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Research Article

The Relationship Between Type 2 Diabetes Mellitus and Osteoporosis in Elderly Patients: A Retrospective Study

Soha Abd El Aziz Abd El Aal, Anood Jamal Alshaali*, Mohammed Hammam Fawzy, Mona Sobhy Elsherbiny and Amal Mohamad AlJaziri

Geriatric medicine section, Primary Health Care Sector, Dubai Health Authority, Dubai, United Arab Emirates

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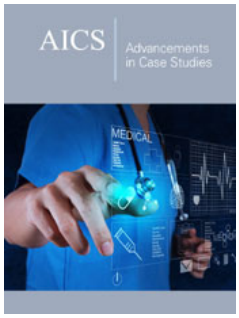

***Corresponding author:** Anood Jamal Alshaali, Geriatric medicine section, Primary Health Care Services Sector, Dubai Health Authority, Dubai, United Arab Emirates

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Abstract

Type 2 diabetes mellitus (T2DM) effect bone metabolism, but the relationship of T2DM with bone mineral density remains inconsistent across studies. The objective of this study was to determine the relationship between osteoporosis and T2DM in elderly patients.A total of 313 elderly was included in the study with a mean age of 68.20±7.07 years. The prevalence of osteoporosis in this study was 39.5%. The results showed that, non- diabetic elderly had higher prevalence of osteoporosis in comparison to diabetic elderly (44.0% and 33.1%, respectively). This difference was statistically significant (P=0.007). It was observed that males had higher femur and lumbar spine BMD in comparison with females. The present study gave better understanding of the effect of diabetes mellitus on bone architecture will help to improve the quality of provided health services at the primary health care level hence, improving the outcomes.

Keywords: Osteoporosis; Type 2 diabetes mellitus;Bone mineral density; Primary health care (PHC), Dubai health authority (DHA)

Introduction

Osteoporosis is defined as a metabolic skeletal disorder characterized by compromised bone strength and altered bone quality along with micro-architectural abnormalities predisposing a person to an increased risk of fracture, hence leading to a significant morbidity and mortality [1,2]. The risk of osteoporosis increases with advanced age and is higher in women than in men. The lifetime risk of developing osteoporosis and osteoporotic fracture is estimated to be 30-50% in women and 15-30% in men [3]. The United Nation described population aging as a key demographic feature of the 20th century and stated that it will remain an important population issue throughout the 21st century. Elderly population forms a significant proportion of the world total population. In 2015, 12% of the 7.3billions living individuals were aged 60 years and above. This is expected to increase to 21.6% by 2050 [4].

The proportion of elderly in the United Arab Emirates population is increasing constantly. The UAE population above 60 years of age was 5.1% in 2000% and expected to reach 23.6% in 2025 [5]. A study conducted in the primary health care facilities in Dubai reported that the prevalence of osteoporosis in elderly was 8.3%. A higher prevalence was noted among female compared to male (12.9% and 2.4% respectively) [6]. Like osteoporosis, type 2 diabetes mellitus (T2DM) is also highly prevalent in aging populations, putting this group at higher risk of bone fracture. Demographic trends with longer life expectancy and a lifestyle characterized by low physical activity and high-energy food intake contribute to the increasing incidence of type 2 diabetes mellitus and osteoporosis [7].

Despite the presence of different reports describing skeletal disorders among patients with type 2 diabetes mellitus, controversy remains concerning the risk of osteoporosis and its clinical importance among these patients [8]. Studies on the association between bone

mineral density (BMD) and type 2 diabetes mellitus revealed conflicting results with variations towards higher [9-11] normal [12,13] and lower values [14-17] of BMD in patient with T2DM. A study conducted among diabetic females in the UAE reported that the BMD were similar in diabetic and control groups [12]. A second study was conducted in UAE reported that osteoporosis was significantly higher in diabetic group [14].

A better understanding of the effect of diabetes mellitus on bone architecture will help to improve the quality of provided health services at the primary health care level hence, improving the outcomes. This study is conducted to determine the relationship between osteoporosis and type 2 diabetes mellitus in elderly patients and type 2 diabetes mellitus in elderly patients.

Methodology

Study design and setting: Retrospective study was conducted in osteoporosis clinic in the primary health care center in Dubai health authority.

