

Bone Mineral Density Evaluation of Postmenopausal Women with Type 2 Diabetes Mellitus

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Abstract

Introduction:

Osteoporosis, marked by reduced bone mass and increased fracture risk, is common in postmenopausal women due to estrogen deficiency. Type 2 diabetes mellitus may further compromise bone health.

Objective:

This study aimed to evaluate bone mineral density in postmenopausal women with T2DM to assess their risk of osteoporosis.

Methods:

This cross-sectional analytical study was conducted in the Medicine Department of Sir Salimullah Medical College and Mitford Hospital during the study period. A total of 120 cases were included in this study according to the selection criteria. Data were processed and analyzed by SPSS 22.0. A p-value of <0.05 was considered statistically significant.

Results:

Mean age of the patients was 65.83 ± 8.75 years and 62.17 ± 7.67 years in diabetic and non-diabetic post-menopausal patients. Mean duration of DM was 10.53 ± 5.09 years, and mean duration since menopause was 19.70 ± 7.82 years. Osteoporosis was 38(63.3%) and osteopenia was 20(33.3%) in the diabetic group, and osteoporosis was 24(40.0%) and osteopenia was 31(51.7%) in the non-diabetic group.

Conclusion:

Postmenopausal women with type 2 diabetes mellitus exhibited significantly reduced bone mineral density and a higher prevalence of osteoporosis compared to their healthy counterparts, highlighting the need for early screening and proactive management to mitigate fracture risk.

Keywords: Post menopause, Diabetic, Osteoporosis, Bone mineral density

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Introduction:

One of the most frequent complications for postmenopausal women is osteoporosis, which can be uncomfortable due to the physical changes that take place during and after menopause. All over the world, 30–50% of women's lifetime risk for osteoporosis and its related fractures all over the world.^{1,2} Due to oestrogen shortage and ageing, the menopausal period is linked to increased bone loss.³ Diabetes is a metabolic disorder that makes endocrinopathy-related complications worse. Bone

fractures are more common in people with diabetes mellitus. Evidence indicates that people with chronic hyperglycemia experience a high rate of bone deterioration. Despite having higher bone mineral density (BMD), type 2 diabetic patients are at higher risk because their bones are of inferior quality.⁴ Diabetes and osteoporosis are significant and growing public health issues, especially for postmenopausal women.⁵ There is no standardised diabetic osteopathy, though, due to the different pathogenetic mechanisms of type 1 and type 2

diabetes. Jackuliak and Payer(2012)⁴ revealed that diabetic postmenopausal women with osteoporosis had higher BMD levels than non-diabetics, though these differences were not statistically significant. However, the diabetic group's T-scores were also significantly higher. The pathogenic complexity of diabetes mellitus has produced contradictory findings regarding the involvement of the bones in this disease. Numerous clinical studies have demonstrated that both types of diabetes affect bone quality, microarchitecture, and new bone formation, which increases the risk of fracture. Low bone turnover is linked to T2DM, which slows bone loss and could raise BMD levels.⁶ Compared to healthy postmenopausal women, type 2 diabetic patients have significantly lower T-score values and more instances of osteoporosis. Low socioeconomic status, limited sun exposure, a diet low in calcium, a lack of hormone replacement therapy, or the use of other osteoporosis prevention drugs may all contribute to the high prevalence of osteoporosis among post-menopausal diabetic women.⁷ In their study, an author⁸ found that because insulin has an anabolic effect on bone, there is a positive correlation between insulin levels and BMD. Additionally, some reports suggest that insulin has cortical bone differently different effect on cortical bone than it does on cancellous bone.⁹ A cross-sectional analytical study showed a significant difference in femoral neck T score between the diabetic and non-diabetic groups.

This study was conducted to evaluate the bone mineral density between diabetic and non-diabetic postmenopausal women.

Methods:

This cross-sectional study was conducted in the Department of Medicine, Sir Salimullah Medical College & Mitford Hospital (SSMC & MH) from January 2018 to December 2018. A total of 120 postmenopausal women (60 with diabetes and 60 without diabetes) admitted to the Department of Medicine, Sir Salimullah Medical College and Mitford Hospital (SSMC and MH) during the study period were included as per the selection criteria in this study. Patients with a history of heavy smoking, alcohol abuse, a history of taking glucocorticoids, thyroxin, sedatives, anticonvulsants, heparin, etc., patients on treatment with calcium or vitamin D supplements, bisphosphonates, calcitonin, or hormone replacement therapy, and seriously ill

patients with H/O chronic diarrhea, malabsorption, Crohn's disease, COPD, CLD, and CKD were excluded from this study. Patients who had a history of rheumatoid arthritis, ankylosing spondylitis, or other rheumatic-inflammatory diseases were also excluded from this study. Cases were selected from the Medicine Department of Sir Salimullah Medical College and Mitford Hospital during the study period based on inclusion and exclusion criteria. History was taken, clinical examination was performed, and recorded in a predesigned data sheet. A questionnaire was prepared considering key variables like demographic data, clinical presentation, clinical findings, and investigation findings. Informed written consent was taken from each participant. Statistical analysis was performed using SPSS version 26.0 for Windows. Assumptions of normality and homogeneity of variance were initially checked. When the distribution was asymmetric, the data were presented as the median with ranges, and when the distribution was normal, the data were presented as the mean with SD. Categorical variables were expressed as proportions and were compared using the Chi-square test. For all tests, $p < 0.05$ was considered statistically significant.

