DOI: https://doi.org/10.53350/pjmhs02024181330

**ORIGINAL ARTICLE**

# Prevalence of Type 2 Diabetes Mellitus in Women with Osteoporosis: A Cross-Sectional Study

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## ABSTRACT

**Objective:** To determine the prevalence of type 2 diabetes mellitus (T2DM) in postmenopausal women with osteoporosis and evaluate its association with metabolic and inflammatory parameters.

**Material and Methodology:** This Descriptive cross-sectional study was conducted in the Department of Obstetrics and Gynecology, Jinnah postgraduate medical Center (JPMC) Karachi, from 31 May 2021 to 30 November 2021. A total of 147 postmenopausal women aged 45–70 years with established osteoporosis were enrolled through non-probability consecutive sampling. Patients with secondary causes of bone loss were excluded. Data were collected using a structured proforma. T2DM diagnosis was based on fasting/random blood sugar and HbA1c criteria. Associations between T2DM and variables including age, residence, BMI, duration of osteoporosis, hypertension, CRP, magnesium levels, and vitamin D were analyzed using chi-square test. A p-value $\leq 0.05$ was considered statistically significant.

**Results:** Out of 147 osteoporotic women, 61 (41.5%) had type 2 diabetes mellitus. T2DM was significantly associated with hypertension ($p = 0.02$), raised CRP levels ($p = 0.01$), and hypomagnesemia ($p = 0.02$). No significant association was observed with age, BMI, residence, vitamin D deficiency, or other clinical parameters.

**Conclusion:** A high prevalence of type 2 diabetes was found among osteoporotic women. The significant associations with hypertension, systemic inflammation, and hypomagnesemia highlight the need for comprehensive screening and metabolic evaluation in these patients to guide timely interventions and improve bone and metabolic health outcomes.

**Keywords:** T2DM, Osteoporosis, CRP, Mg, Vit D, HTN, Inflammation

## INTRODUCTION

Type-2 diabetes mellitus (T2DM) and osteoporosis are two of the most frequent metabolic chronic diseases, especially in the elderly, resulting in significant morbidity and mortality[1]. It is noticed in patients with T2DM, they experience a higher fracture risk paradoxically and their bone mineral density is normal or high [2]. Older adult with diabetic complication such as neuropathy, retinopathy and hypoglycemics episode have three times risk for falls[3]. Other factors such as poor calcium intake, inadequate vitamin D, lack of exercise, smoking and genetic predisposition increase the risk of osteoporosis in those with T2DM[4].

The precise cause of bone loss in type 2 diabetes is not well understood, however bone resorption is thought to play a more significant role than another [5] Bone quality includes microarchitecture, remodelling, and matrix properties and again, these may be affected by aging, hyperglycaemia, advanced glycation end products accumulation, and decreased muscle mass or strength [6]. AGEs can potentially weaken bone strength, but this can be attenuated by the soluble receptor for AGEs[7].

DEXA is the clinical gold standard for BMD measurement and osteoporosis diagnosis. [8] Diabetes mellitus is a public health problem-world cross that has associated to a series of bone complications including osteopenia, osteoporosis, Charcot arthropathy, and finally the diabetic foot. [9] Several studies have related T2DM to microvascular (retinopathy, neuropathy) and macrovascular (coronary artery disease, cerebrovascular disease and peripheral artery disease) complications and emphasised an increased fracture risk. [10] Osteoporosis represents the major metabolic bone disease among T2DM patients. [11]

Documented T2DM percentages in subjects with OP differ, ranging from 25% [12] over 33%[13] to 43.7%[14]. Owing to increasing prevalence of osteoporosis and diabetes and lack of local data, we need more exploration into the relationship of osteoporosis with diabetes in our population. Particularly it emphasizes diabetes specific factors, such as glycaemic control, disease duration and co-morbid complications, to increase clinicians' awareness and to enhance the readiness and timing for intervention.

The purpose of this study was to determine the incidence of osteoporosis in T2DM patients through DEXA. The results will inform early treatment approaches and facilitate evidence-based provision of care. The results will be disseminated via health seminars and conferences to promote knowledge, attitudes, and practice that will ensure comprehensive management for this high-risk group and optimise outcomes linked to life threatening consequences of osteoporosis.

