Supplemental Table 1. Linear Association of Annualized Total 25 hydroxyvitamin D and Parathyroid Hormone with HOMA-IR and HOMA-B among Participants without Diabetes at Baseline (n=5603)

HOMA-IR	HOMA-IR Unadjusted model			HOMA-IR Adjusted model[2]		
	beta coefficient	95% CI	p-value	beta coefficient	95% CI	p-value
Categorical exposure						
25(OH)D (ng/mL)						
<20	Ref			Ref		
20--<30	-0.0655	-0.1007, -0.0302	0.0003	-0.0197	-0.0511, 0.0116	0.2177
30+	-0.2339	-0.2691, -0.1987	<.0001	-0.0924	-0.1259, -0.0589	<.0001
Parathyroid hormone (pg/mL)						
0.3--31.2	Ref			Ref		
31.3--40.5	0.0431	0.0025, 0.0837	0.0373	-0.0098	-0.0437, 0.0242	0.5728
40.6--52.8	0.1268	0.0861, 0.1675	<.0001	0.0103	-0.0243, 0.0449	0.5594
52.9-356.2	0.2099	0.1693, 0.2506	<.0001	0.0117	-0.0242, 0.0477	0.5228
	HOMA-B Unadjusted model			HOMA-B Adjusted model[2]		
	beta coefficient	95% CI	p-value	beta coefficient	95% CI	p-value
Categorical exposure						
25(OH)D (ng/mL)						
<20	ref			ref		
20--<30	-0.0267	-0.0599, 0.0066	0.1157	0.0126	-0.0197, 0.045	0.4441
30+	-0.0667	-0.0999, -0.0335	<.0001	0.0088	-0.0258, 0.0434	0.6178
Parathyroid hormone (pg/mL)						
0.3--31.2	ref			ref		
31.3--40.5	-0.0066	-0.0447, 0.0315	0.7341	-0.0159	-0.0509, 0.019	0.3713
40.6--52.8	0.024	-0.0143, 0.0622	0.2191	-0.0102	-0.0459, 0.0254	0.5728
52.9-356.2	0.0429	0.0047, 0.081	0.0277	-0.0175	-0.0545, 0.0195	0.3531

[1] Dependent variable: log HOMA-IR (5,603 participants) or log HOMA-B (5,598 participants)
[2] Model was adjusted for age, sex, race/ethnicity(except for in race/ethnicity-stratified analysis), study site, alcohol use, smoking, education, occupation, systolic blood pressure, anti-hypertensive use, estimated glomerular filtration rate (eGFR) and waist circumference
Note. When adjusted for age, sex, race/ethnicity, study site, alcohol use, smoking, education, occupation, systolic blood pressure, anti-hypertensive use, estimated glomerular filtration rate (eGFR) and waist circumference, only 25(OH) Vitamin D /100 and 25(OH) Vitamin D3 /100 were still significantly associated with HOMA-IR (both p<.0001).

Supplemental Table 2: The Categorical Associations of total annualized 25 hydroxyvitamin D and Parathyroid Hormone with Incident Diabetes (n=5611)

Categorical variable	Total participants	Number of incident diabetes (%)	Unadjusted HR (95% CI), p-value	Model 1 HR (95% CI), p-value	Model 2 HR (95% CI), p-value
Annualized 25(OH)D (ng/mL)					
<20	1520	257 (39.97%)	Ref	Ref	Ref
20--<30	1689	218 (33.9%)	0.758 (0.633, 0.908), p=0.0026	0.855 (0.705, 1.037), p= 0.1120	0.937 (0.773, 1.137), p=0.5092
30+	1759	168 (26.13%)	0.548 (0.451, 0.665), p<.0001	0.678 (0.544, 0.844), p= 0.0005	0.850 (0.680, 1.063), p=0.1538
Parathyroid hormone (pg/mL)					
0.3--31.2	1278	17 (18.2%)	Ref	Ref	Ref
31.3--40.5	1266	149 (23.17%)	1.298 (1.019, 1.653), p= 0.0350	1.209 (0.947, 1.542), p= 0.1275	1.078 (0.844, 1.377), p=0.5462
40.6--52.8	1233	162 (25.19%)	1.511 (1.191, 1.917), p= 0.0007	1.305 (1.025, 1.663), p= 0.0310	1.104 (0.865, 1.408), p=0.4268
52.9-356.2	1191	215 (33.43%)	2.079 (1.660, 2.605), p <.0001	1.674 (1.321, 2.121), p <.0001	1.271 (0.999, 1.615), p=0.0507

