Zagazig University Medical Journal
www.zumj.journals.ekb.eg
https://doi.org/10.21608/zumj.2024.287688.3380 Volume 31, Issue 1.1, JAN. 2025, Supplement Issue
Manuscript ID ZUMJ-2405-3380
DOI 10.21608/ZUMJ.2024.287688.3380
Original article

The Relation between Coronary Artery Disease and Osteopenia: A Study Using Coronary Artery Calcium Score and Bone Mineral Density

Magdy Mohamad Abdelsame [(1)], Hisham Samir Roshdy [(1)], Mohamed Abdalla Eltahlawi[(1)], Ahmed Tantawy Hassan Tantawy [(2)], Elsayed Nabeeh Elshafey
[(1)] Cardiology Department, Faculty of Medicine, Zagazig University, Egypt
[(2)] Cardiology Department, Agouza Police Hospital, Egypt

Corresponding Author:

Ahmed Tantawy Hassan Tantawy

E-Mail:
Ahmedtantawy813@gmail.com

Submit Date 06-05-2024
Revise Date 04-06-2024
Accept Date 10-06-2024

ABSTRACT

Background: The correlation between bone mineral density (BMD) and coronary arterial calcification (CAC) was still controversial **Aim of the study:** The objectives of this study were to assess the relation between coronary artery calcification and osteopenia /osteoporosis using Multidetector computed tomography (MDCT) and Dual-energy X-ray (DEXA). **Patients and methods:** This study was a cross sectional study included 50 patients who were recruited consecutively from the outpatient clinic in Agouza Police hospital; the recruitment time was 6 months from January 2020 till July 2020. **Results:** There was a weak negative correlation between Agatston CAC score and both RT hip total BMD and LT hip total BMD. Additionally, a moderate negative correlation was identified between Agatston CAC score and Lumbar spine BMD, RT femoral neck BMD, and LT femoral neck BMD in female cases. Conversely, male cases exhibited a weak negative correlation between Agatston CAC score and BMD. Furthermore, a statistically significant moderate positive correlation was found between Agatston CAC score and TG, cholesterol, alkaline phosphatase, and BMI. Conversely, a mild negative correlation was observed between Agatston CAC score and HDL levels. Notably, correlations with age, HBA1C, LDL, and calcium were non-significant. Consequently, BMI, right hip total BMD, left femoral neck BMD, and left hip total BMD were identified as significant risk factors for increased CAC score.
Conclusion: The present study concluded that there was inverse association between Agatston CAC score, and BMD as increased CAC score is associated with decrease in bone mineral density which increased risk of coronary artery disease.
Keywords: Bone mineral density, Coronary artery disease, Osteopenia

INTRODUCTION

The hallmarks of osteoporosis, an orthopedic condition, are decreased bone mass and microstructural deterioration of bone. There are two forms of osteoporosis: primary and secondary. Primary osteoporosis is the type most commonly seen in clinical settings **[1]**.
It is now understood that vascular calcification is a highly regulated type of matrix mineral metabolism, contrary to previous theories that it was a passive degenerative process **[2]**.
Two of the leading causes of death and morbidity are osteoporosis and coronary artery disease (CAD). Because of longer life spans, it is anticipated that the prevalence of both diseases will increase **[3]**.
Additionally, if left untreated, these conditions have the potential to develop into more serious conditions including myocardial infarction (MI) and fractures, which can have a significant financial impact **[4]**.
The correlation between arterial calcification and skeletal fragility carries noteworthy clinical consequences because preventive and therapeutic approaches may decrease the burden of cardiovascular disease and osteoporosis **[5]**.

Aim of the Work

To assess the relation between coronary artery calcification and osteopenia /osteoporosis using Multidetector computed tomography (MDCT) and Dual-energy X-ray (DEXA).

METHODS

This study was a cross sectional study included 50 patients who were recruited consecutively from the outpatient clinic in Agouza Police hospital, the recruitment time was 6 months from January 2020 till July 2020, and all included patients fulfilled the inclusion criteria. The study protocol was explained to the patients, informed consent was obtained from each participant. Ethical approval for the study was granted by the Institutional Review Board (IRB) on May 22, 2019, with approval number 5934-22-5-2019M.