Received on 08-08-2023
Accepted on 15-12-2023

## MATERIALS AND METHODS

This Descriptive cross-sectional study was conducted in the Department of Obstetrics and Gynecology, Jinnah postgraduate medical Center (JPMC) Karachi, from 31 May 2021 to 30 November 2021. 147 subjects were recruited through non-probability consecutive sampling. Inclusion criteria were female gender with age above 40 years and documented diagnosis of type 2 diabetes mellitus (T2DM) duration of the disease more than 5 years.

Enrolment was open to those who attended the diabetes clinic at regular intervals and are alive, and had HbA1c measured at least three times in the past 1 year. Specific exclusions for patients included history of fractures, reduced renal function (eGFR < 60 ml/min/1.73 m²), chronic smoking, alcohol consumption, primary hyperparathyroidism, thyroid disease, celiac disease, multiple myeloma, current active cancer, lactose intolerance, established bone disease or mineral metabolism disorder, chronic pancreatitis, rheumatologic or systemic inflammatory diseases, as well as any malabsorptive disorder. In addition, exclusion criteria included medications known to affect the bone—-such as corticosteroids, immunosuppressants, anticonvulsants, diuretics, calcium or vitamin D supplements, or bone modifying agents. A complete clinical history was obtained, including patient's age, diabetes duration, the kind of anti-diabetic treatment in the previous year, and the presence of signs of diabetes-induced complications (neuropathy, nephropathy or retinopathy). Glycaemic control was assessed with HbA1c values from the previous year. Anthropometric indices were measured by calibrated stadiometer and digital scale. Height and weight were

measured in triplicate and the mean was taken as the final measurement. The weighing machine was calibrated on a daily basis by a 5kg ISI standardized weight. Body mass index (BMI) was computed using the weight in kilograms divided by the square of the height in meters. Neuropathy was assessed with vibrational perception threshold (VPT) testing.

This study was carried out in accordance with the principles of the Declaration of Helsinki, and its amendments. End stage data collection was precluded before obtaining informed assent from each participant. The prevalence of type 2 diabetes mellitus (T2DM) in a population of women who fulfilled the inclusion criteria and consulted in an outpatient clinic for a diagnosis of osteoporosis was then evaluated. 2 cc of venous blood was taken under strictly aseptic measures and submitted for pathologist examination. T2DM was diagnosed if the fasting blood glucose was ≥126 mg/dL or the random blood glucose was ≥200 mg/dL and was confirmed on two different occasions. Other evaluations consisted of pertinent laboratory work, a detailed medical history, and a comprehensive physical examination.

Potential confounders such as age, place of residence (urban/rural), duration of osteoporosis (years), hypertension, smoking, obesity, anaemia, increased C-reactive protein (CRP), high erythrocyte sedimentation rate (ESR), low body mass index (BMI), low calcium level, magnesium level, and vitamin D level were also supervised in this study. All examinations including physical are carried out by the principal investigator under the close supervision of a consultant gynaecologist with more than five years clinical experience.

The information was recorded on a structured proforma and analysed through work sheet extended from SPSS version 22. For continuous variables, means and standard deviations were used while categorical variables were summarized as frequencies and percentages. Normality was assessed using the skewness and kurtosis for data distributions. For data that were not normally distributed, medians were given. To adjust for confound variances, we stratified, then chi-square after stride to compare age, alcohol use among sex orientation groups. p-value of ≤ 0.05 was considered statistically significant.

## RESULTS

This descriptive cross-sectional study was conducted on 147, 45-70 years old women with osteoporosis. The mean age was 59.63 ± 10.49 years, the mean disease course of osteoporosis was 10.72 ± 8.57 weeks, and the mean HbA1c was 7.41 ± 2.56% (Table 1).

The 61 women of the present study population (41.5%) had type 2 diabetes mellitus; 86 (58.5%) were non-diabetic. This distribution is graphically shown in Figure 1, that emphasize in the extreme high of incidence of T2DM in osteoporotic women.

As presented in Figure 2, majority of the respondents (67.3%) belonged to the 56–70 year age group. There was, however, no statistically significant relationship between age category and diabetes status (p = 0.69, Table 2).

