

Supplementary Table 1. Stratified analyses of the associations (hazard ratios, 95% CIs) between serum 25(OH)D concentrations and all-cause mortality among diabetes in NHANES III and NHANES 2001-2014

	Serum 25(OH)D concentrations (nmol/L)				<i>P</i> _{trend}	<i>P</i> _{interaction}
	< 25.0	25.0-49.9	50.0-74.9	≥ 75.0		
Age (years)						0.35
≤ 60	1	0.55(0.40, 0.77)	0.47 (0.31, 0.71)	0.54(0.34, 0.86)	0.21	
> 60	1	0.86 (0.66, 1.12)	0.68 (0.51, 0.92)	0.67 (0.48, 0.94)	0.003	
Sex						0.26
Female	1	0.70 (0.52, 0.95)	0.61 (0.42, 0.88)	0.47 (0.33, 0.68)	<0.001	
Male	1	0.59 (0.38, 0.91)	0.46 (0.30, 0.71)	0.58 (0.35, 0.96)	0.39	
Race/ethnicity						0.15
White	1	0.69 (0.41, 1.18)	0.56 (0.31, 0.99)	0.61 (0.33, 1.12)	0.09	
Non-White	1	0.72 (0.56, 0.92)	0.60 (0.44, 0.81)	0.52 (0.37, 0.72)	<0.001	
Smoking status *						0.08
Never smoker	1	0.52 (0.34, 0.79)	0.52 (0.34, 0.80)	0.46 (0.30, 0.69)	0.03	
Former smoker	1	0.87 (0.53, 1.42)	0.55 (0.32, 0.96)	0.59 (0.34, 1.02)	0.003	
Current smoker	1	0.71 (0.42, 1.20)	0.57 (0.35, 0.94)	0.67 (0.35, 1.28)	0.35	
BMI, kg/m² *						0.56
< 30	1	0.62 (0.41, 0.93)	0.49 (0.30, 0.81)	0.47 (0.30, 0.75)	0.002	
≥ 30	1	0.69 (0.48, 0.99)	0.57 (0.38, 0.84)	0.75 (0.46, 1.22)	0.41	
Physical activity *						0.32
Inactive	1	0.53 (0.39, 0.71)	0.43 (0.30, 0.61)	0.47 (0.31, 0.73)	0.03	
Insufficiently active or active	1	1.11 (0.68, 1.83)	0.88 (0.52, 1.48)	0.99 (0.56, 1.75)	0.34	
Diabetes duration (years) *						0.06
≤ 10	1	0.74 (0.52, 1.05)	0.63 (0.42, 0.93)	0.71 (0.45, 1.13)	0.25	
> 10	1	0.72 (0.49, 1.07)	0.53 (0.33, 0.85)	0.45 (0.27, 0.77)	0.002	
Number of self-reported comorbidities #						0.71
< 1	1	0.62 (0.41, 0.94)	0.50 (0.31, 0.79)	0.59 (0.33, 1.05)	0.31	
≥ 1	1	0.77 (0.58, 1.01)	0.65 (0.46, 0.90)	0.58 (0.40, 0.85)	0.002	

* The number of deaths ranged from 1685 to 2054 due to missing values. Adjusted for age, sex and race, BMI, education level, family income-poverty ratio, drinking status, smoking status, leisure time moderate to vigorous physical activity, duration of diabetes, diabetic medication use, HbA1c levels, self-reported hypertension, hypercholesterolemia, and cardiovascular disease, with exception of stratifying factors.

Self-reported comorbidities included self-reported coronary heart disease, stroke, kidney dysfunction (indicated by eGFR <60 mL/min), and retinopathy.

Supplementary Table 2. Hazard ratios (95% CIs) of all-cause and specific cause mortality according to serum 25(OH)D concentrations among diabetes with further adjustment of month when blood was drawn in NHANES 2001-2014 (n=4629)

