

*Supplementary Material*

**Relationships between blood concentrations of cadmium, lead, mercury, selenium, and manganese and the risk of chronic kidney disease: A cross-sectional study based on NHANES 2011–2018**

**Supplementary Table SI.** Subgroup analysis for the association between blood heavy metals and CKD (model 3).

		subgroup	Q1	Q2	Q3	Q4	P interaction
<b>Cadmium group</b>							
Sex							
	Female	Ref	1.1 (0.91–1.34)	1.25 (1.02–1.54)	1.79 (1.45–2.21)		0.787
	Male	Ref	1.01 (0.82–1.24)	1.17 (0.96–1.43)	1.37 (1.11–1.69)		
Age							
	<60 years	Ref	1.03 (0.85–1.24)	1.15 (0.94–1.41)	1.35 (1.1–1.66)		0.001
	≥60 years	Ref	1.14 (0.92–1.41)	1.3 (1.05–1.6)	2.06 (1.64–2.57)		
BMI, kg/m <sup>2</sup>							
	<25	Ref	0.86 (0.63–1.18)	0.8 (0.6–1.08)	1.12 (0.84–1.51)		0.004
	≥25	Ref	1.12 (0.95–1.31)	1.36 (1.16–1.59)	1.66 (1.4–1.97)		
Ethnicity group							
	Non-hispanic white	Ref	1.13 (0.89–1.43)	1.46 (1.16–1.85)	1.74 (1.35–2.23)		0.045
	Non-hispanic black	Ref	1.03 (0.78–1.37)	1.11 (0.84–1.47)	1.5 (1.12–2.02)		
	Mexican American	Ref	0.86 (0.61–1.22)	0.9 (0.63–1.29)	1.55 (1.03–2.34)		
	Other race	Ref	1.17 (0.86–1.59)	1.2 (0.88–1.63)	1.56 (1.15–2.12)		
Education							
	Below high school level	Ref	1.18 (0.81–1.71)	1.29 (0.9–1.84)	1.83 (1.25–2.68)		0.831
	High school	Ref	1.09 (0.91–1.31)	1.2 (1–1.45)	1.52 (1.25–1.84)		
	Above high school	Ref	0.93 (0.7–1.24)	1.16 (0.88–1.53)	1.39 (1.05–1.83)		
Lifetime smoking of more than 100 cigarettes							
	No	Ref	1.1 (0.93–1.3)	1.22 (1.02–1.44)	1.54 (1.24–1.9)		0.529
	Yes	Ref	1.08 (0.82–1.42)	1.32 (1.03–1.71)	1.75 (1.37–2.24)		
Drinking							

	No	Ref	1.14 (0.92–1.42)	1.23 (1–1.52)	1.55 (1.25–1.93)	0.764
	Yes	Ref	1 (0.83–1.21)	1.19 (0.99–1.44)	1.5 (1.23–1.82)	
Hypertension	No	Ref	1.05 (0.86–1.29)	1.11 (0.91–1.36)	1.3 (1.05–1.6)	0.022
	Yes	Ref	1.09 (0.89–1.33)	1.31 (1.08–1.59)	1.84 (1.5–2.26)	
Hyperlipidemia	No	Ref	1.09 (0.9–1.31)	1.15 (0.96–1.39)	1.33 (1.1–1.62)	0.088
	Yes	Ref	1.03 (0.83–1.28)	1.24 (1–1.54)	1.82 (1.45–2.28)	
Diabetes	No	Ref	1.04 (0.88–1.23)	1.2 (1.02–1.41)	1.5 (1.27–1.78)	0.924
	Yes	Ref	1.1 (0.84–1.46)	1.21 (0.92–1.6)	1.55 (1.15–2.1)	
<b>Lead group</b>						
Sex	Female	Ref	1.04 (0.8–1.36)	1.29 (1.01–1.65)	1.73 (1.36–2.22)	0.067
	Male	Ref	0.95 (0.79–1.15)	1 (0.84–1.2)	1.28 (1.06–1.54)	
Age	<60 years	Ref	1.06 (0.88–1.27)	1.15 (0.94–1.39)	1.44 (1.18–1.76)	<0.001
	≥60 years	Ref	1.18 (0.9–1.54)	1.45 (1.13–1.86)	1.85 (1.44–2.37)	
BMI, kg/m <sup>2</sup>	<25	Ref	0.84 (0.61–1.16)	0.91 (0.68–1.23)	1.07 (0.8–1.44)	0.004
	≥25	Ref	0.98 (0.82–1.16)	1.11 (0.94–1.31)	1.52 (1.29–1.8)	
Ethnicity group	Non-hispanic white	Ref	1.01 (0.77–1.32)	1.27 (0.99–1.63)	1.64 (1.27–2.11)	0.064
	Non-hispanic black	Ref	1 (0.74–1.37)	1.01 (0.75–1.35)	1.47 (1.09–1.99)	
	Mexican American	Ref	0.8 (0.54–1.17)	0.93 (0.63–1.36)	0.99 (0.68–1.44)	
	Other race	Ref	0.93 (0.68–1.26)	0.97 (0.73–1.29)	1.26 (0.94–1.69)	
Education	Below high school level	Ref	0.69 (0.46–1.04)	1.06 (0.74–1.54)	1.16 (0.81–1.67)	0.096
	High school	Ref	0.94 (0.78–1.15)	1.01 (0.83–1.22)	1.26 (1.04–1.53)	
	Above high school	Ref	1.14 (0.83–1.56)	1.2 (0.9–1.6)	1.92 (1.44–2.57)	
Lifetime smoking of more than 100 cigarettes	No	Ref	0.94 (0.78–1.14)	1.01 (0.84–1.21)	1.35 (1.12–1.62)	0.242
	Yes	Ref	1.01 (0.77–1.32)	1.21 (0.95–1.55)	1.59 (1.24–2.04)	