Residence was not associated with having diabetes (p = 0.73, Table3). Similarly, duration of osteoporosis did not have a significant effect on the occurrence of diabetes (p = 0.31, Table 4).

There was a statistically significant relationship between hypertension and diabetes mellitus with diabetes present in 52.6% of those with hypertension and in 34.4% of those without hypertension (p = 0.02; Table 5). This is also reflected in Figure 3 showing metabolic overlap between HT and T2DM.

CRP was also significantly associated with diabetes (p =, Table 9), with the proportion of CRP-positive individuals having diabetes being higher than CRP-negative subjects. This is depicted in Figure 4, and it provides an overview of inflammatory load in T2DM in osteoporotic women.

A remarkable result was the strong association of hypomagnesemia with diabetes mellitus (p = 0.02), with a lower number of diabetic biting in patients with hypomagnesemia than with normomagnesemia, as observed in Figure 5. This inverse relationship requires further studies into the physiological role of Mg in insulin metabolisms and in bone health.

Table 1: Descriptive Statistics

| Variable | Mean ± SD | Range |
|---|---|---|
| Age (Years) | 59.63 ± 10.49 | 45–70 |
| Duration of Osteoporosis (Weeks) | 10.72 ± 8.57 | 06–24 |
| HbA1c (%) | 7.41 ± 2.56 | 5–9 |

Table 2: DM Type II According to Age

| Category | DM Type II (Yes) | DM Type II (No) | p-value |
|---|---|---|---|
| 40–55 Years | 21 | 27 | 0.69 |
| 56–70 Years | 40 | 59 | |

Table 3: DM Type II According to Residence

| Category | DM Type II (Yes) | DM Type II (No) | p-value |
|---|---|---|---|
| Urban | 49 | 71 | 0.73 |
| Rural | 12 | 15 | |

Table 4: DM Type II According to Duration of Osteoporosis

| Category | DM Type II (Yes) | DM Type II (No) | p-value |
|---|---|---|---|
| ≤ 12 weeks | 24 | 27 | 0.31 |
| > 12 weeks | 37 | 59 | |

Table 5: DM Type II According to Hypertension

| Category | DM Type II (Yes) | DM Type II (No) | p-value |
|---|---|---|---|
| Yes | 30 | 27 | 0.02 |
| No | 31 | 59 | |

Table 6: DM Type II According to Smoking

| Category | DM Type II (Yes) | DM Type II (No) | p-value |
|---|---|---|---|
| Yes | 0 | 5 | 0.05 |
| No | 61 | 81 | |

Table 7: DM Type II According to Obesity

| Category | DM Type II (Yes) | DM Type II (No) | p-value |
|---|---|---|---|
| Yes | 25 | 37 | 0.80 |
| No | 36 | 49 | |

Table 8: DM Type II According to Anemia

| Category | DM Type II (Yes) | DM Type II (No) | p-value |
|---|---|---|---|
| Yes | 28 | 46 | 0.36 |
| No | 33 | 40 | |

Table 9: DM Type II According to Raised CRP

| Category | DM Type II (Yes) | DM Type II (No) | p-value |
|---|---|---|---|
| Raised | 45 | 47 | 0.01 |
| Normal | 16 | 39 | |

Table 10: DM Type II According to Raised ESR

| Category | DM Type II (Yes) | DM Type II (No) | p-value |
|---|---|---|---|
| Raised | 19 | 33 | 0.36 |
| Normal | 42 | 53 | |

Table 11: DM Type II According to Low BMI

| Category | DM Type II (Yes) | DM Type II (No) | p-value |
|---|---|---|---|
| Low | 9 | 21 | 0.15 |
| Normal | 52 | 65 | |

Table 12: DM Type II According to Hypocalcemia

| Category | DM Type II (Yes) | DM Type II (No) | p-value |
|---|---|---|---|
| Low | 8 | 19 | 0.16 |
| Normal | 53 | 67 | |

Table 13: DM Type II According to Hypomagnesemia

| Category | DM Type II (Yes) | DM Type II (No) | p-value |
|---|---|---|---|
| Low | 3 | 15 | 0.02 |
| Normal | 58 | 71 | |

Table 14: DM Type II According to Vitamin D Deficiency

| Category | DM Type II (Yes) | DM Type II (No) | p-value |
|---|---|---|---|
| Deficient | 29 | 45 | 0.56 |
| Normal | 32 | 41 | |

Other causes like smoking, obesity, anaemia, increased ESR, low BMI, hypocalcaemia, and vitamin D did not have statistically significant relations with T2DM (Tables 6–8, 10–14).

