Metabolic Syndrome and Chronic Kidney Disease, as Risk Factors of Osteoporosis

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BACKGROUND

- Osteoporosis and its related fractures are a significant cause of morbidity and mortality.
- Osteoporosis is often accompanied by metabolic syndrome (MetS) and chronic kidney disease (CKD).
- We demonstrated the relationship between MetS, CKD and osteoporosis, and investigated the roles of MetS and CKD in the occurrence of osteoporosis in a healthy Korean population.

METHODS

- Data were analyzed from subjects who visited the Health Promotion Center at Chung-Ang University Hospital, Seoul, Korea from January 2007 to December 2010.
- The eGFR was calculated using the abbreviated Modification of Diet in Renal Disease (MDRD) study equation.
- The diagnosis of MetS was made according to the updated guidelines from the American Heart Association/National Heart, Lung, and Blood Institute (AHA/NHLBI).
- Bone mineral density (BMD) values were measured using dual-energy x-ray absorptiometry at the lumbar spine and femoral neck area. A decreased BMD level was then defined as either osteopenia or osteoporosis

RESULTS

Table 1. Baseline characteristics

	Male (n=526)	Female (n=826)
Age, years	44.9±8.1	51.0±9.6
BMI, kg/m²	24.6±2.7	23.1±3.2
Blood pressure, mmHg		
Systolic BP	123.1±14.1	118.3±17.0
Diastolic BP	77.1±11.2	71.1±10.9
Glucose, mg/dl	95.8±16.3	94.2±21.0
Triglyceride, mg/dl	142.3±95.2	100.4±60.1
HDL cholesterol, mg/dl	48.4±10.0	55.6±11.7
Number of MetS components, n (%)		
1	167 (31.7)	241 (29.2)
2	129 (24.5)	131 (15.9)
≥3	123 (23.4)	139 (16.8)
eGFR, ml/min/1.73m²	76.3±10.7	75.3±11.0
Groups of eGFR, n (%)		
>90	60 (11.4)	78 (9.4)
60-90	436 (82.9)	689 (83.4)
<60	30 (5.7)	59 (7.1)
Decreased bone marrow density, n (%)		
Osteopenia	191 (36.3)	193 (23.4)
Osteoporosis	32 (6.1)	133 (16.1)

*Table 2.* Differences between normal and decreased BMD

	Normal BMD (n=500)	Decreased BMD (n=326)	p-value
Females			
Age, years	47.7±8.0	56.1±9.5	<0.001
BMI, kg/m²	23.0±3.2	23.1±3.1	0.591
Blood pressure, mmHg			
Systolic BP	116.9±16.6	120.4±17.3	0.003
Diastolic BP	70.4±10.5	72.3±11.5	0.011
Glucose, mg/dl	93.0±21.5	95.9±19.9	0.049
Triglyceride, mg/dl	96.0±58.6	107.1±61.8	0.009
HDL cholesterol, mg/dl	56.0±11.9	55.1±11.5	0.290
eGFR, ml/min/1.73m²	76.2±10.9	73.9±11.1	0.004
MetS, n (%)	73 (14.6)	66 (20.2)	0.034
CKD, n (%)	30 (6.0)	29 (8.9)	0.114
Males			
Age, years	44.3±7.8	45.7±8.5	0.062
BMI, kg/m²	25.2±2.7	23.9±2.7	<0.001
Blood pressure, mmHg			
Systolic BP	123.5±13.2	122.6±15.1	0.476
Diastolic BP	77.4±10.6	76.7±12.0	0.465
Glucose, mg/dl	95.3±14.0	96.6±19.1	0.368
Triglyceride, mg/dl	145.6±93.1	137.8±98.1	0.351
HDL cholesterol, mg/dl	48.2±9.5	48.8±10.8	0.465
eGFR, ml/min/1.73m²	75.3±10.1	77.6±11.2	0.012
MetS, n (%)	81 (26.7)	42 (18.8)	0.034
CKD, n (%)	21 (6.9)	9 (4.0)	0.157

- We analyzed the OR of the number of MetS components and the decreases of eGFR for decreased BMD in male and female, separately.

Table 3. Odds ratio (OR) for decreased BMD

	Simple		Multiple (Adjusted by age)	
Variables	Odds ratio (95% CI)	p-value	Odds ratio (95% CI)	p-value
Females				
Number of MetS components				
1	1.36 (0.96-1.92)	0.082	1.06 (0.72-1.57)	0.777
2	1.26 (0.83-1.92)	0.278	0.63 (0.39-1.03)	0.063
≥3	1.73 (1.15-2.60)	0.008	0.69 (0.43-1.10)	0.118
eGFR (ml/min/1.73m²)				
>90 (reference)	1		1	
60-90	1.81 (1.08-3.06)	0.026	0.74 (0.41-1.35)	0.328
<60	2.62 (1.28-5.36)	0.008	0.68 (0.30-1.55)	0.357
Males				
Number of MetS components				
1	0.83 (0.51-1.35)	0.455	0.81 (0.50-1.32)	0.393
2	0.71 (0.42-1.19)	0.195	0.68 (0.40-1.14)	0.144
≥3	0.53 (0.31-0.90)	0.019	0.50 (0.29-0.85)	0.011
eGFR (ml/min/1.73m²)				
>90 (reference)	1		1	
60-90	0.54 (0.31-0.93)	0.026	0.51 (0.29-0.89)	0.018
<60	0.33 (0.13-0.83)	0.019	0.29 (0.11-0.74)	0.010