Model 1: Age, sex, study site, race/ethnicity, education, occupation, eGFR, systolic blood pressure, smoking, physical activity, alcohol use
Model 2: Age, sex, study site, race/ethnicity, education, occupation, eGFR, systolic blood pressure, smoking, physical activity, alcohol use, waist circumference

HR: Hazard Ratio
CI: Confidence Interval
eGFR: estimated glomerular filtration rate

Interpretation: Those considered vitamin D sufficient by Endocrine Society cut points (>= 30 ng/mL) had a 32% lower risk of incident diabetes than those considered deficient (<20 ng/mL) after adjustment for demographic factors, kidney function, systolic blood pressure, physical activity, alcohol consumption, and smoking.

Supplemental Table 3: P-values for the interaction term between column and row variables describing incident diabetes in MESA.

	Annualized 25(OH)D	PTH
Age (continuous)	0.5556	0.8428
BMI (continuous)	0.1035	0.0190
Waist (continuous)	0.0248	0.0013
Sex (categorical)	0.8976	0.7976
Race/Ethnicity (categorical)	0.3167	0.5235
BMI (categorical)	0.7518	0.1813
Glucose < or ≥100 (categorical)	0.9194	0.2540
Waist (categorical by quartiles)	0.8134	0.0052

PTH: parathyroid hormone

Legend: models that generated these p-values are unadjusted models with incident diabetes as the outcome variable and an interaction term of row variable * column variable.

Interpretation: there was a significant interaction between waist circumference and the effect of annualized serum 25(OH)D on incident diabetes risk (p=0.0248).

Supplemental Table 4. The continuous association of total annualized 25 hydroxyvitamin D, 25 hydroxyvitamin D3, and PTH with incident diabetes by race/ethnicity.

	Unadjusted model				Adjusted model			
Description	Hazard ratio	95% Confidence Limits		p-interaction	Hazard ratio	95% Confidence Limits		p-interaction
Annualized 25(OH)D (1 ng/mL)								
Black American	0.979	0.963	0.996	0.3167	0.991	0.974	1.008	0.3847
Chinese American	0.986	0.960	1.014		0.990	0.963	1.018	
Hispanic American	0.994	0.979	1.009		1.001	0.985	1.018	
White American	0.975	0.962	0.989		0.982	0.969	0.996	
Parathyroid Hormone (1 pg/mL)								
Black American	1.007	1.003	1.010	0.5235	1.004	1.000	1.008	0.5689
Chinese American	1.012	1.000	1.024		1.006	0.993	1.019	
Hispanic American	1.005	0.998	1.012		0.999	0.992	1.006	
White American	1.011	1.004	1.019		1.000	0.993	1.008	

Model was adjusted for age, sex, study site, alcohol use, smoking, education, occupation, systolic blood pressure, anti-hypertensive use, estimated glomerular filtration rate and waist circumference

Supplemental Figure 1. Associations between adiposity, type 2 diabetes mellitus (T2DM) risk, and 25 hydroxyvitamin D

