

SUPPLEMENTARY MATERIAL

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Supplementary Table S1. Rationale for the selection of biomarker for HMMs

HMMs	Optimal biological samples	Key Basis and Explanation
As	urine	In humans, As is predominantly eliminated via urinary excretion, and urinary As concentrations generally serve as a reliable indicator of internal As exposure ^[1] .
Cd	urine	Cd preferentially accumulates in the kidneys and is predominantly excreted via urine, with renal Cd concentrations generally proportional to urinary levels. Urinary Cd thus reflects total body Cd burden and constitutes a valid biomarker for evaluating Cd exposure ^[2, 3] .
Co	blood	Owing to the longer biological half-life and more stable circulating concentrations of Co in whole blood, whole-blood Co represents a more reliable biomarker than urinary Co for the assessment of Co exposure ^[4] .
Cr	blood	Following systemic absorption, Cr binds to transferrin in the bloodstream and is subsequently distributed to peripheral tissues and organs in an insulin-dependent manner. Nevertheless, the utility of urinary Cr as a biomarker of exposure is severely constrained by its extremely short biological half-life, low bioavailability, high endogenous background levels, and pronounced interindividual variation. Accordingly, whole-blood Cr represents a more appropriate biomarker for assessing Cr exposure compared with urinary Cr ^[5, 6] .
Hg	urine	Given that inorganic Hg in the body is predominantly eliminated renally via urinary excretion and exhibits a short circulatory half-life in blood, urinary Hg represents an optimal biomarker for evaluating Hg exposure and a reliable indicator of systemic Hg burden ^[7, 8] .
Mn	blood	Given its longer biological half-life and more stable circulating concentrations, total blood Mn serves as a reliable indicator of overall systemic Mn burden ^[9] .
Mo	urine	Urine serves as the primary excretion pathway for Mo, making urinary Mo a valuable biomarker for assessing Mo exposure ^[10] .
Ni	urine	Given that Ni can accumulate in the kidneys and is predominantly eliminated in urine, coupled with its rapid metabolism in the

HMMs	Optimal biological samples	Key Basis and Explanation
		circulatory system, urinary Ni represents a more sensitive and practical biomarker than serum Ni for the assessment of Ni exposure ^[11] .
Pb	blood	Whole blood Pb is the most used biomarker for recent and long-term exposures. If exposures are constant, one spot measurement of blood Pb can be a reasonable indicator of long-term exposure ^[12, 13] .
Sb	blood	Reported concentrations of Sb in urine and blood were 1.1 µg/L and 0.9-5.0 µg/L, respectively. On this basis, whole blood represents a more suitable biomarker for assessing Sb exposure compared with urine ^[14] .
Se	blood	Given the exceptional stability of Se in blood (plasma), blood (plasma) Se serves as the preferred biomarker for evaluating Se status ^[15, 16] .
Sn	urine	Urinary measurement of both inorganic and organic Sn is a good biomarker of exposure, as urine is the main route of elimination ^[10] .
Tl	urine	Tl is predominantly eliminated from the body via renal excretion, and urinary Tl determination has become the most widely applied biomarker for assessing Tl exposure ^[17] .

Note. HMMs: heavy metals and metalloids; As: arsenic; Cd: cadmium; Co: cobalt; Cr: chromium; Hg: mercury; Mn: manganese; Mo: molybdenum; Ni: nickel; Pb: lead; Sb: antimony; Se: selenium; Sn: tin; Tl: thallium.

Supplementary Table S2. LOD and detection rate and distribution characteristics of blood and urine HMMs

	HMMs	LOD (µg/L)	Detection Rate (%)	GM	P ₂₅	P ₅₀	P ₇₅
Blood	Co	0.001	96.955	0.133	0.100	0.145	0.223
	Cr	0.050	85.991	0.335	0.190	0.437	0.810
	Mn	0.100	99.818	10.650	8.500	10.870	13.745
	Pb	0.035	99.780	22.086	15.615	21.844	31.442
	Sb	0.030	99.531	2.222	1.910	2.315	2.884
	Se	0.600	99.808	94.997	80.400	96.638	115.365
	As	0.100	100.000	20.472	11.150	20.475	38.310
	Cd	0.020	100.000	0.635	0.327	0.670	1.340
Urine	Hg	0.015	100.000	0.203	0.100	0.217	0.463
	Mo	0.010	100.000	47.013	30.470	51.990	85.470
	Ni	0.200	99.990	1.590	0.850	1.730	3.230
	Sn	0.050	99.990	0.198	0.072	0.201	0.406
	Tl	0.002	100.000	0.264	0.160	0.280	0.474

Note. HMMs: heavy metals and metalloids; LOD: limit of detection; GM: geometric mean; As: arsenic; Cd: cadmium; Co: cobalt; Cr: chromium; Hg: mercury; Mn: manganese; Mo: molybdenum; Ni: nickel; Pb: lead; Sb: antimony; Se: selenium; Sn: tin; Tl: thallium.

Supplementary Table S3. Concentrations of blood and urinary HMMs among different hepatic fibrosis risk participants

	Variables	Total (N = 9543)	Non-high risk of hepatic fibrosis (N = 8022)	high risk of hepatic fibrosis (N = 1521)	P
Blood	Co	0.15 (0.10, 0.22)	0.14 (0.10, 0.23)	0.15 (0.11, 0.21)	0.142
	Cr	0.43 (0.19, 0.81)	0.43 (0.19, 0.80)	0.46 (0.19, 0.81)	0.550
	Mn	10.87 (8.50, 13.74)	10.85 (8.48, 13.68)	10.96 (8.59, 14.01)	0.214
	Pb	21.87 (15.64, 31.49)	21.75 (15.53, 31.08)	22.55 (16.30, 34.05)	< 0.001
	Sb	2.32 (1.91, 2.89)	2.33 (1.92, 2.90)	2.25 (1.87, 2.82)	0.001
	Se	96.73 (80.42, 115.41)	97.00 (80.79, 115.45)	94.80 (78.04, 115.00)	0.005
	As	20.50 (11.18, 38.40)	20.32 (11.20, 38.48)	21.60 (11.12, 37.75)	0.808
	Cd	0.67 (0.33, 1.34)	0.65 (0.32, 1.28)	0.81 (0.39, 1.65)	< 0.001
Urine	Hg	0.22 (0.10, 0.47)	0.22 (0.10, 0.47)	0.21 (0.09, 0.45)	0.153
	Mo	52.05 (30.44, 85.49)	51.51 (30.22, 83.93)	54.90 (32.32, 90.64)	0.003
	Ni	1.73 (0.85, 3.24)	1.72 (0.84, 3.23)	1.77 (0.92, 3.34)	0.159
	Sn	0.20 (0.07, 0.41)	0.21 (0.08, 0.42)	0.16 (0.05, 0.34)	< 0.001
	Tl	0.28 (0.16, 0.48)	0.28 (0.16, 0.48)	0.26 (0.15, 0.47)	0.006

Note. Data presented as the median (interquartile range). Abbreviations: HMMs: heavy metals and metalloids; As: arsenic; Cd: cadmium; Co: cobalt; Cr: chromium; Hg: mercury; Mn: manganese; Mo: molybdenum; Ni: nickel; Pb: lead; Sb: antimony; Se: selenium; Sn: tin; Tl: thallium.

Supplementary Table S4. Association between blood HMMs and FIB-4 in all participants

Blood HMMs	Crude model <i>β</i> (95%CI)	Model 1 <i>β</i> (95%CI)	Model 2 <i>β</i> (95%CI)	Model 3 <i>β</i> (95%CI)
Co				
Q1	Reference	Reference	Reference	Reference
Q2	0.192 (0.073, 0.311)#	0.085 (-0.015, 0.185)	0.078 (-0.020, 0.176)	0.079 (-0.019, 0.177)
Q3	0.315 (0.165, 0.465)*	0.169 (0.043, 0.295)#	0.150 (0.025, 0.274)#	0.149 (0.025, 0.272)#
Q4	0.125 (-0.037, 0.286)	0.185 (0.031, 0.340)#	0.166 (0.013, 0.319)#	0.165 (0.013, 0.318)#
lnCo	0.034 (-0.005, 0.072)	0.028 (-0.011, 0.066)	0.025 (-0.015, 0.065)	0.025 (-0.015, 0.065)
Cr				
Q1	Reference	Reference	Reference	Reference
Q2	0.026 (-0.126, 0.178)	-0.054 (-0.196, 0.087)	-0.060 (-0.202, 0.081)	-0.062 (-0.204, 0.080)
Q3	0.161 (-0.026, 0.348)	0.069 (-0.088, 0.226)	0.063 (-0.092, 0.219)	0.063 (-0.092, 0.217)
Q4	0.054 (-0.158, 0.267)	0.021 (-0.159, 0.200)	0.008 (-0.169, 0.186)	0.008 (-0.170, 0.185)
lnCr	0.024 (-0.033, 0.080)	0.005 (-0.042, 0.053)	0.003 (-0.044, 0.050)	0.003 (-0.044, 0.049)
Mn				
Q1	Reference	Reference	Reference	Reference
Q2	-0.001 (-0.106, 0.105)	0.094 (0.004, 0.183)#	0.091 (0.003, 0.180)#	0.091 (0.003, 0.179)#
Q3	-0.051 (-0.164, 0.063)	0.036 (-0.062, 0.134)	0.036 (-0.060, 0.131)	0.035 (-0.061, 0.131)
Q4	0.098 (-0.071, 0.266)	0.235 (0.071, 0.398)#	0.228 (0.067, 0.389)#	0.227 (0.065, 0.388)#
lnMn	0.035 (-0.073, 0.144)	0.140 (0.042, 0.239)#	0.134 (0.036, 0.231)#	0.133 (0.035, 0.230)#
Pb				
Q1	Reference	Reference	Reference	Reference
Q2	0.028 (-0.070, 0.127)	-0.064 (-0.154, 0.025)	-0.062 (-0.150, 0.026)	-0.061 (-0.149, 0.027)
Q3	-0.005 (-0.116, 0.107)	-0.102 (-0.200, -0.005)#	-0.100 (-0.197, -0.004)#	-0.101 (-0.197, -0.005)#
Q4	0.177 (0.015, 0.339)#	-0.062 (-0.186, 0.062)	-0.058 (-0.181, 0.065)	-0.060 (-0.181, 0.062)
lnPb	0.114 (0.030, 0.198)#	-0.009 (-0.076, 0.058)	-0.006 (-0.072, 0.060)	-0.007 (-0.073, 0.059)
Sb				
Q1	Reference	Reference	Reference	Reference
Q2	-0.032 (-0.184, 0.121)	-0.001 (-0.136, 0.135)	0.003 (-0.131, 0.136)	0.003 (-0.132, 0.137)
Q3	-0.138 (-0.312, 0.035)	-0.019 (-0.177, 0.140)	-0.017 (-0.172, 0.139)	-0.017 (-0.173, 0.140)
Q4	-0.130 (-0.359, 0.099)	0.002 (-0.188, 0.192)	-0.007 (-0.197, 0.184)	-0.008 (-0.199, 0.183)
lnSb	-0.068 (-0.250, 0.113)	-0.027 (-0.186, 0.133)	-0.031 (-0.192, 0.129)	-0.032 (-0.193, 0.129)
Se				
Q1	Reference	Reference	Reference	Reference
Q2	-0.220 (-0.388, -0.051)#	-0.034 (-0.167, 0.098)	-0.043 (-0.175, 0.089)	-0.044 (-0.175, 0.088)
Q3	-0.241 (-0.435, -0.047)#	0.015 (-0.126, 0.156)	0.009 (-0.129, 0.148)	0.009 (-0.129, 0.148)
Q4	-0.174 (-0.376, 0.028)	0.008 (-0.157, 0.173)	-0.009 (-0.168, 0.150)	-0.009 (-0.168, 0.149)
lnSe	-0.097 (-0.254, 0.060)	0.002 (-0.122, 0.127)	-0.009 (-0.129, 0.110)	-0.010 (-0.128, 0.109)

Note. Model 1 Adjusted for age, gender, marriage, nationality, residence, education level, income, areas, smoking status, alcohol consumption, body mass index; Model 2 further adjusted for TG and HDL-C. Model 3 further adjusted for hypertension, diabetes and CKD. #: $P < 0.05$; *: $P < 0.001$. Abbreviations: HMMs: heavy metals and metalloids; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; Co: cobalt; Cr: chromium; Mn: manganese; Pb: lead; Sb: antimony; Se: selenium.