Inclusion criteria: Patients were refered for (cardiac MSCT) for any of the following causes: Identifying individuals with CAD presenting with symptoms but no history of heart disease, whether non-acute or acute, Identifying patients with newly diagnosed or recently onset clinical heart failure, Prior to noncoronary heart surgery, patients with a history of normal ECG testing but persistent symptoms or an intermediate risk Duke treadmill score, necessitating preoperative coronary assessment. Patients with equivocal stress imaging outcomes or incongruent electrocardiographic exercise and imaging results in previous stress tests.. Assessment of newly developed or deteriorating symptoms in the context of a previous normal stress imaging assessment of Age range: 50 to 70 years old.

Exclusion criteria: Post-Coronary Artery Bypass Grafting (CABG) patients, Valvular heart disease by Echocardiography, Patients with Osteoma or bone metastasis. Patients with severe renal impairment, chronic liver diseases or autoimmune diseases affecting bone metabolism. Patients with technical difficulties for either, cardiac MSCT or DEXA scanning.

All patients were subjected to the following:

To identify risk factors for CAD, such as hypertension, diabetes mellitus, smoking, dyslipidemia, obesity, job stress, and a positive family history of early ischemic heart disease, a complete history taking should be conducted, taking into account characteristics such as age, sex, special habits (particularly smoking).

Body Mass Index (BMI) calculated by dividing weight in kgs by height in meters squared. BMI less than 18.5: suggest the person was underweight, BMI between 18.5 to 24.9: suggest optimal weight, BMI between 25 to 29.9: suggest overweight, while BMI 30 or higher: suggest obese range.

Local examination of the heart for cardiomegaly, pulsations, thrills, heart sounds and murmurs. Routine laboratory investigations including CBC, hemoglobin concentration (Hb %), red blood cells (RBCs), white blood cells (WBCs), platelet count, serum urea, serum creatinine, GFR, FBS, HbA1C, Lipid profile (cholesterol, HDL, LDL and triglycerides), Calcium, phosphate, alkaline phosphatase, serum parathyroid hormone (PTH). CRP, ESR.

ECG criteria suggestive of CAD; ST-Segment Changes, T-Wave Changes, Pathological Q Waves, Arrhythmias.

Echocardiography to exclude valvular diseases

Dual –Energy X-ray Absorptiometry (DEXA) to detect mineral densities (BMD, g/cm2). All patients were examined using MEDILINK (MEDIX DR, Gallargguess-Le-Montueux, FRANCE).

Mulitislice CT examination; all patients were examined using Toshiba Aquilon one 320, OTAWARA-SHI, JAPAN to detect coronary artery calcium score using agastone score.

CT Protocol: Every exam was conducted using a 320-MDCT scanner. In order to quantify the amount of coronary calcium, the patients underwent prospectively ECG-gated unenhanced volumetric CT (CT calcium score). If there were no contraindications, patients with a cardiac frequency more than 60 beats per minute were given 25–100 mg of oral metoprolol to reduce their heart rate. The cardiac apex and the carina were the anticipated scan ranges. A detector arrangement of 320 × 0.5 mm or 280 × 0.5 mm was utilized, depending on the anticipated scan range. Just prior to taking a photograph, using an ECG recording during a breath-hold exercise, the ideal reconstruction phase was identified. During inspiration breath hold, the acquisition of the whole cardiac CT calcium score was completed in less than one heartbeat. A patient's size and shape determined the scan parameters, which were 200 mA for tiny or thin individuals, 250 mA for average sized patients, and 300–400 mA for large or obese patients. The tube voltage used was 120 kV, and the tube current range was 200–400 mA (mean, 320 ± 49 mA). The rotation took 0.35 seconds. The scanner's dose–length product for each patient and the correction factor 0.017 for adult chest imaging were the foundations for an accurate assessment of radiation dosage [6].