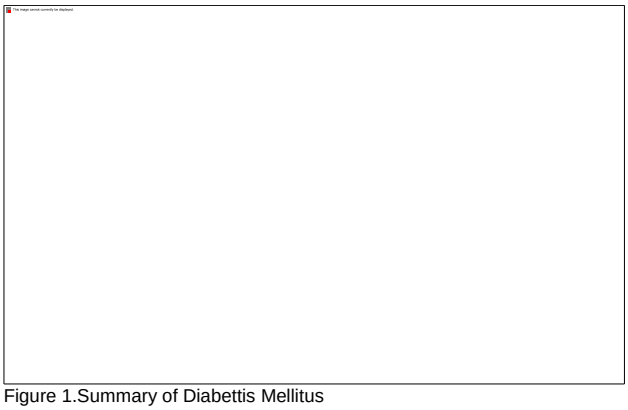

Figure 1.Summary of Diabettis Mellitus

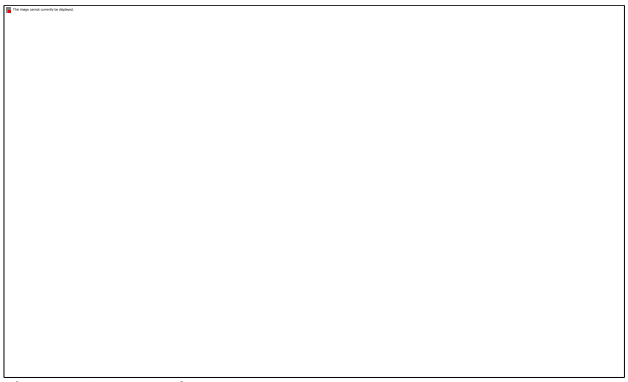

Figure 2: Summary of Age Group

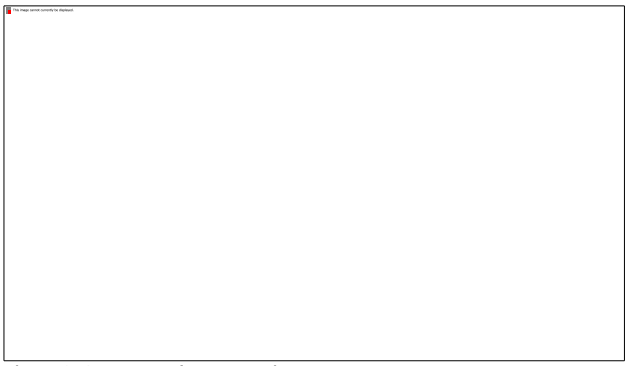

Figure 3: Summary of Hypertension

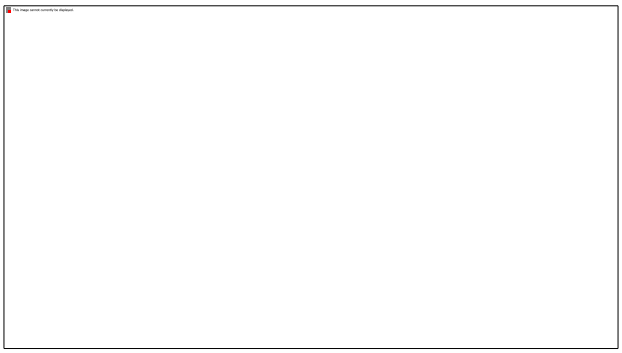

Figure 4: Raised CRP

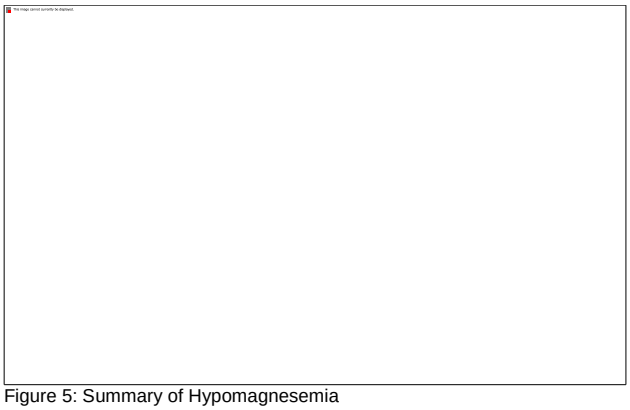

Figure 5: Summary of Hypomagnesemia

## DISCUSSION

Osteoporosis and type 2 diabetes mellitus (T2DM) are common chronic diseases among postmenopausal women. Forty-one and five tenth of percentage of the osteoporotic women had T2DM in our study. This result is consistent with the earlier example which revealed their coexistence in up to 2/5 cases of women older than 50 years and shows a common pathophysiological mechanism between bone metabolism and glycemia[13].

The absence of a significant correlation with age in our study is in contrast with previous reports of higher diabetes rates with increasing age, predominantly attributable to concomitant insulin resistance and β-cell dysfunction[14]. This discrepancy might be explained by our rather narrow range of age (45–70 years) with a limited detection of age-dependent trends.

An independent association between hypertension and T2DM was found (p= 0.02), consistent with the evidence in literature of the presence of the clustering of metabolic syndrome components in postmenopausal women[15] Conclusion These findings indicate that glucose (HbA1c) and lipids levels are associated with arterial hypertension and inversely proportionate to hypertensive after menopausal in postmenopausal women reflecting the effect of hormonal changes during menopause. An elevated BP could aggravate diabetic microvascular complications and augment oxidative stress, and lead to a negative effect on the bone.

We observed an statistically significant association between insulin resistance and raised C-reactive protein (CRP) and diabetes mellitus (p = 0.01), This fact suggests that systemic inflammation has a central role in stimulating resistance to insulin[16]. It has been shown in previous studies that an elevation of proinflammatory markers (e.g., CRP, IL-6) are predictive of the development of T2DM, as well as potentially providing a mechanism for increased bone resorption and decreased bone formation[17].

