UNDERSTANDING THE LINK BETWEEN BONE HEALTH AND CARDIOVASCULAR RISK: A COMPARATIVE ANALYSIS OF BONE MINERAL DENSITY AND CORONARY ARTERY CALCIFICATION IN JORDANIAN PATIENTS

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Abstract

Background: Risk factors, such as smoking, increased age and vitamin D insufficiency are common in cardiovascular disease and osteoporosis. Reduced bone mineral density is affirmed by dual-energy absorptiometry (DXA scan) and coronary artery calcification is recorded by computed tomography. 34% of females and 30.7% of males aged 50-79 years have osteoporosis. Aim: To determine the correlation between coronary artery calcification and bone mineral density in Jordanian patients and the effect of coronary artery disease risk factors on osteoporosis.

Methods: Our retrospective investigation included 120 patients (21 patients with osteoporosis and 99 patients with normal bone mineral density or osteopenia), with an average age of 59.4 (+/-8.4) yrs., of both sexes (57.5% of patients[69/120] were females), with no history of coronary artery disease and who were scheduled to dual-energy absorptiometry for bone mineral density screening for osteoporosis and coronary artery calcification score scanning for coronary artery disease classification during the past year of each other at Rehabilitation center, King Hussein medical city, Amman ,JORDAN, during the period Feb. 2021-Apr. 2023. The correlation between osteoporosis and coronary artery calcification was determined. The calcium score was measured using CT. The coronary artery calcification intensity was classified into two groups of mild or severe. Bone mineral density was recorded as T-scores, and the scores were classified as normal/osteopenic or osteoporotic. Chi-square and Students T tests were used to compare parameters. Logistic regression was used to evaluate the correlation between risk factors and coronary artery calcification.

Results: Patients with coronary artery calcification scores of 0 were remarkably aged less than patients with coronary artery calcification scores more than 0. Hypertension was more in patients with coronary artery calcification scores more than 0. Coronary artery calcification score was not remarkably discrepant between osteoporosis and non-osteoporosis. An increased coronary artery calcification score (more than 100) was found in 27.3%(27/99), 22.2%(2/9), 20%(1/5) and 28.6%(2/7) of patients with no osteoporosis, osteoporosis of the lumbar spine, osteoporosis of the femoral neck and osteoporosis of the lumbar spine and femoral neck, respectively (P>0.05).

Conclusion: Osteoporosis is not correlated with increased coronary artery calcification scores in Jordan. Coronary artery disease risk factors are not remarkably common in osteoporosis. Coronary artery calcification and osteoporosis are independent age-related diseases with similar risk factors.

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Introduction

Cardiovascular disease and osteoporosis incidence is increasing [1]. Risk factors, such as smoking, increased age and vitamin D insufficiency are common in both [2]. There is a correlation between osteoporosis and cardiovascular disease [3]. Reduced bone mineral density has a remarkable correlation with cardiovascular disease in males aged more than 50 years and after menopause in females [4].

Coronary artery calcification is an indicator for atherosclerosis. An increased coronary artery calcification score was correlated with obstructive coronary artery disease [5]. There is no correlation between bone mineral density and coronary artery calcification [6]. There is a correlation between coronary artery calcification and bone mineral density [7], induced by age, smoking, and hormones or inflammatory cytokines [8]. The conflicting results between bone mineral density and coronary artery calcification are caused by gender discrepancies.

34% of females and 30.7% of males aged 50-79 years have osteoporosis [9]. Osteoporosis will increase with increased life expectancy [10]. The increased osteoporosis is caused by reduced calcium intake and vitamin D insufficiency [11]. There is a correlation between bone mineral density and coronary artery calcification in a multiethnic group [11].

The aim of our investigation was to determine the correlation between coronary artery calcification and bone mineral density in Jordanian patients and the effect of coronary artery disease risk factors on osteoporosis and cardiovascular disease.

Methods

This retrospective investigation included 120 patients (21 patients with osteoporosis and 99 patients with normal bone mineral density or osteopenia), with an average age of 59.4 (8.4) yrs., of both sexes (57.5% of patients [69/120] were females) and who were scheduled to dual-energy absorptiometry for bone mineral density screening for osteoporosis and coronary artery calcification score screening for coronary artery disease classification during the past year of each other at Rehabilitation center, King Hussein medical city, Amman, JORDAN, during the period Feb.2021-Apr.2023,after obtaining written informed consent from all participants and approval from our local ethical and research board review committee of the Jordanian Royal medical services. Subjects with previous coronary artery disease or metabolic bone disease were ruled out from the investigation.

The correlation between osteoporosis and coronary artery calcification was determined. The calcium score was measured using CT. The coronary artery calcification intensity was classified into two groups of mild (from score 0 to 100) or severe (score more than100). The bone mineral density of the lumbar spine (L1-L4) and femoral neck was recorded. Bone mineral density was recorded as T-scores, and the scores were classified as normal/osteopenic (T-score between −1 and −2.5) or osteoporotic (T-score less than −2.5).
Statistics

Chi-square test was used to assess the association between qualitative parameters. Students T test was used to compare continuous parameters. Logistic regression was used to evaluate the correlation between risk factors and coronary artery calcification (dependent). P- value less than 0.05 was considered significant.