	Serum 25(OH)D (nmol/L)				<i>P</i> trend
	< 25.0	25.0-49.9	50.0-74.9	≥ 75.0	
All-cause mortality					
No. deaths/total	73/281	360/1727	326/1669	155/952	
Model 1	1	0.57 (0.39, 0.82)	0.36 (0.24, 0.52)	0.36 (0.24, 0.53)	<.0001
Model 2	1	0.55 (0.39, 0.79)	0.37 (0.25, 0.55)	0.36 (0.24, 0.54)	<.0001
Model 3	1	0.61 (0.42, 0.87)	0.42 (0.29, 0.62)	0.41 (0.27, 0.62)	<.0001
CVD mortality					
No. deaths	20	83	78	39	
Model 1	1	0.51 (0.26, 0.98)	0.33 (0.18, 0.61)	0.45 (0.20, 1.05)	0.39
Model 2	1	0.51 (0.26, 1.00)	0.37 (0.19, 0.69)	0.47 (0.21, 1.07)	0.42
Model 3	1	0.54 (0.26, 1.11)	0.38 (0.19, 0.78)	0.45 (0.18, 1.08)	0.25
Cancer mortality					
No. deaths	8	64	52	26	
Model 1	1	0.67 (0.19, 2.35)	0.32 (0.09, 1.19)	0.45 (0.11, 1.85)	0.19
Model 2	1	0.70 (0.20, 2.40)	0.37 (0.10, 1.34)	0.51 (0.12, 2.13)	0.28
Model 3	1	0.70 (0.20, 2.39)	0.37 (0.10, 1.35)	0.52 (0.13, 2.13)	0.29

Model 1: adjusted for age (continuous), sex (male or female) and race/ethnicity (non-Hispanic white, non-Hispanic black, Mexican American, or other);

Model 2: further adjusted for BMI (<25.0, 25.0-29.9, or ≥30.0 kg/m²), education level (less than high school, high school or equivalent, or college or above), family income-poverty ratio (0-1.0, 1.0-3.0, or >3.0), drinking status (non-drinker, low to moderate drinker, or heavy drinker), smoking status (never smoker, former smoker, or current smoker) and leisure time moderate to vigorous physical activity (inactive group, insufficiently active group, or active group);

Model 3: further adjusted for duration of diabetes (≤3, 3-10, or >10 years), diabetic medication use (none, only oral medication, insulin, or others), HbA1c (<7%, or ≥7%), self-reported hypertension, hypercholesterolemia, and cardiovascular disease (yes, or no), and month of blood collection (November 1 through April 30, or May 1 through October 31).

Supplementary Table 3. Hazard ratios (95% CIs) of all-cause and specific cause mortality according to serum 25(OH)D concentrations among diabetes with further adjustment of dietary quality and kidney function in NHANES III and NHANES 2001-2014

	Serum 25(OH)D (nmol/L)				<i>P</i> trend
	< 25.0	25.0-49.9	50.0-74.9	≥ 75.0	
All-cause mortality					
Model 1	1	0.70 (0.55, 0.89)	0.56 (0.42, 0.74)	0.59 (0.42, 0.82)	0.003
Model 2	1	0.69 (0.55, 0.86)	0.53 (0.41, 0.70)	0.56 (0.41, 0.77)	0.001
Model 3	1	0.70 (0.54, 0.89)	0.55 (0.42, 0.73)	0.59 (0.42, 0.82)	0.003
Model 4	1	0.70 (0.55, 0.89)	0.56 (0.42, 0.74)	0.59 (0.42, 0.82)	0.003
CVD mortality					
Model 1	1	0.62 (0.40, 0.96)	0.46 (0.29, 0.73)	0.50 (0.29, 0.87)	0.02
Model 2	1	0.61 (0.39, 0.95)	0.44 (0.27, 0.72)	0.48 (0.27, 0.86)	0.04
Model 3	1	0.61 (0.40, 0.94)	0.43 (0.28, 0.68)	0.49 (0.28, 0.85)	0.01
Model 4	1	0.62 (0.40, 0.96)	0.46 (0.29, 0.73)	0.50 (0.29, 0.86)	0.02
Cancer mortality					
Model 1	1	0.67 (0.36, 1.23)	0.60 (0.32, 1.15)	0.49 (0.22, 1.06)	0.13
Model 2	1	0.68 (0.35, 1.32)	0.58 (0.29, 1.19)	0.48 (0.20, 1.13)	0.14
Model 3	1	0.71 (0.38, 1.32)	0.61 (0.31, 1.19)	0.50 (0.23, 1.10)	0.11
Model 4	1	0.67 (0.37, 1.23)	0.60 (0.32, 1.15)	0.49 (0.23, 1.06)	0.13