Supplementary Table S5. Association between urine HMMs and FIB-4 in all participants

Urine HMMs	Crude model β (95%CI)	Model 1 β (95%CI)	Model 2 β (95%CI)	Model 3 β (95%CI)
As				
Q1	Reference	Reference	Reference	Reference
Q2	0.038 (-0.090, 0.167)	0.029 (-0.079, 0.136)	0.030 (-0.076, 0.136)	0.029 (-0.077, 0.135)
Q3	0.098 (-0.050, 0.246)	0.032 (-0.082, 0.145)	0.038 (-0.077, 0.152)	0.036 (-0.078, 0.151)
Q4	0.092 (-0.071, 0.256)	-0.018 (-0.167, 0.130)	-0.020 (-0.168, 0.129)	-0.021 (-0.169, 0.127)
lnAs	0.025 (-0.018, 0.067)	-0.010 (-0.048, 0.028)	-0.011 (-0.049, 0.027)	-0.011 (-0.049, 0.027)
Cd				
Q1	Reference	Reference	Reference	Reference
Q2	0.200 (0.092, 0.307)*	-0.014 (-0.094, 0.065)	-0.015 (-0.094, 0.063)	-0.016 (-0.094, 0.063)
Q3	0.344 (0.223, 0.464)*	-0.032 (-0.129, 0.064)	-0.036 (-0.131, 0.059)	-0.036 (-0.131, 0.060)
Q4	0.559 (0.413, 0.705)*	0.025 (-0.118, 0.168)	0.028 (-0.113, 0.170)	0.027 (-0.114, 0.169)
lnCd	0.193 (0.142, 0.244)*	0.020 (-0.023, 0.063)	0.021 (-0.021, 0.063)	0.021 (-0.022, 0.063)
Hg				
Q1	Reference	Reference	Reference	Reference
Q2	-0.047 (-0.199, 0.104)	0.003 (-0.123, 0.130)	0.008 (-0.117, 0.134)	0.009 (-0.118, 0.135)
Q3	-0.039 (-0.197, 0.119)	-0.037 (-0.176, 0.101)	-0.032 (-0.169, 0.104)	-0.031 (-0.168, 0.106)
Q4	0.052 (-0.127, 0.232)	0.046 (-0.130, 0.221)	0.036 (-0.135, 0.208)	0.037 (-0.134, 0.208)
lnHg	0.012 (-0.034, 0.058)	0.013 (-0.031, 0.057)	0.010 (-0.033, 0.054)	0.011 (-0.032, 0.054)
Mo				
Q1	Reference	Reference	Reference	Reference
Q2	0.094 (-0.019, 0.207)	0.010 (-0.086, 0.106)	0.004 (-0.090, 0.098)	0.004 (-0.090, 0.097)
Q3	0.164 (0.049, 0.278)#	-0.009 (-0.110, 0.093)	-0.018 (-0.120, 0.083)	-0.019 (-0.120, 0.083)
Q4	0.205 (0.054, 0.356)#	-0.067 (-0.201, 0.066)	-0.066 (-0.200, 0.067)	-0.068 (-0.203, 0.067)
lnMo	0.066 (0.030, 0.103)*	-0.006 (-0.040, 0.028)	-0.007 (-0.041, 0.027)	-0.007 (-0.041, 0.027)
Ni				
Q1	Reference	Reference	Reference	Reference
Q2	0.119 (-0.005, 0.243)	0.032 (-0.072, 0.136)	0.025 (-0.078, 0.129)	0.027 (-0.075, 0.130)
Q3	0.236 (0.106, 0.366)*	0.071 (-0.038, 0.180)	0.066 (-0.043, 0.174)	0.066 (-0.042, 0.175)
Q4	0.202 (0.087, 0.317)#	-0.024 (-0.125, 0.078)	-0.034 (-0.134, 0.066)	-0.034 (-0.135, 0.068)
lnNi	0.076 (0.033, 0.119)#	0.005 (-0.031, 0.042)	0.003 (-0.033, 0.039)	0.003 (-0.034, 0.039)
Sn				
Q1	Reference	Reference	Reference	Reference
Q2	0.049 (-0.107, 0.205)	0.054 (-0.081, 0.189)	0.057 (-0.076, 0.191)	0.058 (-0.075, 0.191)
Q3	-0.183 (-0.337, -0.030)#	-0.098 (-0.229, 0.032)	-0.097 (-0.225, 0.031)	-0.095 (-0.222, 0.032)
Q4	-0.114 (-0.273, 0.046)	-0.041 (-0.176, 0.093)	-0.045 (-0.179, 0.088)	-0.045 (-0.178, 0.088)
lnSn	-0.049 (-0.101, 0.004)	-0.024 (-0.068, 0.020)	-0.025 (-0.068, 0.018)	-0.028 (-0.082, 0.025)
Ti				
Q1	Reference	Reference	Reference	Reference
Q2	-0.030 (-0.189, 0.129)	-0.062 (-0.196, 0.072)	-0.070 (-0.203, 0.063)	-0.071 (-0.204, 0.063)
Q3	-0.016 (-0.166, 0.135)	-0.072 (-0.202, 0.058)	-0.076 (-0.206, 0.053)	-0.077 (-0.206, 0.053)
Q4	0.058 (-0.119, 0.234)	-0.112 (-0.282, 0.058)	-0.120 (-0.288, 0.049)	-0.121 (-0.289, 0.047)

lnTl	0.018 (-0.040, 0.075)	-0.026 (-0.080, 0.028)	-0.028 (-0.082, 0.026)	-0.028 (-0.082, 0.025)
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Note. Model 1 Adjusted for age, gender, marriage, nationality, residence, education level, income, areas, smoking status, alcohol consumption, body mass index; Model 2 further adjusted for TG and HDL-C. Model 3 further adjusted for hypertension, diabetes and CKD. #: $P < 0.05$; *: $P < 0.001$. Abbreviations: HMMs: heavy metals and metalloids; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; As: arsenic; Cd: cadmium; Hg: mercury; Mo: molybdenum; Ni: nickel; Sn: tin; Tl: thallium.

Supplementary Table S6. T3 level-stratified associations of blood HMMs with FIB-4 and hepatic fibrosis risk

Blood HMMs	FIB-4		Hepatic fibrosis risk	
	Low T3 Group β (95%CI)	High T3 Group β (95%CI)	Low T3 Group OR(95%CI)	High T3 Group OR(95%CI)
Co				
Q1	Reference	Reference	Reference	Reference
Q2	0.158 (0.033, 0.283)#	0.011 (-0.126, 0.148)	1.502 (1.094, 2.062)#	1.096 (0.713, 1.684)
Q3	0.187 (0.056, 0.318)#	0.088 (-0.074, 0.251)	1.583 (1.060, 2.365)#	1.318 (0.893, 1.947)
Q4	0.161 (0.013, 0.309)#	0.158 (-0.049, 0.366)	1.760 (1.163, 2.664)#	1.448 (0.941, 2.228)
lnCo	0.024 (-0.017, 0.064)	0.027 (-0.032, 0.086)	1.148 (1.006, 1.311)#	1.059 (0.925, 1.211)
Cr				
Q1	Reference	Reference	Reference	Reference
Q2	-0.042 (-0.235, 0.150)	-0.082 (-0.222, 0.058)	0.947 (0.597, 1.503)	0.705 (0.471, 1.055)
Q3	0.025 (-0.154, 0.204)	0.090 (-0.092, 0.272)	1.145 (0.748, 1.752)	1.041 (0.677, 1.599)
Q4	0.025 (-0.154, 0.205)	-0.030 (-0.242, 0.181)	1.276 (0.837, 1.945)	0.846 (0.514, 1.391)
lnCr	0.008 (-0.042, 0.057)	-0.004 (-0.056, 0.048)	1.088 (0.956, 1.238)	0.942 (0.822, 1.078)
Mn				
Q1	Reference	Reference	Reference	Reference
Q2	0.112 (-0.015, 0.239)	0.068 (-0.059, 0.195)	1.136 (0.837, 1.541)	1.139 (0.827, 1.568)
Q3	0.065 (-0.075, 0.204)	0.005 (-0.134, 0.144)	1.341 (0.886, 2.029)	0.998 (0.724, 1.376)
Q4	0.169 (0.004, 0.334)#	0.265 (0.049, 0.480)#	1.491 (0.989, 2.248)	1.839 (1.270, 2.663)*
lnMn	0.093 (-0.002, 0.188)	0.167 (0.020, 0.314)#	1.280 (0.966, 1.696)	1.523 (1.075, 2.158)#
Pb				
Q1	Reference	Reference	Reference	Reference
Q2	0.055 (-0.057, 0.167)	-0.178 (-0.321, -0.035)#	1.120 (0.829, 1.515)	0.603 (0.401, 0.906)#
Q3	0.005 (-0.100, 0.110)	-0.200 (-0.335, -0.064)#	0.999 (0.722, 1.382)	0.558 (0.350, 0.889)#
Q4	0.000 (-0.135, 0.136)	-0.125 (-0.279, 0.030)	0.759 (0.513, 1.121)	0.694 (0.457, 1.052)
lnPb	0.021 (-0.053, 0.096)	-0.035 (-0.117, 0.046)	0.882 (0.742, 1.049)	0.901 (0.742, 1.094)
Sb				
Q1	Reference	Reference	Reference	Reference
Q2	-0.001 (-0.153, 0.152)	-0.008 (-0.156, 0.139)	0.893 (0.625, 1.274)	1.100 (0.783, 1.545)
Q3	-0.011 (-0.177, 0.154)	-0.038 (-0.231, 0.155)	0.888 (0.597, 1.318)	1.131 (0.734, 1.743)
Q4	-0.042 (-0.259, 0.175)	0.000 (-0.213, 0.213)	0.765 (0.461, 1.267)	1.061 (0.672, 1.677)
lnSb	-0.029 (-0.187, 0.129)	-0.061 (-0.241, 0.119)	0.884 (0.686, 1.139)	0.918 (0.601, 1.404)
Se				
Q1	Reference	Reference	Reference	Reference
Q2	-0.004 (-0.163, 0.155)	-0.085 (-0.233, 0.064)	0.883 (0.552, 1.411)	0.997 (0.718, 1.385)
Q3	-0.046 (-0.208, 0.117)	0.049 (-0.119, 0.216)	0.822 (0.520, 1.299)	1.321 (0.881, 1.982)
Q4	-0.030 (-0.204, 0.145)	-0.008 (-0.204, 0.189)	0.774 (0.504, 1.188)	1.406 (0.935, 2.114)
lnSe	-0.004 (-0.125, 0.117)	-0.028 (-0.184, 0.127)	0.879 (0.673, 1.148)	1.260 (0.803, 1.977)

Note. Adjusted associations between health outcomes and potential risk factors, including age, gender, marriage, nationality, residence, education level, income, areas, smoking status, alcohol consumption, body mass index, TG, HDL-C, hypertension, diabetes and CKD. #: $P < 0.05$; *: $P < 0.001$. Abbreviations: HMMs: heavy metals and metalloids; OR: Odds ratios; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; Co: cobalt; Cr: chromium; Mn: manganese; Pb: lead; Sb: antimony; Se: selenium.