Results

51/120 patients (42.5%) were men with an average age of 59.8 (8.3) years. The average age of participants with coronary artery calcification score of 0 was remarkably less than patients with coronary artery calcification score more than 0. Table I. 21 participants (30.9%) with coronary artery calcification score more than 0 experienced a family history of coronary artery disease and 8 participants (15.4%) with coronary artery calcification score 0 experienced a family history of coronary artery disease. Hypertension in patients with coronary artery calcification score more than 0 were more than in patients with a coronary artery calcification score 0. P<0.05. There were no

remarkable discrepancies in sex, smoking and T-score between coronary artery calcification patients. 21/120 patients experienced a T-score less than −2.5 (osteoporotic) and 99/120 patients experienced a T-score between −1 and −2.5 (normal or osteopenic). Table I.

No coronary artery disease risk factors were remarkably discrepant between osteoporotic and non-osteoporotic patients. Table II. The age of subjects with coronary artery calcification scores more than 100 was remarkably more than with less coronary artery calcification scores. Table III. There was a correlation between family history of coronary artery disease and an increased coronary artery calcification score (P<0.05). There was no remarkable discrepancy regarding sex or smoking within the reduced and increased coronary artery calcification patients. The incidence of hypertension in increased coronary artery calcification scores remarkably was more than in reduced coronary artery calcification scores. Comparing risk factors by increased and decreased coronary artery calcification patients between sexes, men and women varied for a family history of coronary artery disease, remarkably only in women. Table IV.

Coronary artery calcification is correlated with increasing age(P<0.05), male sex(P<0.005) and hypertension(P<0.0005). Each one-year increase in age was correlated with an increase in the risk of more coronary artery calcification score compared to a reduced score. For men, the risk of an increased coronary artery calcification score was more than that of women. Hypertension had a risk of more coronary artery calcification score than that of normal blood pressure. An increased coronary artery calcification score (more than100) was found in 45 (27.3%) [27/99] of patients with no osteoporosis, 22.2% [2/9] of patients with osteoporosis of the lumbar spine, 20% [1/5] of patients with osteoporosis of the femoral neck and 28.6% [2/7] of patients with osteoporosis of lumbar spine and femoral neck, but not remarkable (P>0.05). There is no correlation between coronary artery calcification score and osteoporosis.

Table I. Investigation features according to coronary artery calcification.

Parameter	Overall	coronary artery calcification		P
score		0	more than 0	
No.	120	52	68	
Age(yrs.)average(SD+/-)	59.4(8.4)	55(8)	62.8(7.3)	<0.005
Gender (No., %) M	51(42.5)	22(42.3)	29(42.6)	>0.05
F	69(57.5)	30(57.7)	39(57.4)	
Family History of coronary artery disease (no.,%)	29(24.2)	8(15.4)	21(30.9)	<0.005
Smoking(no.,%)	4(3.3)	2(3.8)	2(2.9)	>0.05
Hypertension(No.,%)	63 (52.5)	22 (42.3)	41 (60.3)	<0.05
T score less than −2.5(No.,%)	21 (17.5)	9 (17.3)	12 (17.6)	>0.05

Table II. Features of normal and osteoporotic patients

parameter	overall	T score		P
		more than −2.5	less than −2.5	
No.	120	99	21	
Age(years)average(SD+/-)	59.4(8.4)	59.73 (8)	58 (9.9)	>0.05
Gender (no, %) M	51(42.5)	39(39.4)	12(57.1)	>0.05
F	69(57.5)	60(60.6)	9(42.9)	
Family history of coronary artery disease(no,%)	29 (24.2)	24 (24.2)	5 (23.8)	>0.05
Smoking(no.%)	4 (3.3)	4 (4.04)	-	>0.05
Hypertension(no,%)	63 (52.5)	55 (55.6)	8 (38.1)	>0.05
Coronary artery calcification score(average)	139.7	147.5	103.1	>0.05

Table III. Features according to Coronary artery calcification

Parameter	Overall	Coronary artery calcification		P
Score		Less than 100	More than 100	
No.	120	88	32	
Age(yrs)average(SD+/-)	59.4 (8.4)	57.8 (8.1)	63.8 (7.9)	<0.005
Male gender(no,%)	51 (42.5)	35 (39.8)	16 (50)	>0.05
Family history of coronary artery disease(no,%)	29 (24.2)	16 (18.2)	13 (40.6)	<0.05
Smoking(no,%)	4 (3.3)	3 (3.4)	1 (3.1)	>0.05
Hypertension(no,%)	63 (52.5)	39 (44.3)	24 (75)	<0.005
Spine Bone mineral density (average, SD+/-)	1.31 (0.227)	1.3 (0.221)	1.33 (0.243)	>0.05
Femoral bone mineral density(average, SD+/-)	1.122 (0.196)	1.117(0.195)	1.134 (0.198)	>0.05
T score of Femoral or Spine less than −2.5(no,%)	21 (17.5)	16 (18.2)	5 (15.6)	>0.05