Results:

Most of the patients were in the age group 60 – 69 years in both groups. The mean age of the patients was 65.83 ± 8.75 years and 62.17 ± 7.67 years in diabetic and non-diabetic post-menopausal patients (Table-I).

Table-I: Distribution of the study subjects according to age in diabetic and non-diabetic (N=120)

Age (Years)	Diabetic (n=60) (Mean±SD)	Non diabetic (n=60) (Mean±SD)	p-value
50 – 59	8(13.3)	19(31.7)	0.013
60 - 69	32(53.3)	32(53.3)	
≥70	20(33.3)	9(15.0)	
Mean±SD	65.83±8.75	62.17±7.67	

There was no significant difference in the age of menarche and age at menopause. But the duration since menopause was significantly higher in diabetic patients than in non-diabetic patients (Table-II).

Table-II: Distribution of the study subjects according to risk factors in diabetic and non-diabetic (N=120)

Variable	Diabetic (n=60) (Mean±SD)	Non diabetic (n=60) (Mean±SD)	p-value
Age of menarche (years)	14.78±0.69	14.63±0.64	0.219
Age at menopause (years)	46.90±3.39	46.95±3.04	0.932
Duration since menopause (years)	19.70±7.82	15.15±8.27	0.002

Mean BMI was almost similar in both groups. Fasting blood glucose, 2hABF, HbA1c, and serum creatinine were significantly higher in the diabetic group than non-diabetic group (Table-III).

Table-III: BMI, glycaemic status, and serum creatinine in diabetic and non-diabetic (N=120)

Variable	Diabetic (n=60) (Mean±SD)	Non diabetic (n=60) (Mean±SD)	p-value
Body Mass Index (kg/m ²)	24.60±4.87	25.26±3.40	0.397
Fasting Blood Sugar (mmol/L)	8.36±3.36	4.92±0.69	<0.001
2HBF (mmol/L)	14.03±6.72	7.53±0.29	<0.001
HbA1c (%)	7.03±1.25	5.85±0.29	<0.001
Serum Creatinine (mg/dl)	1.20±0.06	1.16±0.14	0.046

Duration of DM was 10.53±5.09 years, and the mean duration since menopause was 19.70±7.82 years. Of the DM patients, 31(51.7%) were taking OAD and 29(48.3%) were taking insulin with OAD (Table-IV).

Table-IV: Duration of diabetes mellitus, duration since menopause and type of treatment of DM (n=60)

Variable	No. (%)
Duration of DM (years)	
1 - 5	12(20.0)
6 - 10	23(38.3)
11 - 15	16(26.7)
>15	9(15.0)
Mean±SD	10.53±5.09
Duration since menopause (years)	
1 - 5	2(3.3)
6 - 10	5(8.3)
11 - 15	14(23.3)
16 - 20	14(23.3)
21 - 25	15(25.0)
26 - 30	4(6.7)
>30	6(10.0)
Mean±SD	19.70±7.82
Type of treatment of DM	
OAD	31(51.7)
OAD + insulin	29(48.3)

Table-V showed T-score and Z-score in the femoral neck and lumbar spine in diabetic and non-diabetic post menopause patients. T-score and Z-score both in the femoral neck and lumbar spine were significantly lower in diabetic patients than those of non-diabetic patients.

Table-V: T-score and Z-score in diabetic and non-diabetic (N=120)

Variable	Diabetic (n=60) (Mean±SD)	Non diabetic (n=60) (Mean±SD)	p-value
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T-score

Femoral neck	-2.72±1.08	-2.03±1.06	0.001
Lumbar spine	-3.32±1.51	-2.25±1.21	<0.001

Z-Score

Femoral neck	-1.16±1.01	-0.75±0.86	0.017
Lumbar spine	-1.61±1.25	-0.74±1.15	<0.001

Table-VI showed T-score and Z-score in the femoral neck and lumbar spine in controlled and uncontrolled diabetic post menopause patients. T-score and Z-score both in the femoral neck and lumbar spine were significantly lower in diabetic patients with HbA1c ≤7.