Supplementary Table S7. T4 level-stratified associations of blood HMMs with FIB-4 and hepatic fibrosis risk

Blood HMMs	FIB-4		Hepatic fibrosis risk	
	Low T4 Group β (95%CI)	High T4 Group β (95%CI)	Low T4 Group OR(95%CI)	High T4 Group OR(95%CI)
Co				
Q1	Reference	Reference	Reference	Reference
Q2	0.083 (-0.053, 0.219)	0.057 (-0.079, 0.193)	1.115 (0.743, 1.673)	1.379 (0.939, 2.025)
Q3	0.165 (0.016, 0.313)#	0.124 (-0.035, 0.283)	1.543 (0.963, 2.472)	1.371 (0.973, 1.930)
Q4	0.156 (0.004, 0.307)#	0.175 (-0.023, 0.372)	1.454 (0.896, 2.360)	1.744 (1.198, 2.539)#
lnCo	0.038 (0.003, 0.073)#	0.016 (-0.041, 0.073)	1.106 (0.982, 1.245)	1.089 (0.957, 1.240)
Cr				
Q1	Reference	Reference	Reference	Reference
Q2	-0.051 (-0.180, 0.079)	-0.062 (-0.261, 0.136)	0.965 (0.615, 1.514)	0.698 (0.447, 1.088)
Q3	0.081 (-0.078, 0.240)	0.046 (-0.134, 0.226)	1.373 (0.871, 2.162)	0.879 (0.582, 1.328)
Q4	0.060 (-0.116, 0.235)	-0.050 (-0.266, 0.166)	1.338 (0.850, 2.107)	0.865 (0.533, 1.404)
lnCr	0.027 (-0.018, 0.072)	-0.023 (-0.078, 0.032)	1.137 (0.993, 1.302)	0.924 (0.811, 1.053)
Mn				
Q1	Reference	Reference	Reference	Reference
Q2	0.095 (0.000, 0.189)#	0.091 (-0.044, 0.226)	1.162 (0.818, 1.650)	1.131 (0.828, 1.544)
Q3	0.099 (-0.018, 0.215)	-0.026 (-0.153, 0.100)	1.305 (0.866, 1.969)	1.040 (0.757, 1.430)
Q4	0.268 (0.108, 0.429)*	0.186 (-0.035, 0.406)	1.848 (1.186, 2.879)#	1.604 (1.126, 2.283)#
lnMn	0.154 (0.047, 0.261)#	0.108 (-0.024, 0.240)	1.398 (0.960, 2.035)	1.421 (1.045, 1.933)#
Pb				
Q1	Reference	Reference	Reference	Reference
Q2	0.005 (-0.105, 0.114)	-0.129 (-0.263, 0.006)	1.000 (0.713, 1.402)	0.667 (0.430, 1.036)
Q3	-0.051 (-0.164, 0.061)	-0.155 (-0.306, -0.004)#	0.867 (0.610, 1.232)	0.619 (0.378, 1.014)
Q4	-0.050 (-0.192, 0.092)	-0.076 (-0.239, 0.087)	0.713 (0.473, 1.074)	0.723 (0.482, 1.085)
lnPb	0.001 (-0.076, 0.079)	-0.017 (-0.100, 0.066)	0.859 (0.716, 1.029)	0.922 (0.763, 1.115)
Sb				
Q1	Reference	Reference	Reference	Reference
Q2	0.006 (-0.116, 0.128)	0.017 (-0.174, 0.208)	0.969 (0.664, 1.415)	1.071 (0.758, 1.514)
Q3	0.047 (-0.113, 0.207)	-0.078 (-0.280, 0.124)	1.084 (0.695, 1.689)	0.942 (0.611, 1.450)
Q4	0.002 (-0.185, 0.189)	0.004 (-0.238, 0.246)	0.849 (0.520, 1.388)	1.032 (0.639, 1.666)
lnSb	-0.028 (-0.145, 0.089)	-0.029 (-0.247, 0.189)	0.873 (0.669, 1.139)	0.960 (0.690, 1.335)
Se				
Q1	Reference	Reference	Reference	Reference
Q2	-0.068 (-0.260, 0.123)	-0.025 (-0.153, 0.103)	0.847 (0.544, 1.321)	1.009 (0.724, 1.405)
Q3	-0.032 (-0.209, 0.146)	0.041 (-0.121, 0.203)	0.863 (0.538, 1.385)	1.262 (0.862, 1.847)
Q4	-0.069 (-0.239, 0.102)	0.058 (-0.154, 0.270)	0.864 (0.560, 1.333)	1.260 (0.857, 1.851)
lnSe	-0.019 (-0.139, 0.102)	0.004 (-0.162, 0.170)	0.906 (0.688, 1.193)	1.199 (0.793, 1.814)

Note. Adjusted associations between health outcomes and potential risk factors, including age, gender, marriage, nationality, residence, education level, income, areas, smoking status, alcohol consumption, body mass index, TG, HDL-C, hypertension, diabetes and CKD. #: $P < 0.05$; *: $P < 0.001$. Abbreviations: HMMs: heavy metals and metalloids; OR: Odds ratios; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; Co: cobalt; Cr: chromium; Mn: manganese; Pb: lead; Sb: antimony; Se: selenium.

Supplementary Table S8. T3 level-stratified associations of urine HMMs with FIB-4 and hepatic fibrosis risk

Urine HMMs	FIB-4		Hepatic fibrosis risk	
	Low T3 Group $\beta(95\%CI)$	High T3 Group $\beta(95\%CI)$	Low T3 Group $OR(95\%CI)$	High T3 Group $OR(95\%CI)$
As				
Q1	Reference	Reference	Reference	Reference
Q2	0.007 (-0.113, 0.126)	0.038 (-0.106, 0.182)	1.101 (0.779, 1.558)	1.428 (0.958, 2.127)
Q3	0.034 (-0.114, 0.182)	0.020 (-0.127, 0.167)	1.136 (0.776, 1.664)	1.187 (0.792, 1.780)
Q4	-0.061 (-0.231, 0.108)	0.006 (-0.165, 0.176)	0.785 (0.521, 1.183)	1.187 (0.802, 1.756)
lnAs	-0.028 (-0.069, 0.014)	0.004 (-0.042, 0.051)	0.886 (0.787, 0.997)#	1.014 (0.915, 1.124)
Cd				
Q1	Reference	Reference	Reference	Reference
Q2	-0.024 (-0.137, 0.089)	0.003 (-0.094, 0.100)	0.988 (0.619, 1.577)	0.975 (0.648, 1.468)
Q3	-0.057 (-0.186, 0.072)	-0.022 (-0.139, 0.094)	0.763 (0.455, 1.280)	0.863 (0.612, 1.216)
Q4	0.035 (-0.136, 0.206)	0.014 (-0.146, 0.175)	1.232 (0.792, 1.915)	1.023 (0.679, 1.543)
lnCd	0.020 (-0.030, 0.070)	0.017 (-0.032, 0.065)	1.042 (0.899, 1.207)	1.056 (0.943, 1.182)
Hg				
Q1	Reference	Reference	Reference	Reference
Q2	0.032 (-0.103, 0.167)	-0.019 (-0.177, 0.139)	0.993 (0.677, 1.457)	0.977 (0.658, 1.448)
Q3	-0.020 (-0.157, 0.117)	-0.051 (-0.227, 0.126)	0.899 (0.609, 1.328)	0.929 (0.606, 1.423)
Q4	0.054 (-0.093, 0.201)	-0.004 (-0.226, 0.218)	1.013 (0.695, 1.476)	1.115 (0.703, 1.769)
lnHg	0.018 (-0.016, 0.053)	-0.002 (-0.059, 0.055)	1.022 (0.918, 1.137)	1.032 (0.913, 1.167)
Mo				
Q1	Reference	Reference	Reference	Reference
Q2	-0.011 (-0.131, 0.109)	0.018 (-0.104, 0.139)	0.877 (0.592, 1.298)	0.982 (0.670, 1.438)
Q3	-0.009 (-0.134, 0.115)	-0.032 (-0.176, 0.112)	0.928 (0.595, 1.447)	0.894 (0.601, 1.330)
Q4	-0.026 (-0.177, 0.125)	-0.099 (-0.263, 0.064)	0.841 (0.508, 1.393)	0.749 (0.502, 1.118)
lnMo	0.001 (-0.031, 0.033)	-0.014 (-0.060, 0.031)	0.985 (0.859, 1.129)	0.922 (0.833, 1.022)
Ni				
Q1	Reference	Reference	Reference	Reference
Q2	0.024 (-0.097, 0.145)	0.028 (-0.117, 0.173)	1.019 (0.717, 1.448)	1.011 (0.623, 1.640)
Q3	0.057 (-0.069, 0.183)	0.070 (-0.082, 0.223)	1.043 (0.742, 1.466)	1.152 (0.803, 1.652)
Q4	-0.018 (-0.136, 0.101)	-0.057 (-0.196, 0.083)	0.960 (0.684, 1.347)	0.825 (0.560, 1.213)
lnNi	0.001 (-0.038, 0.040)	0.001 (-0.047, 0.048)	0.954 (0.853, 1.067)	0.974 (0.876, 1.082)
Sn				
Q1	Reference	Reference	Reference	Reference
Q2	0.004 (-0.141, 0.150)	0.111 (-0.065, 0.287)	0.786 (0.549, 1.125)	1.263 (0.852, 1.874)
Q3	-0.084 (-0.211, 0.044)	-0.110 (-0.260, 0.039)	0.622 (0.425, 0.910)#	0.642 (0.453, 0.908)#
Q4	-0.087 (-0.230, 0.055)	-0.003 (-0.166, 0.159)	0.572 (0.381, 0.858)#	0.908 (0.636, 1.298)
lnSn	-0.037 (-0.080, 0.007)	-0.014 (-0.068, 0.041)	0.838 (0.733, 0.958)#	0.934 (0.826, 1.056)
Tl				
Q1	Reference	Reference	Reference	Reference
Q2	-0.048 (-0.192, 0.097)	-0.092 (-0.273, 0.090)	0.688 (0.420, 1.127)	1.048 (0.726, 1.515)

Q3	-0.003 (-0.153, 0.146)	-0.159 (-0.326, 0.007)	0.992 (0.617, 1.596)	0.825 (0.581, 1.173)
Q4	-0.086 (-0.278, 0.106)	-0.164 (-0.361, 0.034)	0.829 (0.507, 1.355)	0.815 (0.554, 1.198)
lnTl	-0.011 (-0.071, 0.049)	-0.047 (-0.108, 0.015)	0.957 (0.809, 1.132)	0.911 (0.802, 1.036)

Note. Adjusted associations between health outcomes and potential risk factors, including age, gender, marriage, nationality, residence, education level, income, areas, smoking status, alcohol consumption, body mass index, TG, HDL-C, hypertension, diabetes and CKD. #: $P < 0.05$. Abbreviations: HMMs: heavy metals and metalloids; OR: Odds ratios; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; As: arsenic; Cd: cadmium; Hg: mercury; Mo: molybdenum; Ni: nickel; Sn: tin; Tl: thallium.

Supplementary Table S9. T4 level-stratified associations of urine HMMs with FIB-4 and hepatic fibrosis risk

Urine HMMs	FIB-4		Hepatic fibrosis risk	
	Low T4 Group β (95%CI)	High T4 Group β (95%CI)	Low T4 Group OR(95%CI)	High T4 Group OR(95%CI)
As				
Q1	Reference	Reference	Reference	Reference
Q2	-0.012 (-0.137, 0.113)	0.052 (-0.078, 0.183)	1.315 (0.931, 1.859)	1.194 (0.842, 1.692)
Q3	-0.011 (-0.150, 0.128)	0.080 (-0.055, 0.216)	1.075 (0.751, 1.538)	1.320 (0.872, 1.998)
Q4	-0.145 (-0.294, 0.004)	0.101 (-0.087, 0.288)	0.732 (0.495, 1.081)	1.256 (0.828, 1.906)
lnAs	-0.036 (-0.074, 0.002)	0.017 (-0.033, 0.067)	0.886 (0.795, 0.988)#	1.003 (0.889, 1.133)
Cd				
Q1	Reference	Reference	Reference	Reference
Q2	0.014 (-0.106, 0.133)	-0.062 (-0.186, 0.062)	0.971 (0.630, 1.497)	0.951 (0.635, 1.424)
Q3	0.031 (-0.062, 0.124)	-0.127 (-0.263, 0.008)	0.816 (0.547, 1.216)	0.813 (0.544, 1.217)
Q4	0.039 (-0.118, 0.197)	-0.007 (-0.180, 0.167)	1.129 (0.710, 1.794)	1.083 (0.719, 1.631)
lnCd	0.027 (-0.023, 0.076)	0.010 (-0.042, 0.062)	1.034 (0.882, 1.211)	1.058 (0.939, 1.192)
Hg				
Q1	Reference	Reference	Reference	Reference
Q2	0.010 (-0.119, 0.139)	0.008 (-0.159, 0.176)	1.125 (0.713, 1.775)	0.852 (0.583, 1.245)
Q3	0.004 (-0.151, 0.160)	-0.067 (-0.257, 0.123)	0.873 (0.554, 1.377)	0.970 (0.657, 1.432)
Q4	0.014 (-0.154, 0.183)	0.058 (-0.180, 0.296)	1.031 (0.640, 1.661)	1.139 (0.747, 1.735)
lnHg	0.011 (-0.031, 0.054)	0.012 (-0.047, 0.071)	1.033 (0.895, 1.193)	1.041 (0.938, 1.156)
Mo				
Q1	Reference	Reference	Reference	Reference
Q2	0.026 (-0.094, 0.147)	-0.014 (-0.148, 0.121)	0.894 (0.592, 1.350)	1.000 (0.697, 1.435)
Q3	0.044 (-0.081, 0.169)	-0.084 (-0.230, 0.062)	1.014 (0.642, 1.600)	0.853 (0.613, 1.188)
Q4	-0.019 (-0.175, 0.138)	-0.129 (-0.296, 0.037)	0.874 (0.533, 1.434)	0.696 (0.475, 1.020)
lnMo	0.010 (-0.025, 0.046)	-0.031 (-0.078, 0.016)	1.015 (0.890, 1.158)	0.889 (0.793, 0.997)#
Ni				
Q1	Reference	Reference	Reference	Reference
Q2	-0.021 (-0.135, 0.092)	0.075 (-0.066, 0.216)	0.999 (0.673, 1.484)	1.089 (0.736, 1.611)
Q3	0.036 (-0.094, 0.167)	0.096 (-0.046, 0.238)	1.003 (0.668, 1.505)	1.263 (0.920, 1.733)
Q4	-0.033 (-0.154, 0.088)	-0.039 (-0.179, 0.101)	0.918 (0.670, 1.256)	0.871 (0.594, 1.276)
lnNi	-0.004 (-0.048, 0.040)	0.007 (-0.034, 0.048)	0.920 (0.820, 1.033)	1.005 (0.917, 1.101)
Sn				
Q1	Reference	Reference	Reference	Reference
Q2	0.136 (-0.003, 0.274)	-0.021 (-0.181, 0.140)	1.137 (0.791, 1.634)	0.906 (0.592, 1.386)
Q3	0.007 (-0.134, 0.149)	-0.199 (-0.355, -0.043)#	0.713 (0.471, 1.078)	0.589 (0.395, 0.879)#
Q4	0.009 (-0.149, 0.167)	-0.102 (-0.250, 0.045)	0.694 (0.431, 1.117)	0.748 (0.528, 1.059)
lnSn	-0.009 (-0.060, 0.041)	-0.040 (-0.089, 0.008)	0.880 (0.754, 1.026)	0.892 (0.790, 1.008)
Tl				
Q1	Reference	Reference	Reference	Reference
Q2	-0.037 (-0.178, 0.105)	-0.103 (-0.272, 0.067)	0.722 (0.444, 1.174)	0.990 (0.679, 1.443)