Target population: Elderly aged 60 years and above attended the osteoporosis clinic for screening in the primary health care centre in Dubai health authority in 2018.

Exclusion criteria:

A. patients with malignancy

B. patients with untreated hyperthyroidism and hyperparathyroidism

C. patients with diagnosed diffuse connective tissue disease (Rheumatoid arthritis, poliomyelitis, and dermatomyositis)

D. patients with liver and / or renal faliure

E. patients diagnosed previously as osteoporotic patients and receiving treatment (antiresorptive, bone forming, HRT, and SERM)

F. patients with solid organ or bone marrow transplant

G. immobilized patients for more than one year

H. patients on the following medications

a. anticoagulants

b. antiepileptic(phenobarbital, phenytoin, carbamazepine)

c. hormonal replacement therapy

d. chemotherapeutic drugs

e. glucocorticoids more than 5 mg for ≥ 3 months

Data collection

The Dubai Health Authority has an electronic medical system and the patient electronic medical record was used as a source for data collection. The data collected aimed at eliciting the following information

A. Demographic data including age, sex, nationality and Body mass index (BMI).

B. Diabetes history and if yes then the duration of the disease was recorded.

C. Lab investigations results including HBA1C, creatinine, Vitamin D and calcium.

D. Bone Mineral Density Measurement results

Definitions of the study variables

Body Mass Index (BMI) was categorized by WHO as follows: elderly with BMI <18.5kg/m^2, 18.5-24.9kg/m^2, 25.0-29.9kg/m^2 or ≥30.0kg/m^2 are defined as underweight, normal, overweight or obese respectively [18]. Bone Mineral Density (BMD) Measurement. The BMD of the hip and the lumbar spine was measured using dual energy X-ray absorptiometry (DEXA) (Lunar, GE Health Care) and the result was expressed as BMD, T-score and Z score. The reference standard of a T-score is the peak bone density, as reached in men or women between 20-30 years of age. The T-score is then defined as the number of standard deviations from this score. According to the WHO definition, "osteoporosis" is defined as a T-score equal to or lower than -2.5,"osteopenia" is defined as a T-score between -2.5 and -1.0,and when the T-score is equal to greater than -1.0 BMD is "normal" [19].

Ethical consideration

The procedures used were approved by the Research Ethics Committee (Medical Research Section, Dubai Health Authority, Dubai, UAE).

Data analysis

Statistical Package for social science (SPSS) program version 20 was used for analysis of data as follows:

(i) Descriptive statistics were carried out in the form of mean, standard deviation, and range for quantitative values.

(ii) Frequency and percentage were done for qualitative variables

(iii)Mean and SD were calculated for different continuous variables, and student's t test was used to compare mean values to test the significance level.

(iv) Categorical variables are expressed as percentage, and chi-square test was used to assess the statistical significance level. P value < 0.05 was considered statistically significant with 95% confidence interval.

Results

The present study comprised 313 elderly, most of whom were in the age range 60years to <70years (64.4%) with a mean age of 68.20 ± 7.07 years. More than 70% of elderly were female and the majority were local to the UAE (89.1%). It was found that 51.1% of elderly were obese and 31.5% were overweight. (Table 1). As

shown in Table 2, 39.5% of the elderly who were newly referred to the osteoporosis clinic were osteoporotic and 40.8% of the elderly were diabetic. The mean duration for diabetic elderly was 13.34 ± 8.77. In Table 3 clinical parameter of elderly with and without diabetes were compared. Vitamin D and HBA1C were significantly higher in diabetic elderly.

Table 1: Distribution of elderly attending the osteoporosis clinic according to personal characteristics.

Personal characteristics	n=313	%
Age		
60-64	114	36.7
65-69	86	27.7
70-74	54	17.4
75-79	29	9.3
80 +	28	9.0
mean ± SD	68.20 ± 7.07	
range	60-99	
Sex		
male	90	28.9
female	221	71.1
Nationality		
UAE national	277	89.1
non-UAE national	34	10.9
Body mass index (BMI)		
underweight <18.5	9	2.9
Normal 18.5-24.99	45	14.5
Overweight 25-29.99	98	31.5
Obese ≥30	159	51.1
mean ± SD	30.32 ± 6.24	
range	15.15 -56.80	

Table 2: Bone Mineral Density (BMD) classification and the prevalence of diabetes mellitus type 2.