Drinking	No	Ref	0.99 (0.78–1.26)	1.05 (0.85–1.31)	1.41 (1.14–1.76)	0.878
	Yes	Ref	0.91 (0.74–1.11)	1.06 (0.87–1.28)	1.37 (1.13–1.67)	
Hypertension	No	Ref	0.89 (0.72–1.1)	0.86 (0.7–1.06)	1.21 (0.99–1.48)	<0.001
	Yes	Ref	1.08 (0.87–1.35)	1.36 (1.1–1.68)	1.72 (1.39–2.13)	
Hyperlipidemia	No	Ref	0.88 (0.72–1.08)	0.94 (0.78–1.14)	1.35 (1.12–1.63)	0.072
	Yes	Ref	1.07 (0.84–1.36)	1.26 (1–1.58)	1.52 (1.2–1.91)	
Diabetes	No	Ref	0.92 (0.77–1.1)	0.99 (0.84–1.17)	1.33 (1.12–1.56)	0.114
	Yes	Ref	1.03 (0.76–1.39)	1.31 (0.98–1.74)	1.69 (1.25–2.28)	
<b>Manganese B group</b>						
Sex	Female	Ref	1 (0.84–1.18)	0.85 (0.71–1.03)	1 (0.81–1.22)	0.132
	Male	Ref	0.78 (0.66–0.93)	0.91 (0.76–1.08)	0.89 (0.75–1.07)	
Age	<60 years	Ref	0.9 (0.74–1.09)	1.01 (0.84–1.22)	1.08 (0.89–1.31)	<0.001
	≥60 years		0.92 (0.77–1.09)	0.82 (0.68–0.98)	0.82 (0.67–1)	
BMI, kg/m <sup>2</sup>	<25	Ref	0.92 (0.72–1.18)	0.92 (0.72–1.19)	0.91 (0.7–1.19)	0.974
	≥25	Ref	0.89 (0.77–1.02)	0.9 (0.78–1.04)	0.99 (0.85–1.16)	
Ethnicity group	Non-hispanic white	Ref	0.99 (0.82–1.2)	0.85 (0.69–1.04)	0.92 (0.74–1.15)	0.506
	Non-hispanic black		0.76 (0.61–0.96)	1.01 (0.79–1.28)	1.03 (0.77–1.38)	
	Mexican American		0.89 (0.6–1.33)	1 (0.69–1.46)	1.04 (0.71–1.52)	
	Other race		0.88 (0.65–1.2)	0.83 (0.62–1.11)	0.93 (0.7–1.23)	
Education	Below high school level	Ref	0.93 (0.67–1.3)	0.76 (0.54–1.06)	1.01 (0.72–1.42)	0.460
	High school		0.84 (0.71–0.99)	0.88 (0.74–1.03)	0.9 (0.75–1.08)	
	Above high school		0.97 (0.77–1.21)	1.04 (0.82–1.31)	1.07 (0.83–1.37)	
Lifetime smoking of more than 100 cigarettes	No	Ref	0.88 (0.74–1.04)	0.81 (0.68–0.96)	0.92 (0.77–1.1)	0.283