Statistical Analysis

SPSS 26 for Windows was used to gather, tabulate, and statistically analyse all of the data (SPSS Inc., Chicago, IL, USA). The Shapiro Walk test was used to determine if the data were normally distributed. Frequencies and relative

percentages were used to display the qualitative data. The standard deviation, range, and mean of quantitative data were presented as mean ± SD. The difference between categorical variables was calculated using the Fisher exact test and the Chi square test. The CAC score and other parameters were correlated using Pearson and Spearman. To ascertain risk for CAC score, multivariate linear regression analysis was performed. Every statistical comparison had two tails and was considered significant. A P-value of less than 0.05 suggests a significant difference, p <0.001 a highly significant difference, and P> 0.05 a non-significant difference.

RESULTS

As described in table 1, mean age of studied cases was 58.8±5.6, ranged from 50 to 69 years with 52% of studied cases males and about three fourth were non-smoker, as regard BMI, mean was 26.3±4.5 and ranged from 18.5 to 36.5.For comorbidities, about one fourth of cases were diabetic, 14% were hypertensive, 16% had dyslipidemia and only 10% had DM had hypertension

As demonstrated in table 2, mean systolic and diastolic blood pressure of studied cases were 120 and 76.5 respectively, ranged from 80 to 170 for systolic blood pressure and from 60 to 100 regarding diastolic blood pressure, regarding heart rate and respiratory rate, mean was 101±14.8 and 29.7±5.6 respectively

As demonstrated in table 3, all cases underwent routine lab investigation included CBC (HB, TLC and platelet), renal function test (urea and creatinine), liver function test (ALT, AST and serum albumin), lipid profile (cholesterol, TG, LDL and HDL) plus HBA1C, blood glucose, ca and alkaline phosphatase. Regarding CBC, mean HB, TLC and platelet was 12.3±1.5, 6.4±1.5 and 207±100 respectively. Regarding renal function test, mean urea and creatinine was 26.3±10.7 and 1.13±0.62 respectively. For liver function test, mean ALT, AST and albumin was 28.9±17.7, 26.7±12.2 and 4.2±0.43 respectively.

For lipid profile as shown in table 4, mean serum cholesterol and triglyceride was 179±65 and 148.7±65 respectively, with 16 cases had serum cholesterol above normal limit (>200mg/dl) and 19 cases had serum TG above normal limit (>150 mg/dl). As regard HBA1C and blood glucose, mean was 6±1.7 and 105.7±18.9 respectively. Finally, as regard ca and alkaline phosphatase, mean was 2.2±0.19 and 72.9±20.1 respectively with 4 cases had serum alkaline phosphatase below normal limit and 7 cases above normal limit which is 44:147 IU/L

As shown in table 5, bone mineral density for lumbar spine, RT femoral neck, LT femoral neck, RT hip and LT hip were done using DEXA and mean BMD for these parameters were 0.89±0.12, 0.65±0.08, 0.66±0.08, 0.80±0.10 and 0.77±0.10 respectively

As described in table 6, about 18% and 24% of cases had osteoporosis and osteopenia in lumbar spine and the remaining 58% were normal. As regard RT femoral neck and RT hip, about 22% and 8% had osteoporosis respectively For LT femoral neck and LT hip, about 28% and 8% had osteoporosis respectively

CAC score was calculated for all cases as shown in table 7, and it was found that, the majority of cases (40%) had minimal risk of coronary artery disease, then one fifth of cases had moderate increased risk for future cardiovascular events, then 16% had high risk for future cardiovascular events such as myocardial ischemia while only 6% had no risk

As found in table S1, there is mild negative correlation between Agatston CAC score and both Lumbar spine BMD, RT femoral neck BMD, RT hip total BMD, LT femoral neck BMD and LT hip total BMD (r=-0.37, -0.40, -0.31, -0.38 and -0.33 respectively) with significant p value <0.05 and this can be interpreted as when CAC score increase and increase risk for coronary artery disease, there is also decrease in bone mineral density. When Agatston CAC score was correlated with t score, it was found that decrease in t score and increase risk for osteoporosis will be associated with increased CAC score with mild significant negative correlation between CAC score and t score.