BMD classification	n=313	%
Normal	60	19.3
Osteopenia	128	41.2
Osteoporosis	123	39.5
Diabetes		
Diabetic	127	40.8
non-diabetic	184	59.2
Duration of diabetes for diabetic; mean ± SD (years)	13.34 ± 8.77	

Table 3: Clinical parameter of elderly with and without diabetes (mean ± SD).

Clinical parameter	Diabetes Status	Mean	P- value
HBA1C	Diabetic	7.44±1.42	0.00
	Non-diabetic	5.82±4.51	
creatinine	Diabetic	0.75±0.37	0.138
	Non-diabetic	0.69±0.24	
calcium	Diabetic	9.49±0.35	0.350
	Non-diabetic	9.42±0.80	
Vitamin D	Diabetic	34.57±15.08	0.007
	Non-diabetic	30.20±12.99	
BMI	Diabetic	30.98±6.14	0.123
	Non-diabetic	29.87±6.28	

It was found that non- diabetic elderly had higher prevalence of osteoporosis in comparison to diabetic elderly (44.0% and 33.1%, respectively). This difference was statistically significant (P=0.007) (Table 4). In Table 5 the mean Femur BMD in non-diabetic was 0.81g/cm^2 ± 0.16 and in the diabetic was 0.87g/cm^2 ±1.76 (P=0.004). The mean Lumbar spine BMD in non- diabetic 1.00g/cm^2 ± 0.21 and in the diabetic was 1.04g/cm^2 ± 0.20, the difference was not statistically significant (P=0.071). As shown in Table 6, the mean Femur BMD in non- diabetic male was lower in comparison to diabetic male (0.90g/cm^2 ± 0.17 and 0.94g/cm^2 ± 0.14 respectively). The difference was statistically not significant (P=0.218). In Table 7 the mean Femur BMD in non-diabetic male was lower in comparison to diabetic female (0.77g/cm^2 ± 0.15 and 0.84g/cm^2 ± 0.18 respectively). The difference was statistically significant (P=0.003).

Table 4: Distribution and the percentage of Bone Mineral Density (BMD) in diabetics and non-diabetics elderly.

	BMD classification			P- value
	Normal N (%)	Osteopenia N (%)	Osteoporosis N (%)	
Diabetics	35 (27.6%)	50 (39.4%)	42 (33.10%)	0.007
Non- diabetics	25 (13.6%)	78 (42.40%)	81 (44.00%)	

Table 5: Distribution of Bone Mineral Density (BMD) T score and Z score in diabetics and non-diabetics elderly.

Variable	Diabetes Status	Mean	P- value
Femur BMD(g/cm^2)	Diabetic	0.87± 1.76	0.004
	Non- diabetic	0.81±0.16	
Femur T score	Diabetic	-1.25±1.15	0.001
	Non- diabetic	-1.67±1.12	
Femur Z score	Diabetic	0.124±1.11	0.00
	Non- diabetic	-0.29±0.95	
Lumbar spine BMD (g/cm^2)	Diabetic	1.04±0.20	0.071
	Non- diabetic	1.00±0.21	
Lumbar spine T score	Diabetic	-1.24±1.60	0.062
	Non- diabetic	-1.59±1.67	
Lumbar spine Z score	Diabetic	-0.28±1.39	0.071
	Non- diabetic	-0.57±1.42	

Table 6: Distribution of Bone Mineral Density (BMD) T score and Z score in diabetics and non-diabetics elderly male.

Variable	Diabetes Status	Mean	P- value
Femur BMD(g/cm^2)	Diabetic	0.94± 0.14	0.218
	Non- diabetic	0.90±0.17	
Femur T score	Diabetic	-0.83±1.10	0.250
	Non- diabetic	-1.13±1.25	
Femur Z score	Diabetic	0.20±1.11	0.332
	Non- diabetic	-0.03±1.10	
Lumbar spine BMD (g/cm^2)	Diabetic	1.17±0.24	0.258
	Non- diabetic	1.12±0.20	
Lumbar spine T score	Diabetic	-0.33±1.95	0.304
	Non- diabetic	-0.73±1.64	
Lumbar spine Z score	Diabetic	-0.03±1.85	0.419
	Non- diabetic	-0.31±1.46	

Table 7: Distribution of Bone Mineral Density (BMD) T score and Z score in diabetics and non-diabetics elderly female.

