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Reduced renal function is associated with faster loss of bone mineral density in patients with non-dialysis CKD

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Objectives : Bone mineral density (BMD) predicts fracture risk in patients with chronic kidney disease (CKD) and in the general population. However, few studies have investigated risk factors for bone loss in patients with CKD. The aim of this study was to investigate whether renal function is associated with the rate of BMD decline.
Methods : A prospective cohort study included 1,006 patients with CKD stages 2–4 between 2011 and 2016. BMD was measured using dual-energy X-ray absorptiometry at baseline and 4 years. The eGFR was measured 2–6 times during the 4-year follow-up. We analyzed the decline in bone mineral density according to CKD stage and further compared the rate of BMD decline according to eGFR trajectory at each stage.
Results : Advanced CKD stage was associated with a faster rate of decline in total hip BMD (stage 2: −0.23, stage 3A: −0.39, stage 3B: −0.80, stage 4: −1.23 % change/year in men [p<0.001]; stage 2: −0.86, stage 3A: −1.19, stage 3B: −1.20, stage 4: −1.58 % change/year in women [p <0.03]). Two distinct eGFR trajectories (Class 1: stable group; Class 2: rapid decline group) were observed. The rapid decline group showed a trend toward an increased rate of decline in total hip BMD. Subgroup analysis according to eGFR trajectories revealed a significant difference in BMD decline rate between stable and rapid decline groups.
Conclusions : Advanced CKD stage and accelerated decline in renal function were associated with rapid BMD decline in non-dialysis patients with CKD.

Table 1. Decline in total hip bone mineral density (% change/year) according to CKD Stage

	Unadjusted N = 1,006		Model 1[a] N = 996		Model 2[b] N = 878		Model 3[c] N = 614	
	BMD Slope (95% CI)	*p**	BMD Slope (95% CI)	*p**	BMD Slope (95% CI)	*p**	BMD Slope (95% CI)	*p**
Men								
Stage 2	−0.19 (−0.36, −0.02)		−0.18 (−0.35, −0.02)		−0.20 (−0.38, −0.03)		−0.23 (−0.42, −0.03)	
Stage 3A	−0.40 (−0.57, −0.23)	<.001	−0.40 (−0.57, −0.23)	<.001	−0.38 (−0.56, −0.21)	<.001	−0.39 (−0.58, −0.20)	<.001
Stage 3B	−0.81 (−1.10, −0.52)		−0.81 (−1.09, −0.53)		−0.82 (−1.13, −0.52)		−0.80 (−1.13, −0.47)	
Stage 4	−1.19 (−1.60, −0.78)		−1.19 (−1.61, −0.77)		−1.22 (−1.66, −0.78)		−1.23 (−1.67, −0.78)	
Women								
Stage 2	−0.73 (−1.01, −0.45)		−0.73 (−1.01, −0.45)		−0.69 (−0.97, −0.41)		−0.86 (−1.19, −0.53)	
Stage 3A	−1.19 (−1.48, −0.90)	0.005	−1.16 (−1.45, −0.88)	0.004	−1.15 (−1.44, −0.85)	0.005	−1.19 (−1.51, −0.87)	0.03
Stage 3B	−1.23 (−1.50, −0.96)		−1.21 (−1.47, −0.95)		−1.21 (−1.47, −0.95)		−1.20 (−1.47, −0.93)	
Stage 4	−1.51 (−1.89, −1.13)		−1.51 (−1.90, −1.12)		−1.45 (−1.85, −1.06)		−1.58 (−1.98, −1.17)	

CI, confidence interval
*: *p* for interaction
a: adjusted for center, age, BMI, smoking
b: adjusted for above plus eGFR, UPCR, albumin, diabetes
c: adjusted for above plus calcium, phosphate, 25(OH) Vit D, PTH, ALP, FGF23, klotho

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Figure 1. Decline in total hip bone mineral density according to CKD stage and eGFR decline group

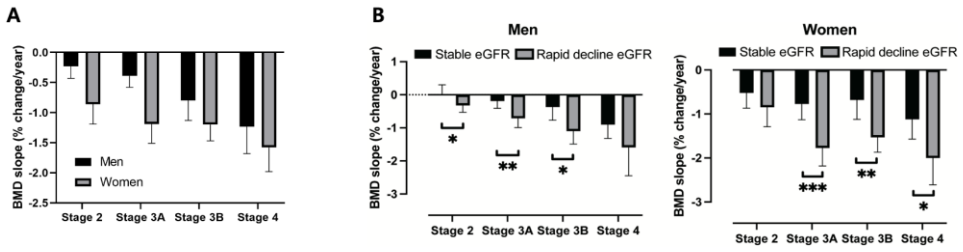

Fig. A. Decline in total hip BMD (% change/year) according to CKD stage, B. Decline in total hip BMD according to eGFR groups (stable eGFR, rapid decline eGFR) for each CKD stage.