Model 1: adjusted for age (continuous), sex (male or female) and race/ethnicity (non-Hispanic white, non-Hispanic black, Mexican American, or other), BMI (<25.0, 25.0-29.9, or ≥30.0 kg/m²), education level (less than high school, high school or equivalent, or college or above), family income-poverty ratio (0-1.0, 1.0-3.0, or >3.0), drinking status (non-drinker, low to moderate drinker, or heavy drinker), smoking status (never smoker, former smoker, or current smoker) and leisure time moderate to vigorous physical activity (inactive group, insufficiently active group, or active group), duration of diabetes (≤3, 3-10, or >10 years), diabetic medication use (none, only oral medication, insulin, or others), HbA1c (<7%, or ≥7%), self-reported hypertension, hypercholesterolemia, and cardiovascular disease (yes, or no);

Model 2: model 1 + dietary supplement use (yes, or no), polyunsaturated fatty acid intake (in tertiles), and calcium and magnesium intake (in tertiles);

Model 3: model 1 + healthy eating index scores (HEI for NHANES 1988-94 and HEI-2010 for NHANES 2001-2014, both in quartiles);

Model 4: model 1 + eGFR (≤90, or >90).

Supplementary Table 4. Hazard ratios (95% CIs) of all-cause and specific cause mortality according to quartiles of serum 25(OH)D concentrations among diabetes in NHANES III and NHANES 2001-2014

	Serum 25(OH)D (nmol/L)				<i>P</i> _{trend}
	< 37.5	37.5-51.9	51.9-68.2	≥ 68.2	
All-cause mortality					
No. deaths/total	597/1548	546/1614	501/1576	412/1591	
Model 1	1	0.77 (0.64, 0.92)	0.71 (0.58, 0.87)	0.64 (0.54, 0.76)	<.0001
Model 2	1	0.74 (0.62, 0.88)	0.72 (0.60, 0.86)	0.65 (0.55, 0.76)	<.0001
Model 3	1	0.78 (0.66, 0.92)	0.73 (0.61, 0.88)	0.65 (0.54, 0.77)	<.0001
CVD mortality					
No. deaths	188	162	135	120	
Model 1	1	0.90 (0.63, 1.29)	0.66 (0.50, 0.87)	0.73 (0.53, 0.99)	0.013
Model 2	1	0.86 (0.60, 1.25)	0.66 (0.49, 0.88)	0.72 (0.53, 0.97)	0.014
Model 3	1	0.88 (0.61, 1.26)	0.64 (0.47, 0.87)	0.69 (0.51, 0.93)	0.003
Cancer mortality					
No. deaths	73	92	82	62	
Model 1	1	1.16 (0.76, 1.78)	0.96 (0.61, 1.53)	0.79 (0.45, 1.37)	0.23
Model 2	1	1.14 (0.75, 1.76)	1.03 (0.68, 1.57)	0.85 (0.49, 1.46)	0.39
Model 3	1	1.07 (0.70, 1.65)	0.97 (0.64, 1.47)	0.78 (0.44, 1.36)	0.28

Model 1: adjusted for age (continuous), sex (male or female) and race/ethnicity (non-Hispanic white, non-Hispanic black, Mexican American, or other);

Model 2: further adjusted for BMI (< 25.0, 25.0-29.9, or ≥30.0 kg/m²), education level (less than high school, high school or equivalent, or college or above), family income-poverty ratio (0-1.0, 1.0-3.0, or >3.0), drinking status (non-drinker, low to moderate drinker, or heavy drinker), smoking status (never smoker, former smoker, or current smoker) and leisure time moderate to vigorous physical activity (inactive group, insufficiently active group, or active group);

Model 3: further adjusted for duration of diabetes (≤3, 3-10, or >10 years), diabetic medication use (none, only oral medication, insulin, or others), HbA1c (<7%, or ≥7%), self-reported hypertension, hypercholesterolemia, and cardiovascular disease (yes, or no).