Table-VI: T-score and Z-score in controlled and uncontrolled glycemic patients (n=60)

Variable	HbA1c ≤7 (n=25) (Mean±SD)	HbA1c >7 (n=35) (Mean±SD)	p-value
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T-score

Femoral neck	-2.04±0.77	-3.24±1.00	<0.001
Lumbar spine	-2.08±1.03	-4.27±1.06	<0.001

Z-Score

Femoral neck	-0.57±0.86	-1.61±0.88	<0.001
Lumbar spine	-0.68±0.97	-2.33±0.94	<0.001

Osteoporosis in diabetic and non-diabetic post menopause patients. Osteoporosis was found to be significantly higher in diabetic patients than in non-diabetic patients (Table-VII).

Table-VII: Osteoporosis in diabetic and non-diabetic patients (N=120)

Variable	Diabetic (n=60) no. (%)	Non diabetic (n=60) no. (%)	p-value
Osteoporosis	38(63.3)	24(40.0)	0.033
Osteopenia	20(33.3)	31(51.7)	
Normal	2(3.3)	5(8.3)	

Discussion:

In this study, most patients in both groups were between the ages of 60 and 69. In diabetic and non-diabetic post-menopausal patients, the mean age was 65.83 ± 8.75 years and 62.17 ± 7.67 years, respectively. In the study of Anaforoglu et al¹⁰ the mean age was 61.9 ± 8.6 years and 60.1 ± 9.3 years in diabetic and non-diabetic post-menopausal women, respectively. The mean age was 67 years in both diabetic and non-diabetic menopausal patients in the study of Hadzibegovic et al.¹¹ Mean age of menarche was 14.78 ± 0.69 years and 14.63 ± 0.64 years in diabetic and non-diabetic post menopause women in this study. There was no significant difference between the two groups. Mean age of menarche was almost similar in the study of Hadzibegovic et al.¹¹ Mean age at menopause was 46.90 ± 3.39 years and 46.95 ± 3.04 years in diabetic and non-diabetic post menopause women in this study. There was no significant difference between the two groups. A similar menopause age was observed in the study of Anaforoglu et al¹⁰ and Hadzibegovic et al.¹¹ Duration since menopause was significantly higher in diabetic patients than that of non-diabetic post menopause women in this study (19.70 ± 7.82 years vs 15.15 ± 8.27 years). Duration since menopause was higher in diabetic women than in non-diabetic women, but the difference was not statistically significant.^{11,12} In this study duration of DM was 10.53 ± 5.09 years. Anaforoglu et al¹⁰ revealed the duration of DM was 10.3 ± 8.2 years. Duration of DM was 7.1 ± 6.5 years in the study of Raika et al.¹² Mean BMI was 24.60 ± 4.87 kg/m² and 25.26 ± 3.40 kg/m² in diabetic and non-diabetic post menopause women in this study. There was no significant difference between the two groups. BMI was significantly higher in diabetic women than in non-diabetic women.^{10,12} This study result was dissimilar to the above findings. Serum creatinine was significantly higher in diabetic patients than in non-diabetic post

menopause women in this study (1.20 ± 0.06 years vs 1.16 ± 0.14). Raika et al¹² revealed that serum creatinine was almost similar in both diabetic and non-diabetic women. In this study, BMD both in the femoral neck and lumbar spine was significantly lower in diabetic patients than that of non-diabetic patients. Femoral neck T-score was -2.72 ± 1.08 in diabetic women and -2.03 ± 1.06 in non-diabetic women ($p=0.001$). Lumbar spine T-score was -3.32 ± 1.51 in diabetic women and -2.25 ± 1.21 in non-diabetic women ($p<0.001$). Karimifar et al⁵ investigated BMD in postmenopausal women with type 2 diabetes and compared it with postmenopausal non-diabetic women. They found that Lumber T scores were -2.16 ± 1.27 vs -2.10 ± 1.08 ($P=0.60$), femoral neck T-score was -1.09 ± 0.96 vs -0.72 ± 1.00 ($P=0.00$) in diabetic and non-diabetic groups, respectively. There was a significant difference in femoral neck T score between the diabetic and non-diabetic group ($p=<0.001$). Femoral neck T-score was significantly lower in diabetic women than in non-diabetic women in the study of Moghimi et al,⁷ conducted in Iran. Femoral and lumbar T-scores were significantly lower in diabetic patients with HbA1c ≤ 7.0 . Femoral neck T-score was -2.04 ± 0.77 in controlled glycemic women and -3.24 ± 1.00 in uncontrolled glycemic women ($p<0.001$). Lumbar spine T-score was -2.08 ± 1.03 in controlled glycemic women and -4.27 ± 1.06 in uncontrolled glycemic women ($p<0.001$). In diabetic women, bone loss was more common in those with HbA1c ≥ 7 compared to those with HbA1c < 7 .⁵ In this study, osteoporosis was 38(63.3%) and osteopenia was 20(33.3%) in the diabetic group, and osteoporosis was 24(40.0%) and osteopenia was 31(51.7%) in the non-diabetic group. Osteoporosis was significantly higher in this study. A similar finding was observed in the study of Moghimi et al⁷ where they found significantly higher prevalence of osteoporosis in diabetic women compared to non-diabetic women.