Q3	-0.024 (-0.181, 0.134)	-0.145 (-0.317, 0.027)	0.953 (0.571, 1.590)	0.848 (0.584, 1.231)
Q4	-0.110 (-0.317, 0.098)	-0.151 (-0.333, 0.032)	0.698 (0.422, 1.154)	0.919 (0.644, 1.313)
lnTl	-0.024 (-0.092, 0.044)	-0.041 (-0.103, 0.021)	0.911 (0.771, 1.076)	0.945 (0.831, 1.075)

Note. Adjusted associations between health outcomes and potential risk factors, including age, gender, marriage, nationality, residence, education level, income, areas, smoking status, alcohol consumption, body mass index, TG, HDL-C, hypertension, diabetes and CKD. #: $P < 0.05$. Abbreviations: HMMs: heavy metals and metalloids; OR: Odds ratios; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; As: arsenic; Cd: cadmium; Hg: mercury; Mo: molybdenum; Ni: nickel; Sn: tin; Tl: thallium.

Supplementary Table S10. Age-stratified associations of blood HMMs with FIB-4 and hepatic fibrosis risk

Blood HMMs	FIB-4		Hepatic fibrosis risk	
	< 40 years Group β (95%CI)	$\geq$ 40 years Group β (95%CI)	< 40 years Group OR(95%CI)	$\geq$ 40 years Group OR(95%CI)
Co				
Q1	Reference	Reference	Reference	Reference
Q2	0.091 (-0.046, 0.227)	0.095 (-0.034, 0.225)	1.576 (0.619, 4.016)	1.197 (0.931, 1.539)
Q3	0.103 (0.004, 0.203)#	0.219 (0.050, 0.387)#	1.202 (0.567, 2.546)	1.501 (1.085, 2.078)#
Q4	0.107 (-0.024, 0.238)	0.134 (-0.066, 0.333)	1.414 (0.569, 3.509)	1.375 (0.970, 1.950)
lnCo	0.013 (-0.025, 0.051)	0.022 (-0.028, 0.072)	1.043 (0.748, 1.453)	1.070 (0.968, 1.181)
Cr				
Q1	Reference	Reference	Reference	Reference
Q2	-0.069 (-0.204, 0.066)	-0.055 (-0.244, 0.135)	0.619 (0.273, 1.402)	0.843 (0.614, 1.157)
Q3	0.010 (-0.160, 0.181)	0.097 (-0.091, 0.286)	0.822 (0.323, 2.094)	1.087 (0.792, 1.494)
Q4	0.009 (-0.151, 0.169)	0.045 (-0.182, 0.271)	1.243 (0.504, 3.068)	1.072 (0.764, 1.504)
lnCr	0.000 (-0.049, 0.049)	0.017 (-0.039, 0.073)	0.994 (0.721, 1.371)	1.031 (0.939, 1.133)
Mn				
Q1	Reference	Reference	Reference	Reference
Q2	0.076 (-0.034, 0.186)	0.023 (-0.104, 0.150)	1.801 (0.742, 4.373)	0.966 (0.770, 1.213)
Q3	0.051 (-0.028, 0.131)	-0.048 (-0.168, 0.072)	1.220 (0.570, 2.613)	1.002 (0.791, 1.268)
Q4	0.154 (0.044, 0.265)#	0.166 (-0.049, 0.381)	2.420 (1.274, 4.597)#	1.338 (0.997, 1.798)
lnMn	0.065 (0.000, 0.130)	0.100 (-0.041, 0.242)	1.395 (0.988, 1.969)	1.188 (0.957, 1.476)
Pb				
Q1	Reference	Reference	Reference	Reference
Q2	-0.039 (-0.132, 0.054)	-0.044 (-0.184, 0.096)	0.640 (0.349, 1.174)	0.850 (0.663, 1.091)
Q3	-0.101 (-0.203, 0.001)	-0.077 (-0.204, 0.051)	0.234 (0.095, 0.573)#	0.845 (0.664, 1.074)
Q4	-0.071 (-0.176, 0.034)	-0.011 (-0.164, 0.143)	0.465 (0.197, 1.096)	0.793 (0.605, 1.038)
lnPb	-0.020 (-0.063, 0.024)	0.026 (-0.060, 0.112)	0.803 (0.652, 0.989)#	0.933 (0.809, 1.076)
Sb				
Q1	Reference	Reference	Reference	Reference
Q2	0.008 (-0.095, 0.111)	0.015 (-0.167, 0.197)	1.211 (0.583, 2.514)	1.022 (0.786, 1.328)
Q3	0.082 (-0.058, 0.221)	-0.085 (-0.283, 0.112)	1.870 (0.749, 4.668)	0.911 (0.672, 1.235)
Q4	0.037 (-0.096, 0.170)	-0.029 (-0.269, 0.212)	1.234 (0.461, 3.302)	0.937 (0.655, 1.341)
lnSb	0.008 (-0.095, 0.111)	-0.059 (-0.263, 0.144)	1.034 (0.470, 2.279)	0.912 (0.724, 1.148)
Se				
Q1	Reference	Reference	Reference	Reference
Q2	0.011 (-0.134, 0.157)	-0.127 (-0.28, 0.026)	0.941 (0.398, 2.229)	0.859 (0.658, 1.121)
Q3	0.058 (-0.060, 0.176)	-0.079 (-0.252, 0.094)	1.27 (0.573, 2.811)	0.927 (0.683, 1.259)
Q4	0.032 (-0.080, 0.144)	-0.086 (-0.290, 0.117)	0.66 (0.284, 1.531)	0.940 (0.694, 1.271)
lnSe	0.018 (-0.066, 0.101)	-0.057 (-0.218, 0.104)	0.906 (0.646, 1.269)	0.956 (0.742, 1.233)

Note: Adjusted associations between health outcomes and potential risk factors, including gender, marriage, nationality, residence, education level, income, areas, smoking status, alcohol consumption, body mass index, TG, HDL-C, hypertension, diabetes and CKD. #: $P < 0.05$. Abbreviations: HMMs: heavy metals and metalloids; OR: Odds ratios; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; Co: cobalt; Cr: chromium; Mn: manganese; Pb: lead; Sb: antimony; Se: selenium.

Supplementary Table S11. Sex-stratified associations of blood HMMs with FIB-4 and hepatic fibrosis risk

Blood HMMs	FIB-4		Hepatic fibrosis risk	
	Female β (95%CI)	Male β (95%CI)	Female OR(95%CI)	Male OR(95%CI)
Co				
Q1	Reference	Reference	Reference	Reference
Q2	0.179 (0.022, 0.335)#	0.051 (-0.067, 0.169)	1.343 (1.011, 1.784)#	1.258 (0.810, 1.955)
Q3	0.145 (-0.016, 0.307)	0.189 (0.035, 0.342)#	1.273 (0.923, 1.754)	1.663 (1.066, 2.595)#
Q4	0.234 (0.054, 0.414)#	0.156 (-0.035, 0.348)	1.556 (1.085, 2.232)#	1.690 (0.984, 2.902)
lnCo	0.026 (-0.033, 0.084)	0.029 (-0.011, 0.069)	1.079 (0.953, 1.221)	1.104 (0.960, 1.269)
Cr				
Q1	Reference	Reference	Reference	Reference
Q2	-0.022 (-0.253, 0.210)	-0.095 (-0.236, 0.046)	0.856 (0.569, 1.288)	0.746 (0.449, 1.241)
Q3	0.067 (-0.172, 0.306)	0.062 (-0.088, 0.212)	0.982 (0.650, 1.483)	1.183 (0.739, 1.893)
Q4	0.026 (-0.243, 0.296)	-0.002 (-0.166, 0.162)	0.848 (0.549, 1.310)	1.278 (0.780, 2.094)
lnCr	0.002 (-0.074, 0.078)	0.004 (-0.039, 0.048)	0.960 (0.851, 1.082)	1.066 (0.910, 1.249)
Mn				
Q1	Reference	Reference	Reference	Reference
Q2	0.220 (0.070, 0.370)*	0.018 (-0.083, 0.119)	1.393 (1.062, 1.828)#	1.004 (0.716, 1.408)
Q3	0.102 (-0.031, 0.235)	0.001 (-0.135, 0.136)	1.286 (0.954, 1.733)	1.058 (0.698, 1.605)
Q4	0.307 (0.104, 0.510)*	0.186 (0.008, 0.365)#	1.774 (1.248, 2.523)#	1.691 (1.078, 2.654)#
lnMn	0.158 (0.026, 0.290)#	0.111 (0.000, 0.222)#	1.404 (1.045, 1.887)#	1.407 (0.991, 1.999)
Pb				
Q1	Reference	Reference	Reference	Reference
Q2	-0.026 (-0.115, 0.063)	-0.111 (-0.275, 0.053)	0.865 (0.708, 1.057)	0.692 (0.356, 1.344)
Q3	-0.090 (-0.206, 0.027)	-0.128 (-0.263, 0.008)	0.785 (0.615, 1.002)	0.649 (0.342, 1.232)
Q4	-0.097 (-0.254, 0.061)	-0.061 (-0.211, 0.090)	0.788 (0.610, 1.017)	0.631 (0.332, 1.201)
lnPb	-0.030 (-0.102, 0.043)	0.013 (-0.073, 0.099)	0.893 (0.782, 1.020)	0.888 (0.701, 1.125)
Sb				
Q1	Reference	Reference	Reference	Reference
Q2	-0.015 (-0.235, 0.204)	0.015 (-0.117, 0.148)	0.868 (0.604, 1.248)	1.117 (0.775, 1.609)
Q3	-0.049 (-0.282, 0.184)	0.008 (-0.154, 0.170)	0.808 (0.558, 1.171)	1.229 (0.778, 1.940)
Q4	-0.021 (-0.290, 0.247)	0.008 (-0.165, 0.180)	0.901 (0.562, 1.446)	0.937 (0.583, 1.507)
lnSb	-0.099 (-0.395, 0.197)	0.014 (-0.060, 0.088)	0.811 (0.541, 1.214)	1.019 (0.826, 1.258)
Se				
Q1	Reference	Reference	Reference	Reference
Q2	-0.032 (-0.181, 0.116)	-0.051 (-0.208, 0.107)	1.090 (0.805, 1.475)	0.831 (0.519, 1.329)
Q3	-0.031 (-0.210, 0.148)	0.028 (-0.142, 0.198)	1.093 (0.791, 1.509)	1.013 (0.607, 1.689)
Q4	-0.003 (-0.230, 0.224)	-0.010 (-0.172, 0.153)	1.082 (0.744, 1.575)	1.036 (0.651, 1.647)
lnSe	-0.005 (-0.156, 0.147)	-0.018 (-0.152, 0.115)	1.028 (0.730, 1.447)	1.026 (0.690, 1.526)

Note. Adjusted associations between health outcomes and potential risk factors, including age, marriage, nationality, residence, education level, income, areas, smoking status, alcohol consumption, body mass index, TG, HDL-C, hypertension, diabetes and CKD. #: $P < 0.05$; *: $P < 0.001$. Abbreviations: HMMs: heavy metals and metalloids; OR: Odds ratios; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; Co: cobalt; Cr: chromium; Mn: manganese; Pb: lead; Sb: antimony; Se: selenium.