Supplementary Table 5. Hazard ratios (95% CIs) of all-cause and specific cause mortality according to serum 25(OH)D concentrations among diabetes after excluding participants with history of CVD (n= 4931)

	Serum 25(OH)D (nmol/L)				<i>P</i> trend
	< 25.0	25.0-49.9	50.0-74.9	≥ 75.0	
All-cause mortality					
No. deaths/total	108/299	611/1997	500/1767	187/868	
Model 1	1	0.83 (0.60, 1.15)	0.68 (0.47, 0.99)	0.68 (0.46, 1.01)	0.03
Model 2	1	0.81 (0.62, 1.06)	0.69 (0.50, 0.95)	0.70 (0.49, 0.99)	0.07
Model 3	1	0.77 (0.58, 1.01)	0.63 (0.45, 0.87)	0.64 (0.45, 0.92)	0.04
CVD mortality					
No. deaths	32	176	129	50	
Model 1	1	0.90 (0.54, 1.50)	0.72 (0.41, 1.26)	0.71 (0.43, 1.20)	0.12
Model 2	1	0.90 (0.54, 1.51)	0.72 (0.40, 1.30)	0.73 (0.41, 1.29)	0.18
Model 3	1	0.86 (0.50, 1.49)	0.65 (0.35, 1.21)	0.64 (0.35, 1.19)	0.07
Cancer mortality					
No. deaths	11	110	100	26	
Model 1	1	1.32 (0.63, 2.76)	1.13 (0.53, 2.37)	0.83 (0.36, 1.92)	0.13
Model 2	1	1.28 (0.64, 2.55)	1.11 (0.53, 2.30)	0.88 (0.40, 1.95)	0.22
Model 3	1	1.23 (0.61, 2.46)	1.08 (0.53, 2.20)	0.80 (0.35, 1.79)	0.17

Model 1: adjusted for age (continuous), sex (male or female) and race/ethnicity (non-Hispanic white, non-Hispanic black, Mexican American, or other);

Model 2: further adjusted for BMI (< 25.0, 25.0-29.9, or ≥30.0 kg/m²), education level (less than high school, high school or equivalent, or college or above), family income-poverty ratio (0-1.0, 1.0-3.0, or >3.0), drinking status (non-drinker, low to moderate drinker, or heavy drinker), smoking status (never smoker, former smoker, or current smoker) and leisure time moderate to vigorous physical activity (inactive group, insufficiently active group, or active group);

Model 3: further adjusted for duration of diabetes (≤3, 3-10, or >10 years), diabetic medication use (none, only oral medication, insulin, or others), HbA1c (<7%, or ≥7%), self-reported hypertension and hypercholesterolemia (yes, or no).

Supplementary Table 6. Hazard ratios (95% CIs) of all-cause and specific cause mortality according to serum 25(OH)D concentrations among diabetes after excluding participants who died within two years of follow-up (n=6035)

	Serum 25(OH)D (nmol/L)				<i>P</i> trend
	< 25.0	25.0-49.9	50.0-74.9	≥ 75.0	
All-cause mortality					
No. deaths/total	143/377	611/2421	500/2145	187/1092	
Model 1	1	0.71 (0.52, 0.95)	0.58 (0.42, 0.81)	0.57 (0.40, 0.80)	0.002
Model 2	1	0.75 (0.58, 0.95)	0.63 (0.47, 0.85)	0.62 (0.46, 0.85)	0.007
Model 3	1	0.73 (0.56, 0.95)	0.60 (0.44, 0.83)	0.61 (0.44, 0.85)	0.004
CVD mortality					
No. deaths	46	232	170	64	
Model 1	1	0.77 (0.49, 1.22)	0.57 (0.34, 0.96)	0.58 (0.35, 0.97)	0.02
Model 2	1	0.79 (0.50, 1.26)	0.60 (0.35, 1.03)	0.60 (0.35, 1.03)	0.03
Model 3	1	0.78 (0.47, 1.28)	0.57 (0.33, 1.01)	0.56 (0.32, 0.99)	0.01
Cancer mortality					
No. deaths	17	116	102	29	
Model 1	1	0.56 (0.24, 1.32)	0.48 (0.20, 1.15)	0.37 (0.14, 0.97)	0.06
Model 2	1	0.63 (0.32, 1.25)	0.55 (0.27, 1.11)	0.47 (0.21, 1.03)	0.13
Model 3	1	0.64 (0.34, 1.22)	0.55 (0.28, 1.08)	0.45 (0.21, 0.99)	0.09

Model 1: adjusted for baseline age (continuous), sex (male or female) and race/ethnicity (non-Hispanic white, non-Hispanic black, Mexican American, or other);

