Supplemental Table 1. Association of Vitamin D Metabolites and the VMR with Percent Annual Change in Thoracic and Lumbar Spine BMD[a]

	VMR		$25D_3$		$24,25D_3$		$1,25D_3$	
	Annual Change in BMD Per 50% Lower (95%CI)	P	Annual Change in BMD Per 50% Lower (95%CI)	P	Annual Change in BMD Per 50% Lower (95%CI)	P	Annual Change in BMD Per 50% Lower (95%CI)	P
Thoracic	-0.2%(-0.3%, -0.01%)	0.041	-0.1% (-0.2%, 0.01%)	0.061	-0.1% (-0.2%, 0.1%)	0.340	0.01% (-0.2%, 0.2%)	0.946
Lumbar	-0.2%(-0.4%, -0.02%)	0.032	0.02% (-0.2%, 0.2%)	0.841	-0.05% (-0.1%, 0.05%)	0.322	-0.1% (-0.3%, 0.06%)	0.181

[a]Data Reported for fully adjusted models, adjusted for age, sex, race, season of measurement, clinic site an, BMI, baseline eGFR, serum calcium, phosphate, parathyroid hormone and fibroblast growth factor 23

Supplemental Table 2: Association of Vitamin D Metabolites and the VMR with Percent Annual Change in Total Hip BMD in VDBP Subcohort

	VMR		$25D_3$		$24,25D_3$		$1,25D_3$	
	Annual Change in BMD Per 50% Lower (95%CI)	P	Annual Change in BMD Per 50% Lower (95%CI)	P	Annual Change in BMD Per 50% Lower (95%CI)	P	Annual Change in BMD Per 50% Lower (95%CI)	P
Fully Adjusted [a]	-0.5% (-0.7%, -0.2%)	>0.001	-0.2% (-0.1%, 0.01%)	0.180	-0.2% (-0.4%, -0.1%)	0.008	-0.3% (-0.6%, 0.05%)	0.101
VDBP Model[b]	-0.5% (-0.7%, -0.2%)	>0.001	-0.2% (-0.1%, 0.01%)	0.180	-0.2% (-0.4%, -0.1%)	0.008	-0.3% (-0.6%, 0.05%)	0.101

a Adjusted for age, sex, race, season of measurement, clinic site an, BMI, baseline eGFR, serum calcium, phosphate, parathyroid hormone and fibroblast growth factor 23

b VDBP model additionally adjusted for VDBP concentration, VDBP phenotype, and serum albumin concentration

Supplemental Table 3: Association of PTH with Changes in BMD[a]

	Total Hip BMD		Thoracic BMD		Lumbar BMD	
Model	Annual Change in BMD Per Doubling (95%CI)	P	Annual Change in BMD Per Doubling (95%CI)	P	Annual Change in BMD Per Doubling (95%CI)	P
Fully Adjusted	-0.3% (-0.4%, -0.1%)	<0.001	-0.1% (-0.3%, 0.04%)	0.124	-0.1% (-0.3%, 0.1%)	0.219

[a]Data Reported for fully adjusted models, adjusted for age, sex, race, season of measurement, clinic site an, BMI, baseline eGFR, serum calcium, phosphate, parathyroid hormone and fibroblast growth factor 23

Supplemental Table 4: First Fracture Sites in Health ABC*

Fracture Site	Number of Fractures
Hip/Pelvis	58
Upper Extremity	54
Lower Extremity	27
Spine	36

*3 fractures occurred without documentation of fracture site

Supplemental Table 5. Association of Vitamin D Metabolites and the VMR with Fracture Risk in VDBP Subcohort

	VMR		**$25D_3$**		**$24,25D_3$**		**$1,25D_3$**	
	HR Per 50% Lower (95%CI)	P	HR Per 50% Lower (95%CI)	P	HR Per 50% Lower (95%CI)	P	HR Per 50% Lower (95%CI)	P
Fully Adjusted [a]	1.35 (0.73, 2.48)	0.337	1.12 (0.74, 1.69)	0.594	1.14 (0.83, 1.56)	0.412	1.51 (1.05, 2.17)	0.025
VDBP Model[b]	1.34 (0.74, 2.44)	0.330	1.13 (0.73, 1.73)	0.587	1.14 (0.84, 1.55)	0.396	1.59 (1.09, 2.33)	0.016

a Adjusted for age, sex, race, season of measurement, clinic site an, BMI, baseline eGFR, serum calcium, phosphate, parathyroid hormone and fibroblast growth factor 23

b VDBP model additionally adjusted for VDBP concentration, VDBP phenotype, and serum albumin concentration

Supplemental Table 6: Association of Vitamin D Metabolites and the VMR with PTH[a]

	VMR		25D		24,25D		1,25D	
Model	Beta Coef Per 1% Higher (95%CI)	P	Beta Coef Per 1% Higher (95%CI)	P	Beta Coef Per 1% Higher (95%CI)	P	Beta Coef Per 1% Higher (95%CI)	P
Fully Adjusted	-0.5% (-0.7%, -0.4%)	<0.001	-0.2% (-0.3%, -0.1%)	<0.001	-0.3% (-0.3%, -0.2%)	<0.001	0.3% (0.2%, 0.4%)	<0.001

a Adjusted for age, sex, race, season of measurement, clinic site an, BMI, baseline eGFR, serum calcium, phosphate, parathyroid hormone and fibroblast growth factor 23