Supplementary Table S12. Alcohol consumption-stratified associations of blood HMMs with FIB-4 and hepatic fibrosis risk

Blood HMMs	FIB-4		Hepatic fibrosis risk	
	Non-drinking β (95%CI)	Drinking β (95%CI)	Non-drinking OR(95%CI)	Drinking OR(95%CI)
Co				
Q1	Reference	Reference	Reference	Reference
Q2	0.166 (0.012, 0.320)#	-0.002 (-0.114, 0.110)	1.374 (0.994, 1.899)	1.153 (0.740, 1.799)
Q3	0.167 (0.024, 0.309)#	0.159 (-0.005, 0.323)	1.446 (1.086, 1.925)#	1.545 (0.884, 2.700)
Q4	0.228 (0.062, 0.394)*	0.084 (-0.096, 0.263)	1.763 (1.222, 2.545)#	1.235 (0.703, 2.167)
lnCo	0.038 (-0.007, 0.082)	0.008 (-0.040, 0.055)	1.127 (1.011, 1.256)#	1.021 (0.883, 1.181)
Cr				
Q1	Reference	Reference	Reference	Reference
Q2	-0.114 (-0.309, 0.082)	0.010 (-0.111, 0.132)	0.704 (0.468, 1.058)	1.043 (0.651, 1.672)
Q3	0.050 (-0.145, 0.245)	0.086 (-0.056, 0.228)	0.843 (0.564, 1.259)	1.793 (1.058, 3.039)#
Q4	-0.047 (-0.277, 0.183)	0.092 (-0.075, 0.259)	0.767 (0.495, 1.187)	1.941 (1.143, 3.295)#
lnCr	-0.014 (-0.075, 0.048)	0.028 (-0.014, 0.070)	0.926 (0.814, 1.054)	1.216 (1.037, 1.427)#
Mn				
Q1	Reference	Reference	Reference	Reference
Q2	0.138 (0.007, 0.269)#	0.041 (-0.068, 0.149)	1.183 (0.908, 1.541)	1.022 (0.641, 1.632)
Q3	0.012 (-0.113, 0.136)	0.062 (-0.071, 0.195)	1.032 (0.771, 1.380)	1.339 (0.818, 2.192)
Q4	0.198 (0.018, 0.378)#	0.273 (0.089, 0.458)*	1.412 (1.000, 1.992)#	2.374 (1.484, 3.798)#
lnMn	0.116 (-0.003, 0.235)	0.164 (0.054, 0.273)*	1.219 (0.912, 1.630)	1.870 (1.279, 2.734)#
Pb				
Q1	Reference	Reference	Reference	Reference
Q2	-0.026 (-0.117, 0.066)	-0.129 (-0.276, 0.018)	0.774 (0.557, 1.078)	0.822 (0.489, 1.383)
Q3	-0.043 (-0.160, 0.074)	-0.189 (-0.322, -0.056)*	0.881 (0.619, 1.253)	0.477 (0.299, 0.761)#
Q4	-0.037 (-0.182, 0.108)	-0.119 (-0.292, 0.055)	0.693 (0.497, 0.966)#	0.694 (0.433, 1.114)
lnPb	-0.023 (-0.096, 0.050)	0.018 (-0.074, 0.109)	0.858 (0.735, 1.002)	0.949 (0.716, 1.258)
Sb				
Q1	Reference	Reference	Reference	Reference
Q2	0.033 (-0.156, 0.223)	-0.031 (-0.158, 0.095)	0.982 (0.724, 1.331)	0.987 (0.646, 1.508)
Q3	-0.045 (-0.262, 0.172)	0.017 (-0.141, 0.174)	0.948 (0.635, 1.416)	1.080 (0.668, 1.744)
Q4	-0.006 (-0.244, 0.232)	-0.007 (-0.174, 0.159)	0.994 (0.645, 1.532)	0.808 (0.456, 1.432)
lnSb	-0.057 (-0.306, 0.193)	-0.006 (-0.085, 0.073)	0.917 (0.666, 1.264)	0.899 (0.686, 1.179)
Se				
Q1	Reference	Reference	Reference	Reference
Q2	-0.033 (-0.189, 0.123)	-0.058 (-0.216, 0.100)	0.965 (0.703, 1.324)	0.821 (0.486, 1.387)
Q3	0.031 (-0.138, 0.199)	-0.021 (-0.180, 0.139)	1.095 (0.756, 1.586)	0.971 (0.566, 1.665)
Q4	-0.029 (-0.219, 0.160)	0.000 (-0.184, 0.184)	0.984 (0.699, 1.385)	1.088 (0.649, 1.824)
lnSe	-0.037 (-0.178, 0.104)	0.036 (-0.111, 0.183)	0.952 (0.730, 1.242)	1.170 (0.662, 2.066)

Note. Adjusted associations between health outcomes and potential risk factors, including age, gender, marriage, nationality, residence, education level, income, areas, smoking status, body mass index, TG, HDL-C, hypertension, diabetes and CKD. #: $P < 0.05$; *: $P < 0.001$. Abbreviations: HMMs: heavy metals and metalloids; OR: Odds ratios; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; Co: cobalt; Cr: chromium; Mn: manganese; Pb: lead; Sb: antimony; Se: selenium.

Supplementary Table S13. Age-stratified associations of urine HMMs with FIB-4 and hepatic fibrosis risk

Urine HMMs	FIB-4		Hepatic fibrosis risk	
	< 40years Group <i>β</i> (95%CI)	≥ 40years Group <i>β</i> (95%CI)	< 40years Group <i>OR</i> (95%CI)	≥ 40years Group <i>OR</i> (95%CI)
As				
Q1	Reference	Reference	Reference	Reference
Q2	0.016 (-0.070, 0.102)	0.007 (-0.156, 0.170)	1.170 (0.608, 2.249)	1.179 (0.891, 1.559)
Q3	0.037 (-0.073, 0.146)	0.038 (-0.124, 0.199)	1.588 (0.636, 3.966)	1.127 (0.849, 1.496)
Q4	0.031 (-0.091, 0.153)	-0.032 (-0.23, 0.165)	1.399 (0.608, 3.223)	0.915 (0.662, 1.265)
lnAs	0.011 (-0.022, 0.044)	-0.019 (-0.071, 0.033)	1.080 (0.868, 1.343)	0.929 (0.844, 1.021)
Cd				
Q1	Reference	Reference	Reference	Reference
Q2	-0.006 (-0.101, 0.089)	0.008 (-0.144, 0.161)	0.521 (0.274, 0.990)#	1.020 (0.747, 1.392)
Q3	0.083 (-0.022, 0.188)	-0.018 (-0.156, 0.120)	0.907 (0.503, 1.635)	0.881 (0.650, 1.193)
Q4	0.152 (0.018, 0.286)#	0.049 (-0.126, 0.223)	0.925 (0.453, 1.888)	1.124 (0.820, 1.540)
lnCd	0.072 (0.035, 0.109)*	0.027 (-0.032, 0.085)	1.174 (0.949, 1.452)	1.035 (0.932, 1.149)
Hg				
Q1	Reference	Reference	Reference	Reference
Q2	0.032 (-0.126, 0.190)	-0.016 (-0.19, 0.159)	1.111 (0.480, 2.572)	0.963 (0.707, 1.311)
Q3	0.045 (-0.079, 0.169)	-0.087 (-0.28, 0.105)	0.853 (0.403, 1.805)	0.893 (0.642, 1.243)
Q4	0.059 (-0.087, 0.206)	-0.051 (-0.277, 0.176)	0.979 (0.413, 2.320)	0.922 (0.650, 1.308)
lnHg	0.025 (-0.006, 0.057)	-0.015 (-0.075, 0.045)	1.035 (0.851, 1.258)	0.988 (0.895, 1.091)
Mo				
Q1	Reference	Reference	Reference	Reference
Q2	0.038 (-0.077, 0.153)	-0.019 (-0.159, 0.121)	0.912 (0.451, 1.845)	0.954 (0.724, 1.258)
Q3	0.084 (-0.060, 0.228)	-0.064 (-0.208, 0.080)	1.333 (0.678, 2.621)	0.942 (0.706, 1.257)
Q4	0.011 (-0.134, 0.156)	-0.067 (-0.247, 0.113)	0.779 (0.356, 1.705)	0.857 (0.605, 1.214)
lnMo	0.007 (-0.030, 0.044)	0.004 (-0.042, 0.049)	1.043 (0.877, 1.240)	0.968 (0.882, 1.062)
Ni				
Q1	Reference	Reference	Reference	Reference
Q2	0.007 (-0.129, 0.143)	0.093 (-0.051, 0.238)	1.010 (0.485, 2.102)	1.105 (0.848, 1.440)
Q3	0.030 (-0.083, 0.143)	0.166 (0.006, 0.325)#	0.832 (0.432, 1.602)	1.314 (1.005, 1.720)#
Q4	-0.013 (-0.134, 0.108)	0.037 (-0.097, 0.172)	0.655 (0.340, 1.263)	1.049 (0.828, 1.330)
lnNi	0.016 (-0.013, 0.046)	0.019 (-0.032, 0.069)	0.953 (0.774, 1.172)	1.004 (0.930, 1.084)
Sn				
Q1	Reference	Reference	Reference	Reference
Q2	0.141 (-0.003, 0.285)	0.017 (-0.153, 0.187)	2.474 (1.003, 6.106)#	0.901 (0.686, 1.185)
Q3	0.021 (-0.097, 0.140)	-0.181 (-0.347, -0.016)#	1.144 (0.484, 2.700)	0.620 (0.459, 0.838)#
Q4	0.023 (-0.073, 0.118)	-0.129 (-0.306, 0.048)	1.218 (0.565, 2.629)	0.672 (0.498, 0.907)#
lnSn	-0.008 (-0.038, 0.023)	-0.051 (-0.109, 0.008)	0.961 (0.812, 1.137)	0.871 (0.783, 0.969)#
Ti				
Q1	Reference	Reference	Reference	Reference
Q2	0.007 (-0.084, 0.098)	-0.113 (-0.296, 0.071)	1.600 (0.738, 3.470)	0.765 (0.547, 1.071)

Q3	0.007 (-0.108, 0.121)	-0.147 (-0.328, 0.034)	1.071 (0.587, 1.957)	0.823 (0.586, 1.156)
Q4	-0.084 (-0.204, 0.036)	-0.173 (-0.389, 0.043)	0.566 (0.251, 1.277)	0.748 (0.535, 1.047)
lnTl	-0.008 (-0.044, 0.029)	-0.052 (-0.127, 0.022)	0.901 (0.743, 1.093)	0.898 (0.802, 1.007)

Note. Adjusted associations between health outcomes and potential risk factors, including gender, marriage, nationality, residence, education level, income, areas, smoking status, alcohol consumption, body mass index, TG, HDL-C, hypertension, diabetes and CKD. #: $P < 0.05$; *: $P < 0.001$. Abbreviations: HMMs: heavy metals and metalloids; OR: Odds ratios; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; As: arsenic; Cd: cadmium; Hg: mercury; Mo: molybdenum; Ni: nickel; Sn: tin; Tl: thallium.