- The prevalence of MetS and CKD according to BMD results.
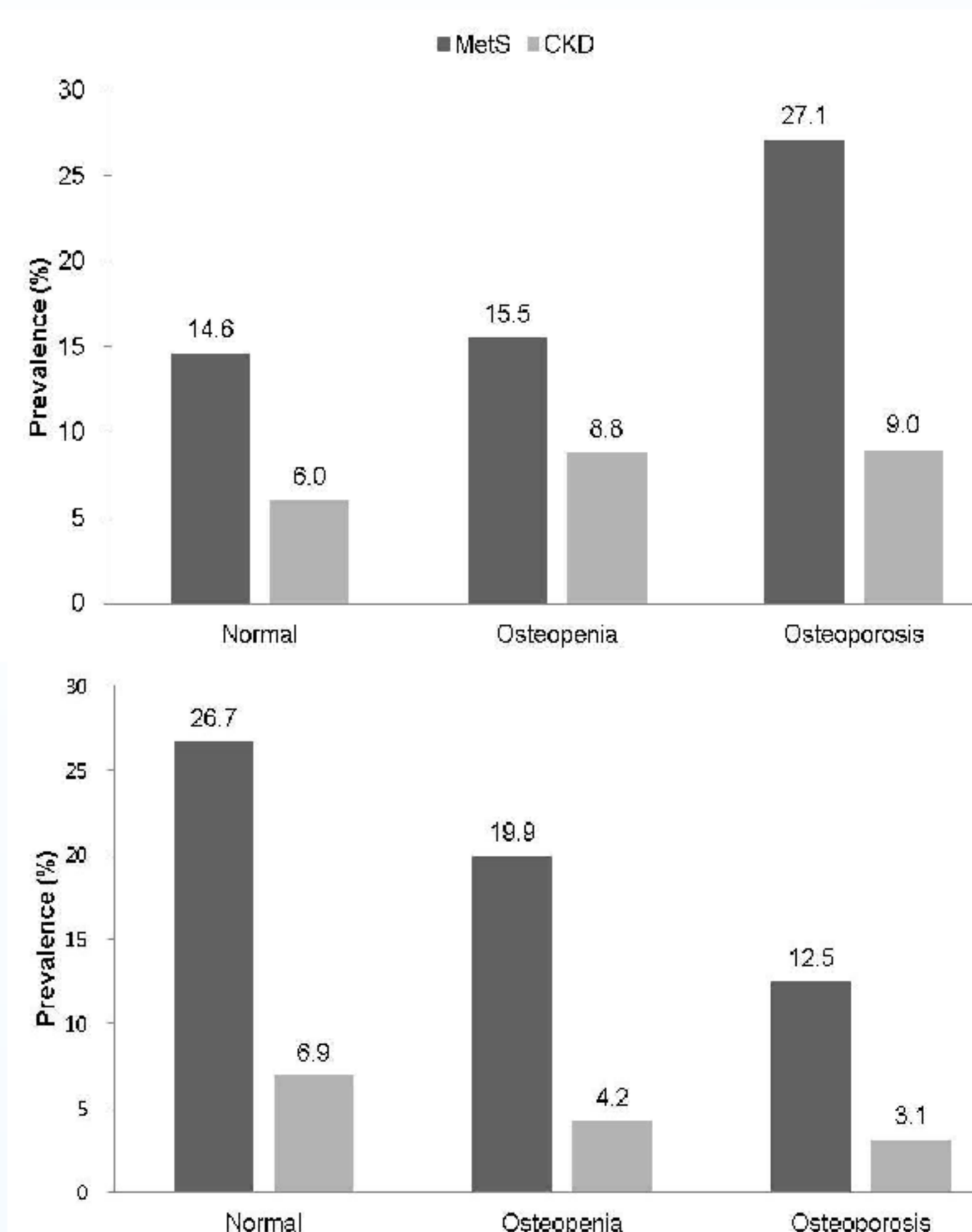
- Figure 1 shows the prevalence of MetS and CKD were higher in those classified as having osteoporosis as compared to those with normal BMD in females.

- Figure 2 shows the prevalence of MetS and CKD was decreased through aggravating BMD results in males.

CONCLUSIONS

There is a correlation among MetS, CKD and osteoporosis in both sexes. In females, lower bone mineral density was positively related to an increased prevalence of both MetS and CKD. However, lower bone mineral density was negatively related to both MetS and CKD in males.