Model 2: further adjusted for BMI (<25.0, 25.0-29.9, or ≥30.0 kg/m²), education level (less than high school, high school or equivalent, or college or above), family income-poverty ratio (0-1.0, 1.0-3.0, or >3.0), drinking status (non-drinker, low to moderate drinker, or heavy drinker), smoking status (never smoker, former smoker, or current smoker) and leisure time moderate to vigorous physical activity (inactive group, insufficiently active group, or active group);

Model 3: further adjusted for duration of diabetes (≤3, 3-10, or >10 years), diabetic medication use (none, only oral medication, insulin, or others), HbA1C (<7%, or ≥7%), self-reported hypertension, hypercholesterolemia, and cardiovascular disease (yes, or no).

Supplementary Table 7. Hazard ratios (95% CIs) of all-cause mortality according to serum 25(OH)D concentrations among diabetes with further adjustment of CRP, blood lipids, or HOMA-IR

	Serum 25(OH)D (nmol/L)				<i>P</i> trend
	< 25.0	25.0-49.9	50.0-74.9	≥ 75.0	
Participants with data of CRP					
Model 1	1	0.77 (0.59,1.02)	0.60 (0.45,0.82)	0.66 (0.47,0.94)	0.01
Model 2	1	0.78 (0.61,1.01)	0.61 (0.46,0.82)	0.68 (0.48,0.96)	0.01
Model 2+CRP	1	0.81 (0.62,1.05)	0.64 (0.47,0.86)	0.72 (0.51,1.01)	0.03
Participants with data of HDL, LDL and TG					
Model 1	1	0.68 (0.34,1.39)	0.44 (0.22,0.91)	0.56 (0.27,1.18)	0.03
Model 2	1	0.56 (0.35,0.89)	0.41 (0.25,0.66)	0.47 (0.28,0.78)	0.04
Model 2+blood lipids	1	0.58 (0.37,0.92)	0.43 (0.26,0.70)	0.46 (0.28,0.76)	0.01
Participants with data of HOMA-IR					
Model 1	1	0.68 (0.47,0.97)	0.56 (0.38,0.84)	0.66 (0.42,1.03)	0.20
Model 2	1	0.61 (0.46,0.82)	0.51 (0.37,0.69)	0.59 (0.41,0.85)	0.24
Model 2+HOMA-IR	1	0.13 (0.05,0.31)	0.14 (0.05,0.34)	0.17 (0.06,0.47)	<0.001

Model 1: adjusted for age (continuous), sex (male or female) and race/ethnicity (non-Hispanic white, non-Hispanic black, Mexican American, or other);

Model 2: further adjusted for BMI (< 25.0, 25.0-29.9, or ≥30.0 kg/m²), education level (less than high school, high school or equivalent, or college or above), family income-poverty ratio (0-1.0, 1.0-3.0, or >3.0), drinking status (non-drinker, low to moderate drinker, or heavy drinker), smoking status (never smoker, former smoker, or current smoker) and leisure time moderate to vigorous physical activity (inactive group, insufficiently active group, or active group), duration of diabetes (≤3, 3-10, or >10 years), diabetic medication use (none, only oral medication, insulin, or others), HbA1C (<7%, or ≥7%), and self-reported hypertension, hypercholesterolemia and cardiovascular disease (yes, or no)