Supplementary Table S14. Sex-stratified associations of urine HMMs with FIB-4 and hepatic fibrosis risk

Urine HMMs	FIB-4		Hepatic fibrosis risk	
	Female β (95%CI)	Male β (95%CI)	Female OR(95%CI)	Male OR(95%CI)
As				
Q1	Reference	Reference	Reference	Reference
Q2	-0.002 (-0.140, 0.137)	0.042 (-0.088, 0.173)	1.004 (0.756, 1.335)	1.565 (1.035, 2.367)#
Q3	0.018 (-0.129, 0.165)	0.045 (-0.090, 0.181)	1.073 (0.806, 1.430)	1.311 (0.839, 2.049)
Q4	-0.048 (-0.239, 0.143)	-0.006 (-0.167, 0.156)	0.894 (0.620, 1.289)	1.071 (0.671, 1.710)
lnAs	-0.026 (-0.079, 0.028)	-0.001 (-0.042, 0.039)	0.950 (0.849, 1.062)	0.955 (0.846, 1.078)
Cd				
Q1	Reference	Reference	Reference	Reference
Q2	0.028 (-0.118, 0.173)	-0.039 (-0.138, 0.059)	0.988 (0.720, 1.355)	0.944 (0.588, 1.516)
Q3	-0.012 (-0.180, 0.156)	-0.046 (-0.163, 0.070)	0.858 (0.584, 1.261)	0.809 (0.509, 1.287)
Q4	0.004 (-0.185, 0.192)	0.061 (-0.104, 0.226)	1.057 (0.707, 1.580)	1.190 (0.747, 1.894)
lnCd	0.005 (-0.052, 0.063)	0.034 (-0.013, 0.080)	1.032 (0.917, 1.161)	1.077 (0.929, 1.250)
Hg				
Q1	Reference	Reference	Reference	Reference
Q2	-0.022 (-0.207, 0.164)	0.024 (-0.121, 0.169)	0.872 (0.618, 1.229)	1.091 (0.703, 1.692)
Q3	-0.062 (-0.230, 0.106)	-0.011 (-0.174, 0.152)	0.926 (0.652, 1.313)	0.929 (0.584, 1.477)
Q4	0.022 (-0.187, 0.232)	0.046 (-0.129, 0.222)	1.065 (0.748, 1.518)	1.088 (0.665, 1.780)
lnHg	0.002 (-0.043, 0.047)	0.019 (-0.032, 0.069)	1.016 (0.932, 1.109)	1.051 (0.904, 1.221)
Mo				
Q1	Reference	Reference	Reference	Reference
Q2	0.036 (-0.091, 0.162)	-0.009 (-0.125, 0.106)	1.025 (0.802, 1.310)	0.928 (0.603, 1.428)
Q3	-0.054 (-0.202, 0.095)	0.004 (-0.119, 0.127)	0.943 (0.710, 1.252)	0.946 (0.630, 1.421)
Q4	-0.098 (-0.258, 0.063)	-0.052 (-0.213, 0.109)	0.918 (0.686, 1.230)	0.679 (0.395, 1.167)
lnMo	-0.014 (-0.059, 0.030)	-0.004 (-0.043, 0.036)	1.012 (0.913, 1.121)	0.908 (0.813, 1.015)
Ni				
Q1	Reference	Reference	Reference	Reference
Q2	0.088 (-0.049, 0.226)	0.024 (-0.103, 0.151)	1.277 (0.934, 1.747)	0.912 (0.575, 1.447)
Q3	0.070 (-0.069, 0.210)	0.067 (-0.068, 0.212)	1.210 (0.889, 1.647)	1.075 (0.746, 1.549)
Q4	-0.064 (-0.192, 0.063)	0.011 (-0.119, 0.142)	1.001 (0.757, 1.324)	0.845 (0.565, 1.263)
lnNi	-0.007 (-0.051, 0.037)	0.012 (-0.034, 0.058)	1.004 (0.920, 1.096)	0.943 (0.842, 1.056)
Sn				
Q1	Reference	Reference	Reference	Reference
Q2	0.060 (-0.110, 0.231)	0.052 (-0.099, 0.203)	1.010 (0.756, 1.349)	1.024 (0.662, 1.583)
Q3	-0.125 (-0.301, 0.050)	-0.074 (-0.216, 0.068)	0.680 (0.494, 0.935)#	0.622 (0.397, 0.974)#
Q4	-0.102 (-0.278, 0.073)	-0.004 (-0.149, 0.142)	0.718 (0.533, 0.968)#	0.745 (0.461, 1.206)
lnSn	-0.051 (-0.103, 0.000)	-0.008 (-0.060, 0.045)	0.879 (0.799, 0.966)#	0.895 (0.763, 1.051)
Tl				
Q1	Reference	Reference	Reference	Reference
Q2	-0.062 (-0.255, 0.131)	-0.074 (-0.207, 0.059)	0.935 (0.685, 1.275)	0.803 (0.467, 1.382)

Q3	-0.122 (-0.326, 0.082)	-0.040 (-0.177, 0.097)	0.824 (0.597, 1.138)	1.008 (0.624, 1.628)
Q4	-0.177 (-0.387, 0.033)	-0.071 (-0.251, 0.108)	0.832 (0.604, 1.147)	0.823 (0.511, 1.324)
lnTl	-0.049 (-0.118, 0.020)	-0.013 (-0.068, 0.042)	0.956 (0.851, 1.074)	0.932 (0.808, 1.076)

Note. Adjusted associations between health outcomes and potential risk factors, including age, marriage, nationality, residence, education level, income, areas, smoking status, alcohol consumption, body mass index, TG, HDL-C, hypertension, diabetes and CKD. #: $P < 0.05$. Abbreviations: HMMs: heavy metals and metalloids; OR: Odds ratios; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; As: arsenic; Cd: cadmium; Hg: mercury; Mo: molybdenum; Ni: nickel; Sn: tin; Tl: thallium.

Supplementary Table S15. Alcohol consumption-stratified associations of urine HMMs with FIB-4 and hepatic fibrosis risk

Urine HMMs	FIB-4		Hepatic fibrosis risk	
	Non-drinking β (95%CI)	Drinking β (95%CI)	Non-drinking OR(95%CI)	Drinking OR(95%CI)
As				
Q1	Reference	Reference	Reference	Reference
Q2	-0.025 (-0.146, 0.096)	0.096 (-0.078, 0.271)	1.132 (0.860, 1.490)	1.598 (0.914, 2.795)
Q3	0.020 (-0.106, 0.146)	0.045 (-0.111, 0.201)	1.154 (0.827, 1.610)	1.209 (0.753, 1.943)
Q4	-0.068 (-0.233, 0.096)	0.038 (-0.137, 0.214)	0.876 (0.595, 1.291)	1.234 (0.742, 2.052)
lnAs	-0.028 (-0.072, 0.016)	0.006 (-0.039, 0.050)	0.914 (0.815, 1.025)	1.004 (0.873, 1.154)
Cd				
Q1	Reference	Reference	Reference	Reference
Q2	0.032 (-0.073, 0.138)	-0.075 (-0.194, 0.044)	0.973 (0.708, 1.338)	0.943 (0.564, 1.577)
Q3	-0.033 (-0.147, 0.080)	-0.048 (-0.172, 0.075)	0.780 (0.570, 1.067)	0.853 (0.501, 1.453)
Q4	0.011 (-0.147, 0.169)	0.051 (-0.119, 0.221)	0.922 (0.658, 1.292)	1.517 (0.967, 2.378)
lnCd	0.009 (-0.042, 0.060)	0.030 (-0.018, 0.079)	0.970 (0.873, 1.077)	1.217 (1.047, 1.415)#
Hg				
Q1	Reference	Reference	Reference	Reference
Q2	-0.048 (-0.192, 0.096)	0.063 (-0.094, 0.219)	0.777 (0.572, 1.057)	1.486 (0.869, 2.541)
Q3	-0.071 (-0.221, 0.079)	-0.009 (-0.166, 0.148)	0.828 (0.594, 1.153)	1.074 (0.651, 1.774)
Q4	-0.031 (-0.236, 0.174)	0.104 (-0.067, 0.276)	0.938 (0.632, 1.393)	1.366 (0.839, 2.225)
lnHg	-0.003 (-0.050, 0.044)	0.022 (-0.025, 0.070)	1.003 (0.902, 1.117)	1.067 (0.930, 1.224)
Mo				
Q1	Reference	Reference	Reference	Reference
Q2	-0.079 (-0.235, 0.078)	0.076 (-0.037, 0.188)	0.719 (0.524, 0.988)#	1.420 (0.834, 2.419)
Q3	-0.093 (-0.234, 0.047)	0.065 (-0.069, 0.199)	0.755 (0.571, 0.999)#	1.274 (0.695, 2.338)
Q4	-0.125 (-0.305, 0.055)	-0.006 (-0.162, 0.149)	0.702 (0.496, 0.993)#	0.935 (0.519, 1.684)
lnMo	-0.028 (-0.073, 0.017)	0.017 (-0.021, 0.055)	0.909 (0.818, 1.010)	1.051 (0.915, 1.206)
Ni				
Q1	Reference	Reference	Reference	Reference
Q2	0.033 (-0.110, 0.175)	0.024 (-0.103, 0.151)	1.004 (0.714, 1.413)	1.051 (0.670, 1.646)
Q3	0.054 (-0.074, 0.183)	0.073 (-0.066, 0.212)	1.021 (0.774, 1.346)	1.242 (0.808, 1.908)
Q4	-0.050 (-0.181, 0.082)	-0.002 (-0.129, 0.125)	0.845 (0.634, 1.126)	0.992 (0.644, 1.529)
lnNi	-0.005 (-0.046, 0.037)	0.011 (-0.037, 0.059)	0.952 (0.871, 1.041)	0.982 (0.859, 1.123)
Sn				
Q1	Reference	Reference	Reference	Reference
Q2	0.120 (-0.044, 0.283)	-0.032 (-0.184, 0.120)	1.198 (0.832, 1.727)	0.697 (0.434, 1.120)
Q3	-0.133 (-0.279, 0.014)	-0.055 (-0.201, 0.091)	0.728 (0.517, 1.026)	0.509 (0.300, 0.864)#
Q4	-0.086 (-0.237, 0.065)	0.002 (-0.141, 0.145)	0.705 (0.505, 0.985)#	0.771 (0.466, 1.276)
lnSn	-0.051 (-0.100, -0.002)#	0.005 (-0.043, 0.054)	0.858 (0.763, 0.965)#	0.940 (0.779, 1.135)
Tl				
Q1	Reference	Reference	Reference	Reference
Q2	-0.138 (-0.304, 0.028)	-0.004 (-0.130, 0.121)	0.821 (0.595, 1.133)	0.879 (0.478, 1.616)

Q3	-0.157 (-0.340, 0.026)	-0.005 (-0.122, 0.112)	0.708 (0.495, 1.013)	1.310 (0.748, 2.293)
Q4	-0.253 (-0.459, -0.047)#	0.039 (-0.136, 0.215)	0.641 (0.458, 0.898)#	1.222 (0.700, 2.135)
lnTl	-0.067 (-0.133, -0.001)#	0.011 (-0.043, 0.065)	0.843 (0.748, 0.951)#	1.089 (0.938, 1.264)

Note. Adjusted associations between health outcomes and potential risk factors, including age, gender, marriage, nationality, residence, education level, income, areas, smoking status, body mass index, TG, HDL-C, hypertension, diabetes and CKD. #: $P < 0.05$. Abbreviations: HMMs: heavy metals and metalloids; OR: Odds ratios; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; As: arsenic; Cd: cadmium; Hg: mercury; Mo: molybdenum; Ni: nickel; Sn: tin; Tl: thallium.