Table IV. Coronary artery disease risk factors in terms of coronary artery calcium score by sex

Gender	Women(NO=69)			Men(NO=51)		
	coronary artery calcium		P	coronary artery calcium		P
Score	Less than 100	More than 100		Less than 100	More than 100	
No.	53	16		35	16	
Age(yrs)average(SD+/-)	60.4 (6.2)	66.5 (7.5)	<0.005	54 (9.4)	61.1 (7.7)	<0.005
Family History of coronary artery disease(no,%)	9 (16.98)	6 (37.5)	<0.05	9 (25.7)	5 (31.3)	>0.05
Smoking(no,%)	0 (0)	1 (6.3)	>0.05	2 (5.7)	1 (6.3)	>0.05
Hypertension(no,%)	29 (54.7)	14 (87.5)	<0.005	10 (28.6)	10 (62.5)	<0.005
Spine bone mineral density(average, SD+/-)	1.31 (0.227)	1.32 (0.06)	>0.05	1.29 (0.24)	1.34 (0.24)	>0.05
Femoral bone mineral density(average, SD+/-)	1.122 (0.196)	1.13 (0.14)	>0.05	1.12 (0.24)	1.14 (0.23)	>0.05
T score of Spinal or Femoral less than −2.5(no,%)	8 (15.1)	1 (6.3)	>0.05	9 (25.7)	3 (18.8)	>0.05

III. DISCUSSION

We tried to determine the correlation between coronary artery calcification and osteoporosis. There was no correlation between coronary artery calcification and osteoporosis confirmed by dual-energy absorptiometry screening between Jordanian subjects. There was no correlation between coronary artery calcification and bone mineral density or coronary artery disease risk factors, away from bone mineral density waste, which was more in females with increased coronary artery calcification scores due to reduced estrogen [12]. There was no remarkable correlation between subclinical coronary calcification and reduced bone mineral density between middle-aged males and females [13]. There was no correlation between osteoporosis and coronary artery calcification between bone mineral density and computerized tomography and coronary artery calcification [6].

There was a negative correlation between bone mineral density and coronary artery calcification [14] due to age, common risk factors (smoking) or hormones of inflammatory cytokines. The correlation between coronary artery calcification and bone mineral density is induced by gender or ethnicity discrepancies [8]. This correlation between osteoporosis and coronary artery calcification is due to difference in populations and the anatomical location of osteoporosis and coronary atherosclerosis. The incidence of coronary artery calcification was 56% [15]. There was a remarkable correlation between coronary artery calcification and age, family of coronary artery disease and

hypertension. There was no correlation between the T-score of the lumbar spine or the T-score of the femoral neck, indicating that reduced bone density and coronary artery calcification are independent of cardiovascular risk factors such as hypertension or gender discrepancies. Atherosclerosis and osteoporosis have common risk factors such as aging, stress, hypertension and inflammation [16]. We showed no correlation between coronary artery calcification score (CAC score less or more than 100) and coronary artery disease risk factors in osteoporotic and non-osteoporotic patients. In this investigation, the coronary artery calcification score was more in non-osteoporotic subjects and there was no remarkable discrepancy between them. We demonstrated no remarkable correlation between coronary artery calcification and osteoporosis in subjects with different coronary artery calcification scores. The incidence of osteoporosis in this study was reduced. Dual-energy absorptiometry mayn't spot osteoporosis of the lumbar spine in severe degenerative modifications and osteophytes, or in calcific plaques in adjacent vessels. Bone mineral density gives a measurement of metabolically active trabecular bone. In this investigation, bone mineral density showed a remarkable correlation between coronary artery calcification and vascular calcification at vascular locations.

34% of fit females and 30.7% of males aged 50–79 years are osteoporotic [9]. The incidence of osteoporosis between females aged 50–70 years was 23% [9]. The incidence of reduced bone mass is more in the Middle East than in the West, because of the increased frequency of vitamin D insufficiency in the Middle East [17,18]. Vitamin D insufficiency is responsible in the cause mechanism of coronary artery disease [19]. Vitamin D insufficiency induces cholesterol uptake by macrophages and causes atherosclerosis. Vitamin D insufficiency is correlated with a reduced high-density lipoprotein, causing atherosclerosis.

There was no remarkable discrepancy in the coronary artery disease risk factors (smoking) in osteoporotic and non-osteoporotic subjects. Coronary artery disease and osteoporosis have common risk factors [20]. The number of subjects in our investigation with high risk for osteoporosis and coronary artery disease is small. Dual-energy absorptiometry is not the proper method to differentiate between bone mineral content and extra osseous calcification. Multi-detector computed tomography used for measurement of coronary artery calcification might not differentiate medial from intimal calcification.
In conclusion

Osteoporosis of the lumbar spine or femoral neck is not correlated with increased coronary artery calcification scores. Osteoporosis and coronary artery calcification are not associated to each other and coronary artery disease risk factors are not remarkably more in osteoporosis. Coronary artery calcification and osteoporosis are independent age-associated diseases with common risk factors.

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