As shown in table S2, there is moderate positive correlation between Agatston CAC score and both TG, cholesterol, alkaline phosphatase and BMI (r=0.61, 0.61, 0.52 and 0.58 respectively) and this correlation is statistically significant (p value <0.05). On other hand there is mild negative correlation between Agatston CAC score and HDL (r=-0.40) with significant p value <0.05. While there is non-significant correlation with age, HBA1C, LDL and ca (p value >0.05

Table S3 show multivariate linear regression analysis for variables independently associated with high risk of CAC score, and the results demonstrated that BMI, right hip total BMD, left femoral neck BMD, left hip total BMD were significantly risk factors for increased CAC score

Table (1): descriptive statistics of the demographic data among studied cases

Demographic data		**Cases (n=50)**
Age (years)	Mean ± SD Median (Range)	58.8±5.6 58(50:69)
Sex	Male Female	26(52%) 24(48%)
BMI (kg/m$^{2)}$	Mean ± SD Median (Range)	26.3±4.5 26(18.5:36.5)
Smoking	Non smoker Current smoker Ex-smoker	38(76%) 6(12%) 6(12%)
Comorbidities	DM HTN DM & HTN Dyslipidemia	13(26%) 7(14%) 5(10%) 8(16%)

Table (2): descriptive statistics of vital data among studied cases

Vital data		**Cases (n=50)**
SBP (mmhg)	Mean ± SD Median (Range)	120.9 ±25.2 115(80:170)
DBP (mmhg)	Mean ± SD Median (Range)	76.5±14.5 70(60:100)
Heart rate (pulse/min)	Mean ± SD Median (Range)	101±14.8 105(64:130)
Respiratory rate (/min)	Mean ± SD Median (Range)	29.7±5.6 30(17:40)
Temperature(c)	Mean ± SD Median (Range)	37.5±0.79 37(36.4:39)

Table (3): descriptive statistics of lab data (CBC, renal function and liver function tests) among studied cases

Lab data			**Cases (n=50)**
CBC	**HB** (gm/dl)	Mean ± SD Median (Range)	12.3±1.5 12(10:16)
	TLC (*10^6/L)	Mean ± SD Median (Range)	6.4±1.5 6(3.5:11)
	Platelet (*10^9/L)	Mean ± SD Median (Range)	207±100 171(77:500)
LFT	**ALT** (U/L)	Mean ± SD Median (Range)	28.9±17.7 26.5(10:98)
	AST(U/L)	Mean ± SD Median (Range)	26.7±12.2 22(9:74)
	Albumin (gm/dl)	Mean ± SD Median (Range)	4.2±0.43 4.3(3.5:5.2)
RFT	**Creatinine** (mg/dl)	Mean ± SD Median (Range)	1.13±0.62 1(0.5:3.5)
	Urea(mg/dl)	Mean ± SD Median (Range)	26.3±10.7 23(13:59)

Table (4): descriptive statistics of lab data (lipid profile, ca, alkaline phosphatase, HBA1C and blood glucose) among studied cases

Lab data		**Cases (n=50)**
TG (mg/dl)	Mean ± SD Median (Range)	148.7±65 122(55:341)
Cholesterol (mg/dl)	Mean ± SD Median (Range)	179±65 152(85:371)
HDL (mg/dl)	Mean ± SD Median (Range)	48.3±14.4 48.5(20:76)
LDL (mg/dl)	Mean ± SD Median (Range)	99±30 89.5(60:190)
Random blood glucose (mg/dl)	Mean ± SD Median (Range)	105.7±18.9 104.5(70:148)
HBA1C	Mean ± SD Median (Range)	6±1.7 5.7(4:11)
Ca (mmol/L)	Mean ± SD Median (Range)	2.2±0.19 2.2(2.1:2.8)
Alkaline phosphatase (IU/L)	Mean ± SD Median (Range)	88.6±37.5 82(29:176)

Table (5): Bone mineral density by DEXA among studied cases

Bone mineral density by DEXA		**Cases (n=50)**
Lumbar spine BMD	Mean ± SD Median (Range)	0.89±0.12 0.92(0.58:1.08)
RT femoral neck BMD	Mean ± SD Median (Range)	0.65±0.08 0.66(0.49:0.86)
RT hip total BMD	Mean ± SD Median (Range)	0.80±0.10 0.79(0.57:1.08)
LT femoral neck BMD	Mean ± SD Median (Range)	0.66±0.08 0.66(0.46:0.82)
LT hip total BMD	Mean ± SD Median (Range)	0.77±0.10 0.80(0.49:0.96)