Supplementary Table S16. Associations between blood HMMs and FIB-4 and hepatic fibrosis risk with excluding participants with alcohol consumption

Blood HMMs	FIB-4		Hepatic fibrosis risk	
	β (95%CI)	P	OR(95%CI)	P
Co				
Q1	Reference		Reference	
Q2	0.166 (0.012, 0.320)#	0.035	1.374 (0.994, 1.899)	0.055
Q3	0.167 (0.024, 0.309)#	0.022	1.446 (1.086, 1.925)#	0.012
Q4	0.228 (0.062, 0.394)#	0.008	1.763 (1.222, 2.545)#	0.003
lnCo	0.038 (-0.007, 0.082)	0.097	1.127 (1.011, 1.256)#	0.031
Cr				
Q1	Reference		Reference	
Q2	-0.114 (-0.309, 0.082)	0.251	0.704 (0.468, 1.058)	0.090
Q3	0.050 (-0.145, 0.245)	0.610	0.843 (0.564, 1.259)	0.400
Q4	-0.047 (-0.277, 0.183)	0.686	0.767 (0.495, 1.187)	0.231
lnCr	-0.014 (-0.075, 0.048)	0.660	0.926 (0.814, 1.054)	0.240
Mn				
Q1	Reference		Reference	
Q2	0.138 (0.007, 0.269)#	0.040	1.183 (0.908, 1.541)	0.210
Q3	0.012 (-0.113, 0.136)	0.855	1.032 (0.771, 1.380)	0.833
Q4	0.198 (0.017, 0.378)#	0.032	1.412 (1.000, 1.992)	0.050
lnMn	0.116 (-0.003, 0.235)	0.056	1.219 (0.912, 1.630)	0.179
Pb				
Q1	Reference		Reference	
Q2	-0.026 (-0.117, 0.066)	0.577	0.774 (0.557, 1.078)	0.128
Q3	-0.043 (-0.160, 0.074)	0.467	0.881 (0.619, 1.253)	0.477
Q4	-0.037 (-0.182, 0.108)	0.617	0.693 (0.497, 0.966)#	0.031
lnPb	-0.023 (-0.096, 0.050)	0.530	0.858 (0.735, 1.002)	0.053
Sb				
Q1	Reference		Reference	
Q2	0.033 (-0.156, 0.223)	0.728	0.982 (0.724, 1.331)	0.906
Q3	-0.045 (-0.262, 0.172)	0.682	0.948 (0.635, 1.416)	0.794
Q4	-0.006 (-0.244, 0.232)	0.958	0.994 (0.645, 1.532)	0.977
lnSb	-0.057 (-0.306, 0.193)	0.652	0.917 (0.666, 1.264)	0.594
Se				
Q1	Reference		Reference	
Q2	-0.033 (-0.189, 0.123)	0.678	0.965 (0.703, 1.324)	0.823
Q3	0.031 (-0.138, 0.199)	0.720	1.095 (0.756, 1.586)	0.628
Q4	-0.029 (-0.219, 0.160)	0.759	0.984 (0.699, 1.385)	0.924
lnSe	-0.037 (-0.178, 0.104)	0.605	0.952 (0.730, 1.242)	0.716

Note. Adjusted associations between health outcomes and potential risk factors, including age, gender, marriage, nationality, residence, education level, income, areas, smoking status, body mass index, TG, HDL-C, hypertension, diabetes and CKD. #: $P < 0.05$. Abbreviations: HMMs: heavy metals and metalloids; OR: Odds ratios; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; Co: cobalt; Cr: chromium; Mn: manganese; Pb: lead; Sb: antimony; Se: selenium.

Supplementary Table S17. Associations between urine HMMs and FIB-4 and hepatic fibrosis risk with excluding participants with alcohol consumption

Urine HMMs	FIB-4		Hepatic fibrosis risk	
	β (95%CI)	P	OR(95%CI)	P
As				
Q1	Reference		Reference	
Q2	-0.025 (-0.146, 0.096)	0.678	1.132 (0.860, 1.490)	0.860
Q3	0.020 (-0.106, 0.146)	0.755	1.154 (0.827, 1.610)	0.827
Q4	-0.068 (-0.233, 0.096)	0.410	0.876 (0.595, 1.291)	0.595
lnAs	-0.028 (-0.072, 0.016)	0.210	0.914 (0.815, 1.025)	0.815
Cd				
Q1	Reference		Reference	
Q2	0.032 (-0.073, 0.138)	0.546	0.973 (0.708, 1.338)	0.708
Q3	-0.033 (-0.147, 0.080)	0.561	0.780 (0.570, 1.067)	0.570
Q4	0.011 (-0.147, 0.169)	0.894	0.922 (0.658, 1.292)	0.658
lnCd	0.009 (-0.042, 0.060)	0.729	0.970 (0.873, 1.077)	0.873
Hg				
Q1	Reference		Reference	
Q2	-0.048 (-0.192, 0.096)	0.512	0.777 (0.572, 1.057)	0.107
Q3	-0.071 (-0.221, 0.079)	0.350	0.828 (0.594, 1.153)	0.260
Q4	-0.031 (-0.236, 0.174)	0.762	0.938 (0.632, 1.393)	0.749
lnHg	-0.003 (-0.050, 0.044)	0.895	1.003 (0.902, 1.117)	0.948
Mo				
Q1	Reference		Reference	
Q2	-0.079 (-0.235, 0.078)	0.321	0.719 (0.524, 0.988)#	0.042
Q3	-0.093 (-0.234, 0.047)	0.189	0.755 (0.571, 0.999)#	0.049
Q4	-0.125 (-0.305, 0.055)	0.171	0.702 (0.496, 0.993)#	0.046
lnMo	-0.028 (-0.073, 0.017)	0.219	0.909 (0.818, 1.010)	0.075
Ni				
Q1	Reference		Reference	
Q2	0.033 (-0.110, 0.175)	0.650	1.004 (0.714, 1.413)	0.980
Q3	0.054 (-0.074, 0.183)	0.402	1.021 (0.774, 1.346)	0.882
Q4	-0.050 (-0.181, 0.082)	0.456	0.845 (0.634, 1.126)	0.247
lnNi	-0.005 (-0.046, 0.037)	0.814	0.952 (0.871, 1.041)	0.280
Sn				
Q1	Reference		Reference	
Q2	0.120 (-0.044, 0.283)	0.150	1.198 (0.832, 1.727)	0.328
Q3	-0.133 (-0.279, 0.014)	0.076	0.728 (0.517, 1.026)	0.069
Q4	-0.086 (-0.237, 0.065)	0.259	0.705 (0.505, 0.985)#	0.041
lnSn	-0.051 (-0.100, -0.002)#	0.040	0.858 (0.763, 0.965)#	0.011
Tl				
Q1	Reference		Reference	
Q2	-0.138 (-0.304, 0.028)	0.102	0.821 (0.595, 1.133)	0.226
Q3	-0.157 (-0.340, 0.026)	0.091	0.708 (0.495, 1.013)	0.059

Q4	-0.253 (-0.459, -0.047)#	0.017	0.641 (0.458, 0.898)#	0.010
lnTl	-0.067 (-0.133, -0.001)#	0.047	0.843 (0.748, 0.951)#	0.006

Note. Adjusted associations between health outcomes and potential risk factors, including age, gender, marriage, nationality, residence, education level, income, areas, smoking status, body mass index, TG, HDL-C, hypertension, diabetes and CKD. #: $P < 0.05$. Abbreviations: HMMs: heavy metals and metalloids; OR: Odds ratios; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; As: arsenic; Cd: cadmium; Hg: mercury; Mo: molybdenum; Ni: nickel; Sn: tin; Tl: thallium.

Supplementary Table S18. Associations between blood HMMs and FIB-4 and hepatic fibrosis risk with excluding participants with diabetes or CKD

Blood HMMs	FIB-4		Hepatic fibrosis risk	
	β (95%CI)	P	OR(95%CI)	P
Co				
Q1	Reference		Reference	
Q2	0.070 (-0.027, 0.166)	0.154	1.400 (1.028, 1.906)#	0.033
Q3	0.163 (0.041, 0.285)#	0.009	1.572 (1.107, 2.233)#	0.012
Q4	0.170 (0.022, 0.318)#	0.025	1.687 (1.146, 2.482)#	0.009
lnCo	0.030 (-0.004, 0.064)	0.082	1.121 (1.018, 1.235)#	0.021
Cr				
Q1	Reference		Reference	
Q2	-0.065 (-0.201, 0.071)	0.347	0.809 (0.554, 1.181)	0.269
Q3	0.048 (-0.102, 0.198)	0.525	1.039 (0.711, 1.517)	0.843
Q4	0.014 (-0.160, 0.188)	0.871	1.086 (0.715, 1.650)	0.696
lnCr	-0.000 (-0.046, 0.045)	0.983	1.007 (0.889, 1.140)	0.911
Mn				
Q1	Reference		Reference	
Q2	0.093 (0.009, 0.177)#	0.031	1.162 (0.913, 1.480)	0.220
Q3	0.044 (-0.049, 0.137)	0.353	1.207 (0.895, 1.626)	0.214
Q4	0.235 (0.081, 0.389)#	0.003	1.818 (1.278, 2.587)#	0.001
lnMn	0.131 (0.036, 0.227)#	0.007	1.468 (1.098, 1.961)#	0.010
Pb				
Q1	Reference		Reference	
Q2	-0.048 (-0.144, 0.048)	0.326	0.803 (0.572, 1.127)	0.201
Q3	-0.108 (-0.218, 0.003)	0.056	0.713 (0.476, 1.068)	0.100
Q4	-0.060 (-0.184, 0.064)	0.337	0.711 (0.478, 1.058)	0.092
lnPb	-0.017 (-0.083, 0.049)	0.608	0.855 (0.732, 1.000)#	0.050
Sb				
Q1	Reference		Reference	
Q2	-0.009 (-0.144, 0.126)	0.896	1.007 (0.724, 1.400)	0.969
Q3	-0.030 (-0.186, 0.126)	0.704	1.024 (0.686, 1.528)	0.906
Q4	-0.005 (-0.200, 0.190)	0.958	0.962 (0.609, 1.520)	0.866
lnSb	-0.026 (-0.183, 0.132)	0.748	0.905 (0.666, 1.229)	0.519
Se				
Q1	Reference		Reference	
Q2	-0.044 (-0.173, 0.086)	0.506	0.929 (0.661, 1.306)	0.669
Q3	0.010 (-0.129, 0.148)	0.890	0.948 (0.637, 1.411)	0.789
Q4	0.004 (-0.151, 0.159)	0.959	1.102 (0.760, 1.596)	0.606
lnSe	-0.005 (-0.118, 0.108)	0.927	0.999 (0.728, 1.371)	0.997

Note. Adjusted associations between health outcomes and potential risk factors, including age, gender, marriage, nationality, residence, education level, income, areas, smoking status, alcohol consumption, body mass index, TG, HDL-C, and hypertension. #: $P < 0.05$. Abbreviations: HMMs: heavy metals and metalloids; OR: Odds ratios; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; Co: cobalt; Cr: chromium; Mn: manganese; Pb: lead; Sb: antimony; Se: selenium.

Supplementary Table S19. Associations between urine HMMs and FIB-4 and hepatic fibrosis risk with excluding participants with diabetes or CKD

Urine HMMs	FIB-4		Hepatic fibrosis risk	
	β (95%CI)	P	OR(95%CI)	P
As				
Q1	Reference		Reference	
Q2	0.001 (-0.113, 0.115)	0.990	1.193 (0.859, 1.657)	0.289
Q3	0.003 (-0.116, 0.123)	0.958	1.211 (0.877, 1.673)	0.242
Q4	-0.035 (-0.183, 0.113)	0.636	1.012 (0.715, 1.433)	0.944
lnAs	-0.013 (-0.052, 0.027)	0.534	0.967 (0.876, 1.068)	0.506
Cd				
Q1	Reference		Reference	
Q2	-0.029 (-0.116, 0.059)	0.518	0.912 (0.634, 1.312)	0.616
Q3	-0.043 (-0.135, 0.049)	0.361	0.772 (0.542, 1.099)	0.150
Q4	0.037 (-0.091, 0.164)	0.567	1.095 (0.779, 1.541)	0.597
lnCd	0.026 (-0.012, 0.063)	0.180	1.060 (0.957, 1.176)	0.261
Hg				
Q1	Reference		Reference	
Q2	-0.005 (-0.123, 0.113)	0.932	0.938 (0.677, 1.300)	0.697
Q3	-0.044 (-0.174, 0.086)	0.502	0.883 (0.619, 1.260)	0.489
Q4	0.051 (-0.112, 0.215)	0.534	1.081 (0.752, 1.553)	0.672
lnHg	0.017 (-0.024, 0.058)	0.408	1.042 (0.942, 1.152)	0.421
Mo				
Q1	Reference		Reference	
Q2	0.021 (-0.073, 0.115)	0.660	0.929 (0.668, 1.292)	0.658
Q3	0.001 (-0.102, 0.103)	0.990	0.922 (0.675, 1.258)	0.605
Q4	-0.022 (-0.150, 0.106)	0.733	0.805 (0.559, 1.158)	0.239
lnMo	-0.000 (-0.033, 0.033)	0.997	0.956 (0.869, 1.052)	0.352
Ni				
Q1	Reference		Reference	
Q2	0.028 (-0.086, 0.142)	0.625	1.136 (0.794, 1.628)	0.481
Q3	0.092 (-0.028, 0.212)	0.130	1.263 (0.932, 1.712)	0.130
Q4	-0.014 (-0.122, 0.093)	0.792	0.948 (0.693, 1.296)	0.735
lnNi	0.011 (-0.027, 0.049)	0.564	0.988 (0.904, 1.079)	0.781
Sn				
Q1	Reference		Reference	
Q2	0.050 (-0.091, 0.190)	0.485	1.018 (0.727, 1.425)	0.918
Q3	-0.056 (-0.182, 0.071)	0.384	0.650 (0.453, 0.931)#	0.019
Q4	-0.032 (-0.173, 0.109)	0.653	0.745 (0.503, 1.104)	0.141
lnSn	-0.016 (-0.061, 0.029)	0.483	0.905 (0.801, 1.022)	0.107
Tl				
Q1	Reference		Reference	
Q2	-0.061 (-0.203, 0.080)	0.392	0.820 (0.548, 1.227)	0.330
Q3	-0.070 (-0.198, 0.058)	0.281	0.897 (0.612, 1.315)	0.574

Q4	-0.084 (-0.245, 0.076)	0.299	0.786 (0.542, 1.140)	0.201
lnTl	-0.015 (-0.066, 0.036)	0.557	0.934 (0.827, 1.056)	0.272

Note. Adjusted associations between health outcomes and potential risk factors, including age, gender, marriage, nationality, residence, education level, income, areas, smoking status, alcohol consumption, body mass index, TG, HDL-C, and hypertension. #: $P < 0.05$. Abbreviations: HMMs: heavy metals and metalloids; OR: Odds ratios; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; As: arsenic; Cd: cadmium; Hg: mercury; Mo: molybdenum; Ni: nickel; Sn: tin; Tl: thallium.