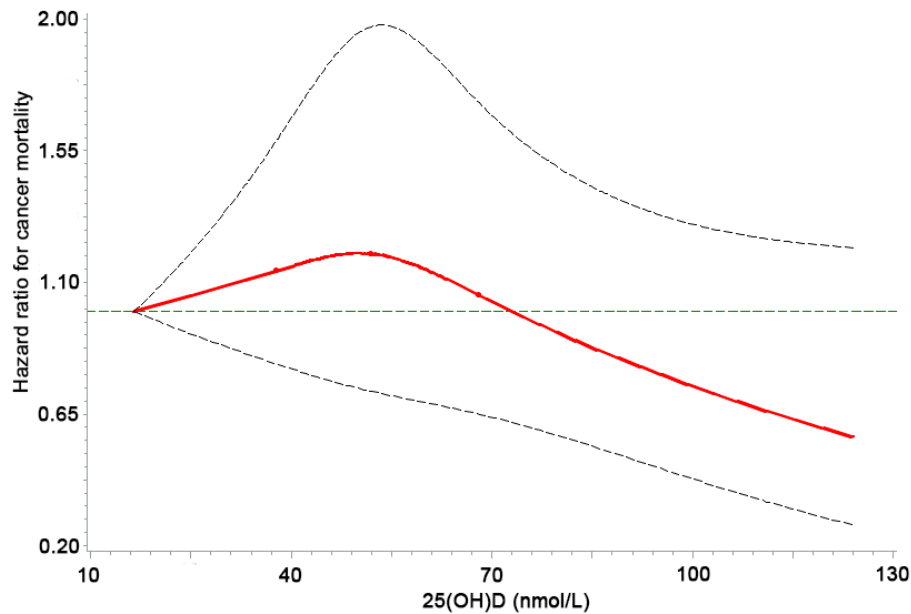
Supplementary Table 8. Hazard ratios (95% CIs) of all-cause and CVD mortality according to serum 25(OH)D concentrations among diabetes with further adjustment of parathyroid hormone (n=1053).

	Vitamin D (nmol/l)				<i>P</i> _{trend}
	< 25.0	25.0-49.9	50.0-74.9	≥ 75.0	
All-cause mortality					
No. deaths/total	34/79	158/488	117/378	32/108	
Model 1	1	0.65 (0.39, 1.08)	0.42 (0.24,0.73)	0.34 (0.18, 0.65)	0.002
Model 2	1	0.66 (0.40, 1.09)	0.49 (0.27,0.92)	0.37 (0.19, 0.71)	0.009
Model 3	1	0.64 (0.38, 1.07)	0.51 (0.27,0.98)	0.50 (0.24, 1.05)	0.21
CVD mortality					
No. deaths/total	11/79	43/488	30/378	9/108	
Model 1	1	0.40 (0.16, 0.98)	0.23 (0.09, 0.58)	0.30 (0.06, 1.55)	0.42
Model 2	1	0.39 (0.15, 1.07)	0.27 (0.10, 0.76)	0.31 (0.06, 1.59)	0.48
Model 3	1	0.37 (0.11, 1.20)	0.28 (0.08, 0.97)	0.32 (0.04, 2.24)	0.56

Model 1: adjusted for baseline age (continuous), sex (male or female) and race/ethnicity (non-Hispanic white, non-Hispanic black, Mexican American, or other);

Model 2: further adjusted for BMI (<25.0, 25.0-29.9, or ≥30.0 kg/m²), education level (less than high school, high school or equivalent, or college or above), family income-poverty ratio (0-1.0, 1.0-3.0, or >3.0), drinking status (non-drinker, low to moderate drinker, or heavy drinker), smoking status (never smoker, former smoker, or current smoker) and leisure time moderate to vigorous physical activity (inactive group, insufficiently active group, or active group);

Model 3: further adjusted for duration of diabetes (≤3, 3-10, or >10 years), diabetic medication use (none, only oral medication, insulin, or others), HbA1C (<7%, or ≥7%), self-reported hypertension, cardiovascular diseases, and hypercholesterolemia (yes, or no), month of blood collection (November 1 through April 30, or May 1 through October 31), and parathyroid hormone (in tertiles).



Supplementary Figure 1. Associations between serum 25(OH)D concentrations with cancer mortality among diabetes in NHANES III and NHANES 2001-2014

Hazard ratios were adjusted for age (continuous), sex (male, or female) and race/ethnicity (non-Hispanic white, non-Hispanic black, Mexican American, or other), BMI (<25.0, 25.0-29.9, or ≥ 30.0 kg/m²), education level (less than high school, high school or equivalent, or college or above), family income-poverty ratio (0-1.0, 1.0-3.0, or >3.0), drinking status (non-drinker, low to moderate drinker, or heavy drinker), smoking status (never smoker, former smoker, or current smoker) and leisure time moderate to vigorous physical activity (inactive group, insufficiently active group, or active group), duration of diabetes (≤ 3 , 3-10, or >10 years), diabetic medication use (none, only oral medication, insulin, or others), HbA1c (<7%, or $\geq 7\%$), self-reported hypertension, hypercholesterolemia, and cardiovascular disease (yes, or no). *P* linearity >0.05.