Lumbar Spine and Femoral Neck Bone Mineral Density in Adults With Type 2 Diabetes With and Without Chronic Kidney Disease: A Cross-Sectional Study

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Abstract

Objective. To compare lumbar spine and right femoral neck bone mineral density across three groups of adults.

Methods. The study included 210 participants, with 70 in each group: type 2 diabetes with chronic kidney disease, type 2 diabetes without chronic kidney disease, and nondiabetic controls. Bone mineral density was assessed with dual-energy X-ray absorptiometry.

Results. Mean lumbar spine T-scores were −2.49, −1.69 and −0.75, respectively. Mean right femoral neck T-scores were −1.29, −0.84 and −0.40. The reported overall group comparisons yielded $p < 0.001$ for lumbar spine T-scores and $p = 0.002$ for right femoral neck T-scores. The right femoral neck Z-score comparison yielded $p = 0.72$.

Conclusion. In this sample, mean T-scores were lowest in the group with type 2 diabetes and chronic kidney disease at both measured sites. The comparison describes group differences at the time of assessment.

Keywords: Type 2 diabetes, chronic kidney disease, bone mineral density, DXA, T-score

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Introduction

Diabetes and kidney disease are associated with factors that may affect skeletal health. Bone mineral density is one component of skeletal assessment [1,2,3,4,5,6,7,8,9,10]. This study compared lumbar spine and right femoral neck DXA results among adults with type 2 diabetes with and without chronic kidney disease and nondiabetic controls.

Materials and Methods

The cross-sectional sample comprised 70 adults per group. Nondiabetic controls were selected from attendants of patients admitted for elective surgery, screened for diabetes and other systemic conditions affecting bone metabolism, and described as age- and sex-matched. Participants younger than 18 years and those with cognitive impairment affecting consent were excluded.

Diabetes was defined using the reported criteria: fasting plasma glucose ≥126 mg/dL, postprandial plasma glucose ≥200 mg/dL, HbA1c ≥6.5%, or a prior diagnosis with ongoing treatment. The study classified diabetic kidney disease using urinary albumin excretion >15 µg, 24-hour albuminuria >300 mg/day, or serum creatinine >120 µmol/L in a patient with diabetes. These are the criteria reported for this study.

Measurements

A standardized questionnaire recorded demographic and clinical characteristics, smoking, alcohol consumption, medications and physical activity. Laboratory assessment included glucose, HbA1c, renal function, 24-hour urinary protein, 25-hydroxyvitamin D, calcium, phosphorus, albumin, alkaline phosphatase and thyroid-stimulating hormone. DXA was performed at the lumbar spine and right femoral neck. The study used T-score categories to report normal bone density, osteopenia and osteoporosis.

Sample Size and Statistical Analysis

The reported calculation used 80% power and two-sided alpha of 0.05 and yielded 70 participants per group. Distributions were assessed with plots and Kolmogorov–Smirnov and Shapiro–Wilk tests. Continuous data were summarized as mean and standard deviation or median and interquartile range. Categorical data were summarized as counts and percentages. The authors report Pearson chi-square or Fisher exact tests, Mann–Whitney U tests for two groups and Kruskal–Wallis tests for more than two groups, using Stata 15.

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Results

The study enrolled 210 participants. Table 1 presents demographic and laboratory measures. Values and p-values are reproduced as reported. The p-values are presented as overall comparisons across the groups.

Table 1. Demographic and clinical measures as reported

Measure	T2DM + CKD	T2DM without CKD	Controls	p-value
Age, years	60.16 ± 10.32	58.26 ± 9.93	59.60 ± 4.92	0.081
Men, n (%)	44 (62.86%)	44 (62.86%)	42 (60%)	0.087
BMI	25.96 ± 4.52	25.71 ± 4.51	23.44 ± 4.44	0.23
Fasting glucose, mg/dL	195.66 ± 55.82	147.32 ± 39.30	90.99 ± 4.76	<0.001
Postprandial glucose, mg/dL	245.64 ± 139.49	220.17 ± 57.08	124.6 ± 25.4	<0.001
HbA1c, %	10.31 ± 1.61	8.59 ± 2.07	5.45 ± 0.02	<0.001
Serum urea, mg/dL	74 ± 23.72	40.77 ± 23.03	38.64 ± 0.46	<0.001
Serum creatinine, mg/dL	2.3 ± 1.17	0.94 ± 0.14	0.72 ± 0.16	<0.001
Serum sodium, mmol/L	140.68 ± 3.11	137.72 ± 3.8	142.4 ± 5.2	0.084
Serum potassium, mmol/L	4.19 ± 0.61	3.82 ± 0.25	3.96 ± 0.32	0.226
Serum calcium, mg/dL	8.81 ± 0.82	9.26 ± 0.46	9.53 ± 0.62	0.569
Serum phosphorus, mg/dL	4.3 ± 1.25	3.78 ± 0.79	4.34 ± 0.56	0.421
Serum albumin, g/dL	3.49 ± 0.41	3.78 ± 0.41	3.96 ± 0.34	0.078
ALP, U/L	174.74 ± 69.82	118.56 ± 40.37	126 ± 24.56	<0.001

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Bone Mineral Density

Table 2. Lumbar spine and right femoral neck scores as reported

Group	Lumbar T-score	Lumbar Z-score	Right neck T-score	Right neck Z-score
T2DM + CKD	−2.49 ± 0.88	−1.62 ± 1.02	−1.29 ± 1.06	−0.42 ± 1.24
T2DM without CKD	−1.69 ± 1.25	−0.76 ± 0.95	−0.84 ± 1.13	−0.25 ± 1.03
Controls	−0.75 ± 1.02	−0.62 ± 1.22	−0.40 ± 0.90	−0.26 ± 1.12
Overall p-value	<0.001	<0.001	0.002	0.72

Scores are mean ± standard deviation. The reported p-values refer to comparisons across all three groups.

Reported T-Score Categories

The study reported lumbar osteoporosis and osteopenia in 54% and 38% of the group with diabetes and CKD and in 24% and 52% of the group with diabetes without CKD. At the right femoral neck, reported osteoporosis percentages were 24%, 8% and 4% in the three groups. Reported osteopenia percentages were 38%, 42% and 20%, respectively.

Discussion

Mean T-scores were lowest in the group with diabetes and CKD at both sites. The results are group comparisons at the time of assessment. Published evidence discusses several mechanisms linking diabetes and kidney disease to skeletal health [11,12,13,14,15,16,17,18,19,20,21,22,23,24,25]. This study does not estimate the independent contribution of each condition.

The hospital-based sample and the study definitions constrain interpretation. T-score categories require consideration of age, sex and menopausal status. The overall tests do not specify which pairs differ, and the tabulated p-values are retained as reported.

Conclusion

In this sample, mean lumbar spine and right femoral neck T-scores were lowest in adults with type 2 diabetes and chronic kidney disease. The findings describe group differences in this cross-sectional sample.

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Declarations

The authors report Institutional Ethics Committee approval and written informed consent. The study was conducted in accordance with the Declaration of Helsinki and applicable standards. All authors contributed to the study and manuscript, approved the final version and agreed to be accountable for the work. No competing interests or funding were reported.

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