if we have a positive family history. In this study, out of 200, total 67 females have positive family history and only 42 were osteoporotic from 67, means 37% females have positive female history. So, there is a strong association among osteoporosis and family history

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Table.1.5: Cross tabulation of family history and disease
Distribution of Patients according to family history

Family History	Osteoporosis	Osteopenia	Total
Positive	42	25	67
Negative	70	63	133
Total	112	88	200

SMOKING:

Smoking is also a risk factor of osteoporosis. In our study among 112 osteoporotic females, 9 were smokers and 103 were non-smokers. It means smoking and many other factors contribute to osteoporosis.

DISCUSSION

The purpose of this study was to determine the prevalence of Osteoporosis with BMD among post–menopausal women of age 40-70 years of Rawalpindi, Islamabad. In Pakistan, Osteoporosis among post-menopausal women has not been clearly identified so far. Our study is the first initiative regarding this matter. Osteoporosis is becoming a main public health problem in post-menopausal women in Pakistan and still research in this field is far behind. This health issue in Pakistan is different from the rest of the world as normative index of Pakistani post-menopausal women is lower as compared to their western counterparts. This emphasizes the need for early screening of osteoporosis and early identification of high-risk groups so that early initiation of treatment can be achieved.

There is limited data on the prevalence of osteoporosis in Pakistan with wide variations in reported estimates. Previously, 2 studies in Pakistan were reported but ultrasound was used for diagnosis of BMD values in both studies as one study conducted in dissimilar socioeconomic divisions of Karachi reported that 6.7% of post-menopausal women were diagnosed with osteoporosis and 32.4% suffer from osteopenia (Baig, Mansuri & Karim, 2009) whereas a study from Lahore reported that 18.6% of the population had osteoporosis and most of them are the postmenopausal women.

Keeping the above facts in light, cross sectional study DEXA scan was performed on 200 post-menopausal women, between the ages of 40 and 70 years. The mean age of the population was 55.09± 6.688 years. The analysis revealed that the prevalence of osteoporosis was 56% while osteopenia was present in 23% and the rest of the 21% population had normal BMD. These results are almost similar with those of (Damodaran, Subramaniam, Omar, Nadkarni & Paramsothy, 2000) as according to their study, 51.8% urban women in Malaysia in their menopause age group had mild osteoporosis.

Among the variables investigated in our study participants, weight, age, menopause, positive family history and smoking were identifying as significant risk factors for osteoporosis. One of the most important factors taken up in our study was the age of the women during which they are most affected by osteoporosis. After the analysis of our study, it was found that osteoporotic females mostly had age 60-69 years. As described earlier with aging estrogen level decreases that result in bone weakening. Older participants had higher prevalence of osteoporosis than the younger ones. Among 200 participants, on further categorization according to age, out of all the participants of 60-69 years age, 76.11% women had osteoporosis as shown in table 4.4. This showed that the risk of osteoporosis increased with an increase in age of participants. Our results regarding the age at which osteoporosis affects the most were in concurrence with the study of (Lau, Lee, Suriwongpaisal, Saw, Das De S, Khir & Sambrook, 2001).

Women with early menopause have higher prevalence of osteoporosis 59% (67/112) as compared to women with late menopause 41 % (45/112). Our results regarding the early menopause age were in concurrence with the study of (Lau, Lee, Suriwongpaisal, Saw, Das De S, Khir & Sambrook, 2001).

Another risk factor of osteoporosis is positive family history; osteoporosis does run in families, probably because there are inherited factors that affect bone development. If a close relative has suffered a fracture linked to osteoporosis then risk of getting osteoporosis is likely to be greater than normal. In our study, about 38% (42/112) of participants with osteoporosis have a positive family history of osteoporosis. Similar results

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were found in a study conducted in 2008 (Henderson, L. N., 2008). Several studies have identified low weight as a risk factor for osteoporosis .in our study among osteoporosis participants, 48 females had a weight in between 50 to 60 kg.

In a study conducted in Peshawar on post-menopausal women assessed BMD of heel using Ultrasonography. It found that 24.5% of post-menopausal women had osteoporosis, (Zahoor & Ayub, 2010) while in this study 56% of females had osteoporosis. Overall, this study reports a higher prevalence of osteoporosis in post-menopausal women compared with other studies. Sample in this study included participants from well-developed twin cities which could have higher prevalence of osteoporosis due to many reasons. Other risk factors of high prevalence of osteoporosis are low Calcium and vitamin D levels, Poor nutrition, deficiency of healthy diet, lack of exercise etc.

STRENGTHS AND LIMITATIONS
Strengths
First ever study in Rawalpindi, Islamabad that assesses the prevalence of osteoporosis among post-menopausal women.
First ever study in Pakistan, which uses DEXA scan a measuring tool for BMD for Osteoporosis.
 It provides statistical data (prevalence) that helps in research field.

Limitations
It was conducted on a diagnostic center which might have over-estimated the prevalence of osteoporosis. So, for true prevalence among population there is need of large-scale studies using DEXA as a diagnosing tool. The study population was from a single diagnostic Centre institution. It was hard to enroll subjects from multiple centers as most institutions perform BMD measurement with ultrasound. However, IDC is one of the largest institutes with vast modalities of radiology and lab.
Findings here are generalizable to females of similar socioeconomic background in Pakistan. As indicated earlier, a cross-sectional study design was used here. Since data was collected it seems that consumption of calcium rich foods depends upon financial level of family.
We used quantitative DEXA scan to calculate BMD although it is the gold standard for   osteoporosis, but it is totally operator dependent, any mistake in demographics, e.g. Weight, height, age and ethnicity could have resulted in large differences in BMD values.

CONCLUSION
The results of the present study concluded that there is a strong positive association between osteoporosis and menopause. After menopause, low level of estrogen results in bone loss and demineralization. As estrogens promote the mineralization of bone. This is one of the reasons of rapid decrease in bone mass in females after menopause as described earlier. Furthermore, in this study, the prevalence of osteoporosis was noted significantly high in each age subgroup. This means that our aged population is at a higher rate of getting osteoporosis and related fractures. Prognosis of the disease depends on how early the condition is diagnosed and treatment initiated and acquiring preventive behavior. To conclude, it must be noted that there were some limitations to this study.

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