Table (6): classification of studied cases according to t score by DEXA

Bone mineral density by DEXA		**Cases (n=50)**
Lumbar spine t score	Normal (t score >-1) Osteopenia (t score -1: -2.5) Osteoporosis (t score >-2.5)	29(58%) 12(24%) 9(18%)
RT femoral neck t score	Normal (t score >-1) Osteopenia (t score -1: -2.5) Osteoporosis (t score >-2.5)	24(48%) 15(30%) 11(22%)
RT hip total t score	Normal (t score >-1) Osteopenia (t score -1: -2.5) Osteoporosis (t score >-2.5)	28(56%) 18(36%) 4(8%)
LT femoral neck t score	Normal (t score >-1) Osteopenia (t score -1: -2.5) Osteoporosis (t score >-2.5)	19(38%) 17(34%) 14(28%)
LT hip total t score	Normal (t score >-1) Osteopenia (t score -1: -2.5) Osteoporosis (t score >-2.5)	33(66%) 13(26%) 4(8%)

Table (7): CAC score among studied cases

CAC score	Risk analysis	Frequency (%) (N=50)
Score 0 (CAC=0)	**(no risk)**	3(6%)
Score 1 (CAC=1-10)	**(minimal risk)**	20(40%)
Score 2 (CAC=11:100)	**(mild risk)**	9(18%)
Score 3 (CAC=101:400)	**(moderate risk)**	10(20%)
Score 4 (CAC >400)	**(high risk)**	8(16%)

DISCUSSION

Among the signs of coronary atherosclerosis is coronary artery calcification (CAC). The insufficient absorption of calcium ions following tissue injury, particularly inflammation, results in calcification. Cardiovascular ischemia and major cardiovascular events are caused by calcified plaque, which further narrows the blood vessel lumen. CAC also decreases vascular compliance and impacts myocardial perfusion [7].

Epidemiological research revealed a number of relationships between CAC and variables, such as age, gender, and calcium metabolism. The aberrant calcium deposit with low bone mineral density (BMD) is one of these issues that become more and more notable. The most dangerous type of fracture is a hip fracture, which is caused by the systemic bone disease osteoporosis, which lowers bone mass density [8].

T score is frequently employed in clinical studies of osteoporosis, and dual-energy X-ray absorptiometry (DXA) is typically utilized to quantify BMD. T-scores between -1 and -2.5 SD were used to define osteopenia while T-scores less than -2.5 SD were used to define osteoporosis, per WHO guidelines [9].

Coronary artery calcium (CAC) is a robust predictor of future cardiovascular events and a marker of subclinical atherosclerosis. Similarly, osteoporosis's characteristic, low bone mineral density (BMD), is a recognized risk factor for future fractures [10].

The main aim of this study was to assess the relation between coronary artery calcification and osteopenia /osteoporosis using Multidetector computed tomography (MDCT) and Dual-energy X-ray (DEXA).

This cross sectional study had been carried out in Zagazig University hospitals and Agouza Police hospital. The study had included 50 patients from outpatient clinic (OPD).

The present study reported that the mean age of studied cases was 58.8±5.6, ranged from 50 to 69 years, 52% of studied cases were males and 38 (76%) cases were non-smoker, and the mean BMI was 26.3±4.5 ranging from 18.5 to 36.5 kg/m^2.

This study supports the findings of Kim et al. [11], who examined the relationship between coronary computed tomographic angiography (CCTA) results, such as the coronary artery calcification (CAC) score, and bone mineral density (BMD). They disclosed that their patients' average age was 52.4±7.2 years, and their average body mass index was 22.2±3.0 kg/m^2.