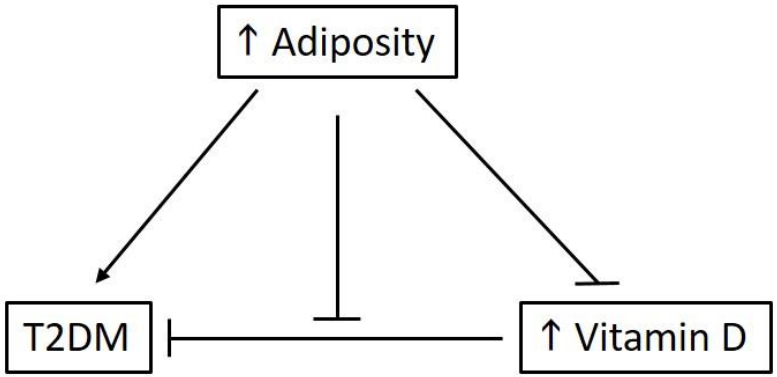
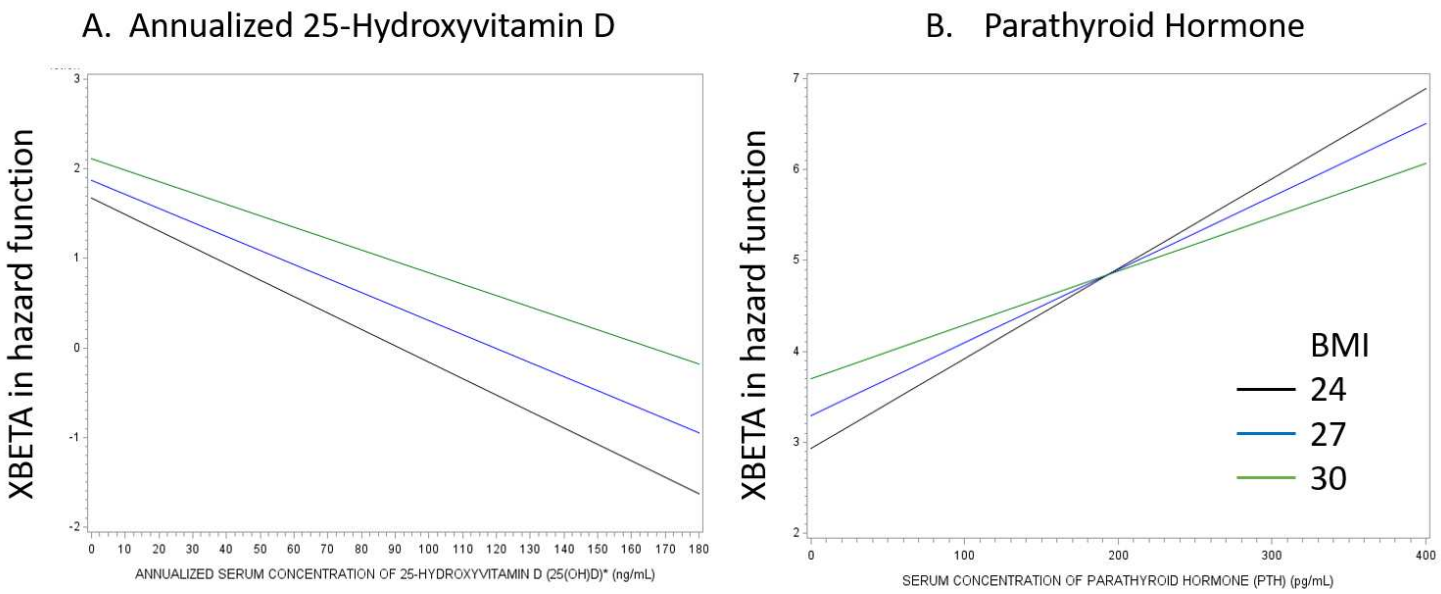


Figure Legend: arrows indicate positive associations, while T-shaped connectors indicate inverse associations or attenuation of an association. These are not causal connections.

Supplemental Figure 2. The interaction between 25 hydroxyvitamin D or Parathyroid Hormone and BMI as evidenced by different slopes (XBETA) in the hazard model describing incident diabetes.



BMI: body mass index (kg/m^2)

The three lines represent the slope of 25 hydroxyvitamin D (x-axis) predicting (XBETA) in the hazard model (y-axis) such that one line was plotted for the cut point of the first quartile of BMI (24 kg/m^2), a second line for the cut point of the second quartile of BMI (27 kg/m^2), and a third line for the cut point of the third quartile of BMI (30 kg/m^2).