Variable	Diabetes Status	Mean	P-value
Femur BMD(g/cm^2)	Diabetic	0.84± 0.18	0.003
	Non-diabetic	0.77±0.15	
Femur T score	Diabetic	-1.14±1.13	0.001
	Non-diabetic	-1.90±0.98	
Femur Z score	Diabetic	0.09±1.11	0.000
	Non-diabetic	-0.40±0.86	
Lumbar spine BMD (g/cm^2)	Diabetic	1.00±0.16	0.073
	Non- diabetic	0.95±0.19	
Lumbar spine T score	Diabetic	-1.58±1.30	0.056
	Non-diabetic	-1.96±1.55	
Lumbar spine Z score	Diabetic	-0.38±1.17	0.083
	Non-diabetic	-0.69±1.39	

Discussion

In 313 elderly evaluated in our study, the prevalence of osteoporosis in this study was 39.5%, higher than a study conducted by Al Yousef et al. [6] who reported that prevalence of osteoporosis was 8.3% among elderly attending the primary health care facilities in Dubai. This could be explained by the patient in this study at high risk of osteoporosis as they referred after being screened by family physician for osteoporosis. Patients identified as having high risk were referred to osteoporosis clinic for DEXA and further assessment.

The investigations of the clinical relevance of osteoporosis in type 2 diabetes mellitus, appear conflicting, and to date, no clear findings have been reached due to the inconsistent findings among researchers [20]. Our data showed that nondiabetics were at a higher risk of developing osteoporosis than T2DM elderly. This finding is consistent with previous studies in Kuwait [9], Jordan [10] and Iran [11] which showed that T2DM is a promoter for bone health. Furthermore, studies have reported that Magnesium deficiency is linked to osteoporosis, insulin resistance and Alzheimer's disease. This could explain that magnesium deficiency in nondiabetics increased the risk for osteoporosis compared to diabetic who consume appropriate magnesium through diet to prevent insulin resistance and therefore prevent osteoporosis [21-24].

In contrast, several studies done in UAE [14], Saudi [25] and china [17] showed that T2DM patients were at higher risk for

osteoporosis. This persistent controversy is probably largely related to the complex pathophysiology of type 2 diabetes and the vast differences in study designs, selection of patients, different diseases stages and BMD measurement technology. It was generally assumed that osteoporosis is less common in men than women. The difference in men and women may be caused by the fact that overall men have a greater BMD at all sites and loose bone at a lower rate than women do [26]. This is in agreement with our study, which reported higher femur and lumbar spine BMD in males in comparison with females.

BMD is used as an indicator for assessing susceptibility to osteoporosis [19]. BMD was analyzed at two sites-femur and lumbar spine using DEXA. BMD was lower in femur indicating higher prevalence of osteoporosis at hip than at lumbar spine.

This observed prevalence of osteoporosis at hip is similar to the finding from Leidig-Bruckner et al. [27] in patients with T2DM who reported the greater prevalence of osteoporosis at hip than at spine. This finding needs further exploration to determine the factors that could contribute to differential rate of bone loss from two sites. The present study revealed that vitamin D was higher in diabetic elderly compared to non- diabetic. This finding in congruent with chen et al. [17] which reported that elderly diabetic men had a higher vitamin D in comparison to non-diabetic. This could be due to the regular comprehensive care provided to the diabetic patients. Body mass index of the participants in this study ranged from 15.15-6.80. In this study, no significant difference was observed in the BMI of two groups. Similarly, Asokan et al. [15] found no difference in BMI between the diabetic and non-diabetic participants. However these findings were against the observation of Saudi study [25], which showed that low BMI is associated with high risk of osteoporosis.

Conclusion

The prevalence of osteoporosis in this study was 39.5%. Our data showed that nondiabetics were at a higher risk of developing osteoporosis than T2DM elderly. BMD in femur was slightly lower than at lumbar spine. The study findings revealed that Vitamin D and HBA1C were significantly higher in diabetic elderly.

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