Furthermore, our research aligns with the findings of Manubolu et al. [11], who investigated the connection between bone mineral density (BMD) and coronary artery calcium (CAC) score severity. The average age of the patients was found to be 62.2 ±10.2 years, with 53% being female and 47% being male. Additionally, the mean body mass index was found to be 28.3 ±5.5 kg/m^2.

As regards comorbidities, our study revealed that 13(26%) of cases were diabetic, 14% were hypertensive, 16% had dyslipidemia and only 10% had DM and hypertension.

Comorbidities show that our results are consistent with those of Manubolu et al. [12], who found that 27% of patients had diabetes mellitus and 45% of their population had hypertension.

The current study reported that the mean systolic and diastolic blood pressure of studied cases were 120 and 76.5 respectively, ranged from 80 to 170 for systolic blood pressure and from 60 to 100 regarding diastolic blood pressure, the mean heart rate was 101±14.8 and the mean respiratory rate was 29.7±5.6.

Furthermore, our results are consistent with those of Kim et al. [11], who reported that the mean diastolic blood pressure was 63.7±10.3 mmHg and the mean systolic blood pressure (SBP) was 110.6±15.8 mmHg.

According to laboratory investigations, our results revealed that the mean HB was 12.3±1.5gm/dl; TLC was 6.4±1.5 10^6/L, platelet 207±100 10^9/L. As regards renal function test, mean urea and creatinine was 26.3±10.7 and 1.13±0.62 respectively. For liver function test, mean ALT, AST and albumin was 28.9±17.7, 26.7±12.2 and 4.2±0.43 respectively. Also, we found that the mean HBA1C and blood glucose were 6±1.7 and 105.7±18.9 mg/dl respectively.

Regarding lipid profile, our study revealed that the mean serum cholesterol and triglyceride was 179±65 and 148.7±65 respectively, with 16 cases had serum cholesterol above normal limit (>200mg/dl) and 19 cases had serum TG above normal limit (>150 mg/dl).

In addition, our findings align with those of Kim et al. [11], who reported mean cholesterol levels of 202.3±35.4 mg/dl, mean triglyceride levels of 91.9±57.7 mg/dl, mean LDL cholesterol levels of 123.9±32.4 mg/dl, and mean HDL cholesterol levels of 59.5±13.8 mg/dL.

According to bone mineral density by DEXA, our results showed that the mean bone mineral density for lumbar spine was 0.89±0.12, RT femoral neck was 0.65±0.08, LT femoral neck was 0.66±0.08, RT hip was 0.80±0.10 and LT hip was 0.77±0.10.

The current study also concurred with Asadi et al. [14] findings, which showed that the median (IQR) of bone mineral density was 0.861 [0.192], 0.733 [0.128] for the femoral neck, and 0.940 [0.156] for the lumbar spine.

Regarding classification of studied cases according to t score by DEXA, our study reported that about 18% and 24% of cases had osteoporosis and osteopenia in lumbar spine and the remaining 58% were normal. As regard RT femoral neck and RT hip, about 22% and 8% had osteoporosis respectively. For LT femoral neck and LT hip, about 28% and 8% had osteoporosis respectively.

The results of the current study are also in line with those of Asadi et al. [14], who found that 65 patients (35.3%) had osteopenia and 27 patients (14.7%) had osteoporosis in the lumbar spine. Twelve patients (6.5%) had osteoporosis and eighty-two (44.6%) had osteopenia at the femoral neck. 62 (33.7%) patients had osteopenia and 8 (4.3%) patients had osteoporosis at the entire hip.

Regarding CAC score, the present study revealed that the majority of cases (40%) had minimal risk of coronary artery disease followed by 10(20%) cases had moderate increased risk for future cardiovascular events, then 16% had high risk for future cardiovascular events such as myocardial ischemia while only 6% had no risk .

Furthermore, our findings are in line with Chuang et al. [15] findings, which stated that 42 (17.1%) patients had a high CAC, 62 (25.2%) patients had a moderate CAC, and 142 (57.7%) patients had no risk of coronary artery disease (CAC= 0).