Drinking	Yes	Ref	0.9 (0.75–1.07)	1.03 (0.86–1.23)	1.01 (0.83–1.24)	
	No	Ref	0.88 (0.73–1.05)	0.86 (0.71–1.04)	1.05 (0.86–1.28)	0.447
Hypertension	Yes	Ref	0.9 (0.76–1.07)	0.93 (0.79–1.11)	0.91 (0.76–1.08)	
	No	Ref	0.92 (0.76–1.1)	0.88 (0.73–1.06)	0.96 (0.79–1.16)	0.670
Hyperlipidemia	Yes	Ref	0.87 (0.74–1.03)	0.92 (0.78–1.09)	0.97 (0.81–1.17)	
	No	Ref	0.87 (0.74–1.03)	0.92 (0.78–1.09)	1.09 (0.92–1.29)	0.006
Diabetes	Yes	Ref	0.92 (0.77–1.11)	0.89 (0.74–1.08)	0.81 (0.66–1)	
	No	Ref	0.89 (0.77–1.02)	0.96 (0.83–1.11)	1 (0.86–1.16)	0.030
Mercury group	Yes	Ref	0.93 (0.72–1.2)	0.73 (0.57–0.95)	0.82 (0.62–1.09)	
	No	Ref	0.89 (0.77–1.02)	0.96 (0.83–1.11)	1 (0.86–1.16)	0.030
Sex	Female	Ref	1.12 (0.93–1.35)	1.03 (0.85–1.24)	1.1 (0.9–1.33)	0.060
	Male	Ref	0.93 (0.79–1.11)	0.85 (0.71–1.01)	0.8 (0.67–0.97)	
Age	<60 years	Ref	1 (0.83–1.19)	0.84 (0.7–1.02)	1.02 (0.85–1.24)	0.047
	≥60 years	Ref	1.09 (0.9–1.31)	1.07 (0.88–1.29)	0.95 (0.78–1.15)	
BMI, kg/m <sup>2</sup>	<25	Ref	0.94 (0.73–1.22)	0.89 (0.69–1.15)	0.9 (0.69–1.16)	0.750
	≥25	Ref	1.05 (0.91–1.22)	0.95 (0.82–1.11)	0.96 (0.82–1.13)	
Ethnicity group	Non-hispanic white	Ref	1.06 (0.87–1.29)	0.95 (0.77–1.17)	0.94 (0.75–1.19)	0.998
	Non-hispanic black	Ref	0.98 (0.75–1.27)	0.9 (0.7–1.16)	0.88 (0.68–1.15)	
	Mexican American	Ref	0.96 (0.7–1.31)	0.8 (0.56–1.15)	0.79 (0.51–1.24)	
	Other race	Ref	1.01 (0.73–1.41)	0.94 (0.69–1.27)	1.06 (0.8–1.42)	
	Education	Ref				
Education	Below high school level	Ref	0.86 (0.63–1.17)	0.67 (0.48–0.94)	0.93 (0.65–1.32)	0.337
	High school	Ref	1.03 (0.86–1.23)	0.95 (0.8–1.13)	0.88 (0.73–1.05)	
	Above high school	Ref	1.09 (0.87–1.37)	1.01 (0.79–1.29)	1.11 (0.86–1.44)	
Lifetime smoking of						