Hypomagnesemia was significantly associated with T2DM (p = 0.02). Magnesium has a key role in many enzymatic activities involved in insulin receptor function and glucose metabolism. Hypomagnesemia is known to be associated with decreased insulin sensitivity and secretion, leading to heightened risk of diabetes[18]. This justifies the requirement for monitoring and correction of Mg levels in osteoporotic diabetic patients.

In contrast, residence, duration of osteoporosis, obesity, anaemia, smoking, high ESR, low BMI, hypocalcaemia, and vitamin D deficiency were not found to be statistically significant associated with diabetes mellitus in this study. These influences may be, at least in part, in accordance with those from regional studies indicating that lifestyle (such as smoking or alcohol consumption), socioeconomic status, or nutritional condition may differentially affect these associations[19].

Our results highlight the need for screening of metabolic and inflammatory markers in women with osteoporosis, as such markers could indicate an increased risk for DM. With such a high

prevalence of comorbid conditions in these patients, an approach combining strategies to address bone health and metabolic health is necessary for improving long-term outcomes among these populations[20].

## CONCLUSION

The current study shows an increased prevalence of type 2 diabetes mellitus in women with osteoporosis and this proportion was found to be 41.5%. Risk factors The presence of diabetes was associated with diabetes, hypertension, increased CRP and hypomagnesemia indicating apparent association between metabolic, inflammatory and nutritional components. However, no such association was noted with age, BMI, place of residence, and vitamin D deficiency. The present results support the necessity of extensive metabolic examinations among patients with osteoporosis, especially for the assessment of parameters related to diabetes. Preventing and treating comorbidities earlier can optimize not only glycemic control but also bone health in this high-risk group.