Regarding relation between CAC score and BMD, the present study reported that there was significant mild negative correlation between Agatston CAC score and both Lumbar spine BMD, RT femoral neck BMD, RT hip total BMD, LT femoral neck BMD and LT hip total BMD and this can be interpreted as increased CAC score accompanied by increased risk for coronary artery disease and decrease in bone mineral density. Also, we revealed that increased risk for osteoporosis will be associated with increased CAC score with mild significant positive correlation between CAC score and t score.

The current study reported that there was moderate positive correlation between Agatston CAC score and both TG, cholesterol, alkaline phosphatase and BMI and this correlation was statistically significant. Also, there was significant mild negative correlation between Agatston CAC score and HDL. While, there was non-significant correlation with age, HBA1C, LDL and Ca.

Furthermore, our results are consistent with those of Lee et al. [4], who reported a statistically significant positive connection between the CAC score and BMI, triglycerides, and HDL cholesterol. However, there was no discernible relationship between LDL cholesterol and CAC score.

The current study demonstrated that BMI, Right hip total BMD, Left femoral neck BMD, Left hip total BMD were significant risk factors for increased CAC score.

In a similar vein, the current study concurs with Xu et al. [13], who found that lumbar spine and left femoral neck BMD were important risk factors for an elevated CAC score.

Our results on multiple logistic regression analysis differed from those of Lee et al. [4], who indicated that there was no independent predictor of CAC based on T-score of the femur and/or lumbar spine, but that there was a substantial correlation between CAC and age and male sex.

Declaration of interest

The authors report no conflicts of interest. The authors along are responsible for the content and writing of the paper.

Funding information

None declared

CONCLUSION

The present study concluded that there was inverse association between Agatston CAC score, and BMD as increased CAC score associated with decrease in bone mineral density so increased risk for coronary artery disease. Subsequent investigations ought to concentrate on evaluating the causal connections between these two entities and clarifying the fundamental pathophysiological mechanisms shared by both ailments. Consequently, this could aid in formulating future treatment plans that address osteoporosis and atherosclerosis.

REFERENCES

1- Kuipers AL, Miljkovic I, Carr JJ, Terry JG, Nestlerode CS, Ge Y et al. Association of circulating sclerostin with vascular calcification in Afro-Caribbean men. Atherosclerosis. 2015 Mar 1;239(1):218-23.

2- Thompson B, Towler DA. Arterial calcification and bone physiology: role of the bone–vascular axis. Nat Rev Endocrinol. 2012 Sep; 8(9):529-43.

3- Epstein FH. Cardiovascular disease epidemiology: a journey from the past into the future. Circulation 1996; 93:1755–64.

4- Lee HT, Shin J, Lim YH, Kim BK, Kim YT, Lee JU et al. The relationship between coronary artery calcification and bone mineral density in patients according to their metabolic syndrome status. Korean Circ J. 2011 Feb;41(2):76.

5- Bolland MJ, Barber PA, Doughty RN, Mason B, Horne A, Ames R et al. Vascular events in healthy older women receiving calcium supplementation: randomised controlled trial. Bmj. 2008 Jan 31;336(7638):262-6.

6- Raff GL, Chinnaiyan KM, Cury RC, Garcia MT, Hecht HS, Hollander JE et al. SCCT Guidelines on the Use of Coronary Computed Tomographic Angiography for Patients Presenting with Acute Chest Pain to the Emergency Department: A Report of the Society of Cardiovascular Computed Tomography Guidelines Committee. J Cardiovasc Comput Tomogr. 2014;8(4):254-71.

7- Zhang P, Yang L, Xu Q, Zeng Y, Yu Y, Peng Q et al. Associations between bone mineral density and coronary artery calcification: a systematic review and meta-analysis. Ther Adv Chronic Dis. 2022 Mar;13:20406223221086998.

8- Fakhry HM, Abo Elsoud MI, Abdel Raheem MA, Abdel Wahab KM. Coronary calcium in patients with metabolic syndrome: presence and extent by msct. Ain Shams Med J. 2023 Mar 1;74(1):99-110.

9- Cherian KE, Kapoor N, Meeta M, Paul TV. Dual-energy X-ray absorptiometry scanning in practice, technical aspects, and precision testing. J Midlife Health. 2021 Oct 1; 12(4):252-6.