more than 100 cigarettes	No	Ref	0.96 (0.8–1.14)	0.86 (0.72–1.03)	0.87 (0.73–1.05)	0.426
	Yes	Ref	1.09 (0.9–1.31)	0.98 (0.81–1.19)	0.99 (0.81–1.21)	
Drinking	No	Ref	0.99 (0.82–1.19)	0.87 (0.72–1.05)	0.87 (0.71–1.06)	0.962
	Yes	Ref	1.05 (0.88–1.25)	0.97 (0.81–1.15)	0.99 (0.82–1.2)	
Hypertension	No	Ref	0.95 (0.79–1.14)	0.83 (0.69–1.01)	0.88 (0.72–1.07)	0.321
	Yes	Ref	1.09 (0.91–1.31)	1 (0.84–1.2)	1.01 (0.83–1.22)	
Hyperlipidemia	No	Ref	1.03 (0.88–1.22)	0.9 (0.76–1.07)	0.89 (0.75–1.07)	0.895
	Yes	Ref	1 (0.82–1.22)	0.96 (0.78–1.17)	1 (0.81–1.23)	
Diabetes	No	Ref	1.01 (0.87–1.16)	0.98 (0.84–1.13)	0.9 (0.77–1.05)	0.045
	Yes	Ref	1.05 (0.81–1.37)	0.72 (0.55–0.95)	1.03 (0.78–1.37)	
<b>Selenium group</b>						
Sex	Female	Ref	0.96 (0.79–1.16)	0.93 (0.77–1.12)	1.06 (0.88–1.28)	0.333
	Male	Ref	0.85 (0.72–1)	0.92 (0.78–1.09)	0.85 (0.72–1.01)	
Age	<60 years	Ref	0.99 (0.82–1.2)	1.16 (0.96–1.39)	1.17 (0.97–1.41)	0.005
	≥60 years	Ref	0.86 (0.72–1.03)	0.81 (0.68–0.97)	0.86 (0.72–1.03)	
BMI, kg/m <sup>2</sup>	<25	Ref	0.91 (0.71–1.16)	0.92 (0.72–1.17)	0.92 (0.72–1.18)	0.960
	≥25	Ref	0.9 (0.77–1.04)	0.93 (0.81–1.08)	0.97 (0.84–1.12)	
Ethnicity group	Non-hispanic white	Ref	0.82 (0.66–1)	0.8 (0.66–0.98)	0.86 (0.7–1.05)	0.473
	Non-hispanic black	Ref	0.87 (0.69–1.11)	1.12 (0.88–1.42)	1.1 (0.86–1.41)	
	Mexican American	Ref	1.06 (0.75–1.49)	0.84 (0.58–1.2)	0.64 (0.44–0.93)	
	Other race	Ref	0.98 (0.75–1.29)	1.02 (0.78–1.33)	1.18 (0.91–1.54)	
Education	Below high school level	Ref	0.82 (0.59–1.13)	0.91 (0.67–1.26)	0.91 (0.66–1.24)	0.452
	High school	Ref	0.88 (0.75–1.04)	0.85 (0.72–1)	0.87 (0.74–1.03)	
	Above high school	Ref	0.92 (0.73–1.16)	1.08 (0.86–1.37)	1.12 (0.88–1.41)	

Lifetime smoking of more than 100 cigarettes	No	Ref	0.9 (0.76–1.07)	0.91 (0.77–1.08)	0.88 (0.74–1.04)	0.628
	Yes	Ref	0.87 (0.72–1.04)	0.93 (0.77–1.11)	1.01 (0.84–1.22)	
Drinking	No	Ref	0.84 (0.7–1.01)	0.87 (0.73–1.05)	0.92 (0.77–1.11)	0.838
	Yes	Ref	0.93 (0.78–1.1)	0.96 (0.81–1.13)	0.96 (0.81–1.14)	
Hypertension	No	Ref	0.91 (0.76–1.09)	0.94 (0.78–1.12)	0.95 (0.79–1.15)	0.991
	Yes	Ref	0.88 (0.74–1.04)	0.92 (0.77–1.09)	0.97 (0.82–1.15)	
Hyperlipidemia	No	Ref	0.95 (0.8–1.12)	1.04 (0.88–1.23)	0.99 (0.84–1.17)	0.120
	Yes	Ref	0.8 (0.66–0.97)	0.78 (0.64–0.95)	0.89 (0.74–1.07)	
Diabetes	No	Ref	0.88 (0.77–1.02)	0.92 (0.8–1.06)	0.94 (0.82–1.09)	0.988
	Yes	Ref	0.92 (0.7–1.21)	0.94 (0.72–1.23)	0.97 (0.75–1.25)	

Model 3 was adjusted for age, sex, ethnicity (white/non-white), Education (0-7 years, 8-10 years, 11-15 years, or 16-years), income(continuous), work(employed/unemployed), Drinking status (never/past/current), smoking status (never/past/current), BMI (continuous), SBP (continuous), and physical activity (MET-min/week).