## REFERENCES


1. Kanis JA, McCloskey EV, Johansson H, Oden A, Melton LJ, Khaltaev N. A reference standard for the description of osteoporosis. Bone. 2008;42(3):467–75.
2. Cosman F, de Beur SJ, LeBoff MS, Lewiecki EM, Tanner B, Randall S, et al. Clinician's Guide to Prevention and Treatment of Osteoporosis. Osteoporos Int. 2014;25(10):2359–81.
3. Schwartz AV. Diabetes Mellitus: Does it Affect Bone? Calcif Tissue Int. 2003;73(6):515–9.
4. Hofbauer LC, Brueck CC, Singh SK, Dobnig H. Osteoporosis in patients with diabetes mellitus. J Bone Miner Res. 2007;22(9):1317–28.
5. Vestergaard P. Discrepancies in bone mineral density and fracture risk in patients with type 1 and type 2 diabetes–a meta-analysis. Osteoporos Int. 2007;18(4):427–44.
6. Thrailkill KM, Lumpkin CK Jr, Bunn RC, Kemp SF, Fowlkes JL. Is insulin an anabolic agent in bone? Dissecting the diabetic bone for clues. Am J Physiol Endocrinol Metab. 2005;289(5):E735–45.
7. Starup-Linde J, Eriksen SA, Lykkeboe S, Handberg A, Vestergaard P. Biochemical markers of bone turnover in diabetes patients–a meta-analysis, and a methodological study on the effects of glucose on bone markers. Osteoporos Int. 2014;25(6):1697–708.
8. Strotmeyer ES, Cauley JA, Schwartz AV, Nevitt MC, Resnick HE, Bauer DC, et al. Nontraumatic fracture risk with diabetes mellitus and impaired fasting glucose in older white and black adults: the Health, Aging, and Body Composition Study. Arch Intern Med. 2005;165(14):1612–7.
9. Dede AD, Tournis S, Dontas I, Trovas G. Type 2 diabetes mellitus and fracture risk. Metabolism. 2014;63(12):1480–90.
10. Napoli N, Strotmeyer ES, Ensrud KE, Sellmeyer DE, Bauer DC, Schwartz AV. Fracture risk in diabetic elderly men: the MrOS study. Diabetologia. 2014;57(10):2057–65.
11. Nilsson AG, Sundh D, Johansson L, Nilsson M, Mellström D, Lorentzon M. Type 2 diabetes mellitus is associated with better trabecular bone microarchitecture but lower bone strength in elderly men. J Bone Miner Res. 2017;32(5):1062–71.
12. Tsourdi E, Barthel A, Rietzsch H, Wehrum T, Hamann C, Hofbauer LC. Current aspects of bone fragility in type 2 diabetes mellitus. Exp Clin Endocrinol Diabetes. 2014;122(02):87–93.
13. Napoli N, Chandran M, Pierroz DD, Abrahamsen B, Schwartz AV, Ferrari SL. Mechanisms of diabetes mellitus-induced bone fragility. Nat Rev Endocrinol. 2017;13(4):208–19.
14. Kirkman MS, Briscoe VJ, Clark N, Florez H, Haas LB, Halter JB, et al. Diabetes in older adults: a consensus report. J Am Geriatr Soc. 2012;60(12):2342–56.
15. Williams K, Tchernof A, Hunt KJ, Wagenknecht LE, Haffner SM, Sniderman AD. Diabetes, abdominal adiposity, and atherogenic dyslipoproteinemia in women compared with men. Diabetes. 2008;57(12):3289–96.
16. Pradhan AD, Manson JE, Rifai N, Buring JE, Ridker PM. C-reactive protein, interleukin-6, and risk of developing diabetes mellitus. JAMA. 2001;286(3):327–34.
17. Wannamethee SG, Lowe GD, Whincup PH, Rumley A, Walker M, Lennon L. Adipokines and risk of type 2 diabetes in older men. Diabetes Care. 2007;30(5):1200–5.
18. Barbagallo M, Dominguez LJ. Magnesium and type 2 diabetes. World J Diabetes. 2015;6(10):1152–7.
19. Siddiqui NI, Salam A, Hossain MI. Socio-demographic determinants of low bone mineral density in postmenopausal women in Bangladesh. Mymensingh Med J. 2012;21(4):698–704.
20. Ferrari SL, Abrahamsen B, Napoli N, Chandran M, Schwartz AV, Bouxsein ML. Diagnosis and management of bone fragility in diabetes: an emerging challenge. Osteoporos Int. 2018;29(12):2585–96.


**This article may be cited as:** Ayub K, Memon H, Bano K, Bhellar GS, Abdullah, Ayub Z: Prevalence of Type 2 Diabetes Mellitus in Women with Osteoporosis: A Cross-Sectional Study. Pak J Med Health Sci, 2023; 18(1): 330-333.