10- Fathala AL, Alkulaybi S, Khawaji A, Alomari A, Almuhaideb A. The association between low bone mineral density and coronary artery calcification in osteoporotic and non-osteoporotic patients in a tertiary center in Saudi Arabia. Ann Saudi Med. 2021 Apr; 41(2):101-8.

11- Kim KM, Yoon YE, La Yun B, Suh JW. Association between bone mineral density and coronary atherosclerotic plaque according to plaque composition: registry for the women health cohort for bone, breast, and coronary artery disease study. J Bone Metab. 2022 May; 29(2):123.

12- Manubolu VS, Mao S, Kinninger A, Dahal S, Ahmad K, Havistin R et al. Association between coronary artery calcium and thoracic spine bone mineral density: Multiethnic Study of Atherosclerosis (MESA). Nutr Metab Cardiovasc Dis. 2023 Mar 1;33(3):532-40.

13- Xu R, Yang HN, Li YQ, Wang QF, Guo AH, Ayiti A et al. Association of coronary artery calcium with bone mineral density in postmenopausal women. Coron Artery Dis. 2016 Nov 1;27(7):586-91.

14- Asadi M, Razi F, Fahimfar N, Shirani S, Behzad G, Salari P. The association of coronary artery calcium score and osteoporosis in postmenopausal women: a cross-sectional study. J Bone Metab. 2022 Nov;29(4):245.

15- Chuang TL, Koo M, Wang YF. Association of bone mineral density and coronary artery calcification in patients with osteopenia and osteoporosis. Diagnostics. 2020 Sep 16; 10(9): 699.

Citation

Abdelsame, M., Roshdy, H., Eltahlawi, M., Hassan Tantawy, A., Elshafey, E. The relation between coronary artery disease and osteopenia: A study using Coronary Artery Calcium Score and Bone Mineral Density. *Zagazig University Medical Journal*, 2025; (24-32): -. doi: 10.21608/zumj.2024.287688.3380

Table (s1): Correlation between Agatston CAC score and BMD by DEXA among all studied cases

	Agatston CAC score	
	R	P value
Lumbar spine BMD	-0.37	0.007*
RT femoral neck BMD	-0.40	0.003*
RT hip total BMD	-0.31	0.02*
LT femoral neck BMD	-0.38	0.006*
LT hip total BMD	-0.33	0.01*
Lumbar spine t score	-0.29	0.03*
RT femoral neck t score	-0.40	0.003*
RT hip total t score	-0.43	0.002*
LT femoral neck t score	-0.39	0.004*
LT hip total t score	-0.33	0.01*

Table (s2) correlation between Agatston CAC score and both age, BMI and different lab parameter among all studied case

	Agatston CAC score	
	r	P value
Age	0.04	0.74
BMI	0.58	<0.001*
HBA1C	0.13	0.37
TG	0.61	<0.001*
HDL	-0.40	0.004*
Cholesterol	0.61	<0.001*
LDL	-0.07	0.61
Ca	0.22	0.12
Alkaline phosphatase	0.52	<0.001*

Table (s3): multivariate linear regression analysis for variables independently associated with high risk of CAC score

	Standardized Coefficients	P value	95.0% Confidence Interval for B	
	Beta		Lower Bound	Upper Bound
(Constant)		0.663	-3.759	5.840
Age	-0.019	0.868	-0.054	0.046
Sex (female)	-0.198	0.089	-1.042	0.076
Smoking	0.043	0.703	-0.453	0.664
BMI	0.553	<0.001*	0.089	0.210
Hypertension	-0.166	0.189	-1.160	0.237
DM	-0.289	0.089	-2.191	0.163
Hypertension and DM	0.325	0.082	-0.175	2.814
Hyperlipidemia	0.046	0.718	-0.693	0.996
L-spine BMD	-0.318	0.311	-9.265	3.032
Right femoral neck BMD	-0.065	0.879	-13.488	11.596
Right hip total BMD	-0.709	0.013*	-14.550	-1.800
Left femoral neck BMD	-1.603	0.005*	-38.475	-7.618
Left hip total BMD	-1.051	0.014*	-22.558	-2.732