Limitations:

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

Conclusion:

This study demonstrate that postmenopausal women with type 2 diabetes mellitus exhibit

significantly reduced bone mineral density and a higher prevalence of osteoporosis compared to their healthy counterparts, highlighting the need for early screening and proactive management to mitigate fracture risk. Routine bone mineral density screening should be incorporated into the clinical management of postmenopausal women with type 2 diabetes mellitus, with timely initiation of preventive and therapeutic measures to reduce osteoporosis-related complications.

References:

1. Siddapur PR, Patil AB, Borde VS. Comparison of bone mineral density, T-scores, and serum zinc between diabetic and non-diabetic postmenopausal women with osteoporosis. *Journal of Laboratory Physicians*. 2015;7(01): 043-8. doi: 10.4103/0974-2727.151681
2. Damodaran P, Subramaniam R, Omar SZ, Nadkarni P, Paramsothy M. Profile of a menopause clinic in an urban population in Malaysia. *Singapore Medical Journal*. 2000;41(9):431-5. <https://pubmed.ncbi.nlm.nih.gov/11193115/>
3. Lindsay R. and Cosman F. Osteoporosis. In: Longo DL, editor. *Harrison's Principles of Internal Medicine*, 18th ed. United States of America: McGraw-Hill Publishers, 2012; 3120–35. <https://biblioteca.uazuay.edu.ec/buscar/item/74596>
4. Jackuliak P, Payer J. Osteoporosis, fractures, and diabetes. *Int J Endocrinol*. 2014; 2014:820615. doi: 10.1155/2014/820615. Epub 2014 Jun 23. Erratum in: *Int J Endocrinol*. 2017;2017:2846080. doi: 10.1155/2017/2846080.
5. Karimifar M, Pasha MA, Salari A, Zamani A, Salesi M, Motaghi P. Evaluation of bone loss in diabetic postmenopausal women. *Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences*. 2012;17(11):1033. <https://pmc.ncbi.nlm.nih.gov/articles/PMC3702084/>
6. Khan AA, Hodsman AB, Papaioannou A, Kendler D, Brown JP, Olszynski WP. Management of osteoporosis in men: an update and case example. *CMAJ*. 2007; 176(3):345-348. doi: 10.1503/cmaj. 050816
7. Moghimi N, Rahimi E, Derakhshan S, Farhadifar F. Osteoporosis in postmenopausal diabetic women: prevalence and related factors. 2008. https://www.researchgate.net/profile/Fariba-Farhadifar-2/publication/228635143_Osteoporosis_in_Postmenopausal_Diabetic_Women_Prevalence_and_Related_Factors_br/links/544a71e30cf2f10303a41d72/Osteoporosis-in-Postmenopausal-Diabetic-Women-Prevalence-and-Related-Factors-br.pdf
8. Shin D, Kim S, Kim KH, Lee K, Park SM. Association between insulin resistance and bone mass in men. *The Journal of Clinical Endocrinology & Metabolism*. 2014 Mar 1;99(3):988-95. doi: 10.1210/jc.2013-3338
9. Majima T, Komatsu Y, Yamada T, Koike Y, Shigemoto M, Takagi C, et al. Decreased bone mineral density at the distal radius, but not at the lumbar spine or the femoral neck, in Japanese type 2 diabetic patients. *osteoporosis International*. 2005;16(8):907-13. doi: 10.1007/s00198-004-1786-z
10. Anaforoglu I, Nar-Demirer A, Bascil-Tutuncu N, Ertorer ME. Prevalence of osteoporosis and factors affecting bone mineral density among postmenopausal Turkish women with type 2 diabetes. *Journal of Diabetes and Its Complications*. 2009;23(1):12-7. doi:10.1016/j.jdiacomp.2007.06.004
11. Hadzibegovic, I., Miskic, B., Cosic, V., Prvulovic, D. and Bistrovic, D. Increased bone mineral density in postmenopausal women with type 2 diabetes mellitus. *Annals of Saudi medicine*, 2008; 28(2), pp.102-104. doi: 10.5144/0256-4947.2008.102
12. Ra ka I, Ra kov6 M, Zik6n V, krha J. Prevalence and risk factors of osteoporosis in postmenopausal women with type 2 diabetes mellitus. *Central European journal of public health*. 2017;25(1):3-10. doi: 10.21101/cejph.a4717