Supplementary Table S20. Associations between blood HMMs and FIB-4 and hepatic fibrosis risk with adjusting for waist circumference

Blood HMMs	FIB-4		Hepatic fibrosis risk	
	β (95%CI)	P	OR(95%CI)	P
Co				
Q1	Reference		Reference	
Q2	0.088 (-0.012, 0.189)	0.085	1.296 (0.961, 1.747)	0.088
Q3	0.150 (0.023, 0.278)#	0.022	1.485 (1.056, 2.088)#	0.024
Q4	0.178 (0.019, 0.336)#	0.029	1.670 (1.153, 2.419)#	0.007
lnCo	0.025 (-0.016, 0.067)	0.230	1.097 (0.987, 1.219)	0.085
Cr				
Q1	Reference		Reference	
Q2	-0.048(-0.192, 0.097)	0.515	0.826 (0.582, 1.171)	0.279
Q3	0.069(-0.090, 0.227)	0.393	1.074 (0.751, 1.538)	0.692
Q4	-0.003(-0.186, 0.181)	0.975	1.035 (0.688, 1.556)	0.867
lnCr	0.001(-0.048, 0.051)	0.956	1.010 (0.898, 1.137)	0.863
Mn				
Q1	Reference		Reference	
Q2	0.096 (0.007, 0.185)#	0.036	1.160 (0.915, 1.471)	0.217
Q3	0.048 (-0.049, 0.146)	0.329	1.187 (0.903, 1.559)	0.216
Q4	0.228 (0.060, 0.396)#	0.008	1.717 (1.234, 2.388)#	0.002
lnMn	0.130 (0.029, 0.231)#	0.012	1.393 (1.064, 1.822)#	0.016
Pb				
Q1	Reference		Reference	
Q2	-0.067 (-0.157, 0.022)	0.139	0.782 (0.585, 1.045)	0.095
Q3	-0.109 (-0.206, -0.012)#	0.029	0.716 (0.520, 0.986)#	0.041
Q4	-0.064 (-0.189, 0.061)	0.309	0.700 (0.494, 0.991)#	0.045
lnPb	-0.007 (-0.074, 0.060)	0.829	0.882 (0.757, 1.027)	0.105
Sb				
Q1	Reference		Reference	
Q2	0.005 (-0.133, 0.142)	0.948	0.996 (0.744, 1.333)	0.979
Q3	0.001 (-0.158, 0.160)	0.988	1.048 (0.736, 1.491)	0.794
Q4	0.010 (-0.187, 0.207)	0.922	0.946 (0.619, 1.446)	0.795
lnSb	-0.025 (-0.187, 0.136)	0.757	0.930 (0.707, 1.224)	0.601
Se				
Q1	Reference		Reference	
Q2	-0.033 (-0.167, 0.102)	0.633	0.914 (0.655, 1.276)	0.594
Q3	0.013 (-0.127, 0.152)	0.858	1.044 (0.736, 1.481)	0.809
Q4	0.004 (-0.157, 0.165)	0.965	1.045 (0.733, 1.490)	0.807
lnSe	-0.000 (-0.119, 0.118)	0.995	1.039 (0.771, 1.402)	0.799

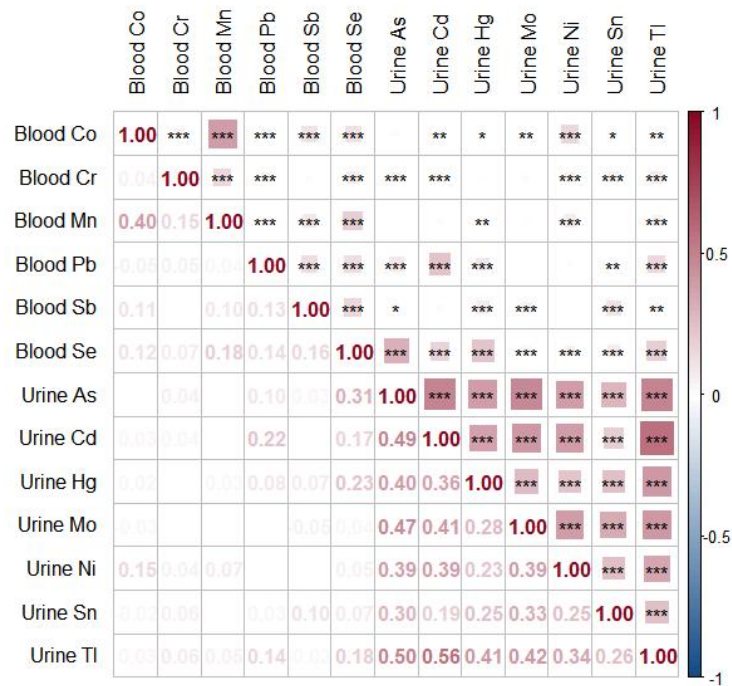
Note. Adjusted associations between health outcomes and potential risk factors, including age, gender, marriage, nationality, residence, education level, income, areas, smoking status, alcohol consumption, body mass index, TG, HDL-C, hypertension, diabetes, CKD and waist circumference. #: $P < 0.05$. Abbreviations: HMMs: heavy metals and metalloids; OR: Odds ratios; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; Co: cobalt; Cr: chromium; Mn: manganese; Pb: lead; Sb: antimony; Se: selenium.

Supplementary Table S21. Associations between urine HMMs and FIB-4 and hepatic fibrosis risk with adjusting for waist circumference

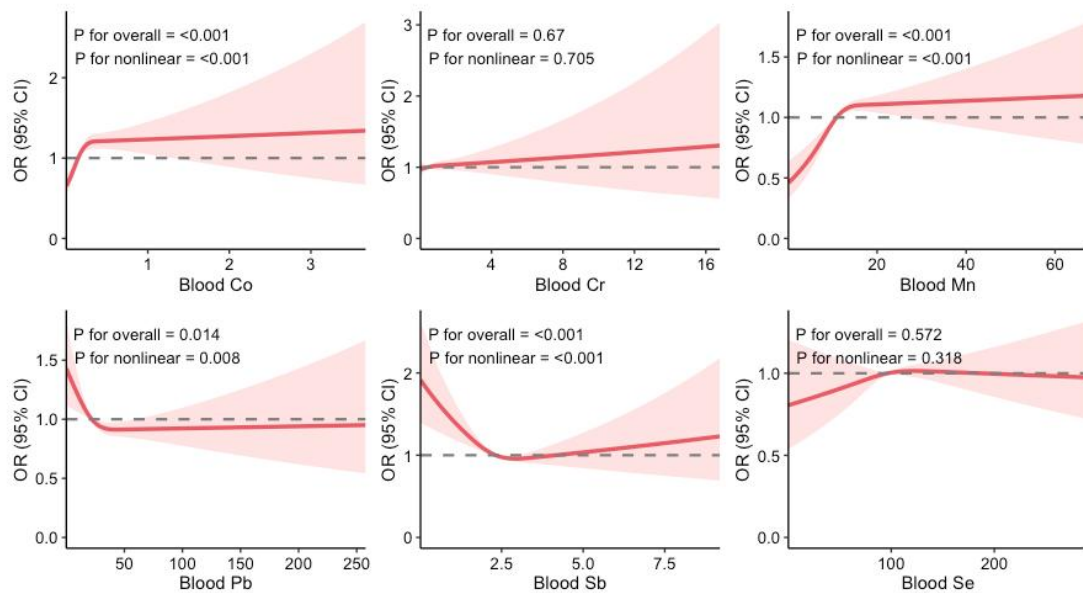
Urine HMMs		FIB-4		Hepatic fibrosis risk	
		β (95%CI)	P	OR(95%CI)	P
As					
	Q1	Reference		Reference	
	Q2	0.018 (-0.090, 0.127)	0.736	1.257 (0.946, 1.669)	0.113
	Q3	0.046 (-0.072, 0.165)	0.439	1.206 (0.890, 1.634)	0.223
	Q4	-0.040 (-0.191, 0.112)	0.605	0.946 (0.677, 1.323)	0.744
	lnAs	-0.016 (-0.058, 0.025)	0.438	0.939 (0.850, 1.036)	0.207
Cd					
	Q1	Reference		Reference	
	Q2	-0.013 (-0.093, 0.066)	0.739	0.987 (0.728, 1.339)	0.932
	Q3	-0.039 (-0.136, 0.059)	0.433	0.830 (0.601, 1.146)	0.254
	Q4	0.002 (-0.142, 0.146)	0.983	1.087 (0.777, 1.521)	0.622
	lnCd	0.013 (-0.031, 0.057)	0.556	1.041 (0.936, 1.157)	0.457
Hg					
	Q1	Reference		Reference	
	Q2	0.017 (-0.112, 0.146)	0.796	0.974 (0.714, 1.327)	0.864
	Q3	-0.030 (-0.170, 0.111)	0.676	0.913 (0.649, 1.284)	0.596
	Q4	0.032 (-0.144, 0.209)	0.716	1.051 (0.728, 1.517)	0.787
	lnHg	0.009 (-0.019, 0.037)	0.696	1.029 (0.928, 1.141)	0.587
Mo					
	Q1	Reference		Reference	
	Q2	-0.006 (-0.102, 0.090)	0.906	0.925 (0.693, 1.233)	0.590
	Q3	-0.024 (-0.128, 0.080)	0.649	0.918 (0.688, 1.225)	0.557
	Q4	-0.089 (-0.228, 0.050)	0.205	0.762 (0.532, 1.091)	0.136
	lnMo	-0.014 (-0.056, 0.027)	0.495	0.947 (0.848, 1.058)	0.331
Ni					
	Q1	Reference		Reference	
	Q2	0.029 (-0.076, 0.135)	0.580	1.042 (0.754, 1.441)	0.800
	Q3	0.049 (-0.064, 0.161)	0.393	1.085 (0.830, 1.420)	0.546
	Q4	-0.037 (-0.144, 0.070)	0.492	0.901 (0.692, 1.172)	0.432
	lnNi	-0.002 (-0.040, 0.036)	0.921	0.965 (0.888, 1.049)	0.396
Sn					
	Q1	Reference		Reference	
	Q2	0.054 (-0.076, 0.184)	0.413	1.016 (0.745, 1.386)	0.917
	Q3	-0.100 (-0.224, 0.024)	0.112	0.642 (0.465, 0.886)#	0.008
	Q4	-0.049 (-0.182, 0.084)	0.466	0.735 (0.523, 1.033)	0.075
	lnSn	-0.025 (-0.069, 0.018)	0.247	0.891 (0.796, 0.996)#	0.043
Tl					
	Q1	Reference		Reference	
	Q2	-0.084 (-0.221, 0.053)	0.226	0.831 (0.579, 1.192)	0.311
	Q3	-0.100 (-0.231, 0.030)	0.131	0.857 (0.605, 1.215)	0.383

Q4	-0.135 (-0.305, 0.035)	0.118	0.781 (0.547, 1.114)	0.170
lnTl	-0.038 (-0.096, 0.020)	0.193	0.918 (0.812, 1.037)	0.166

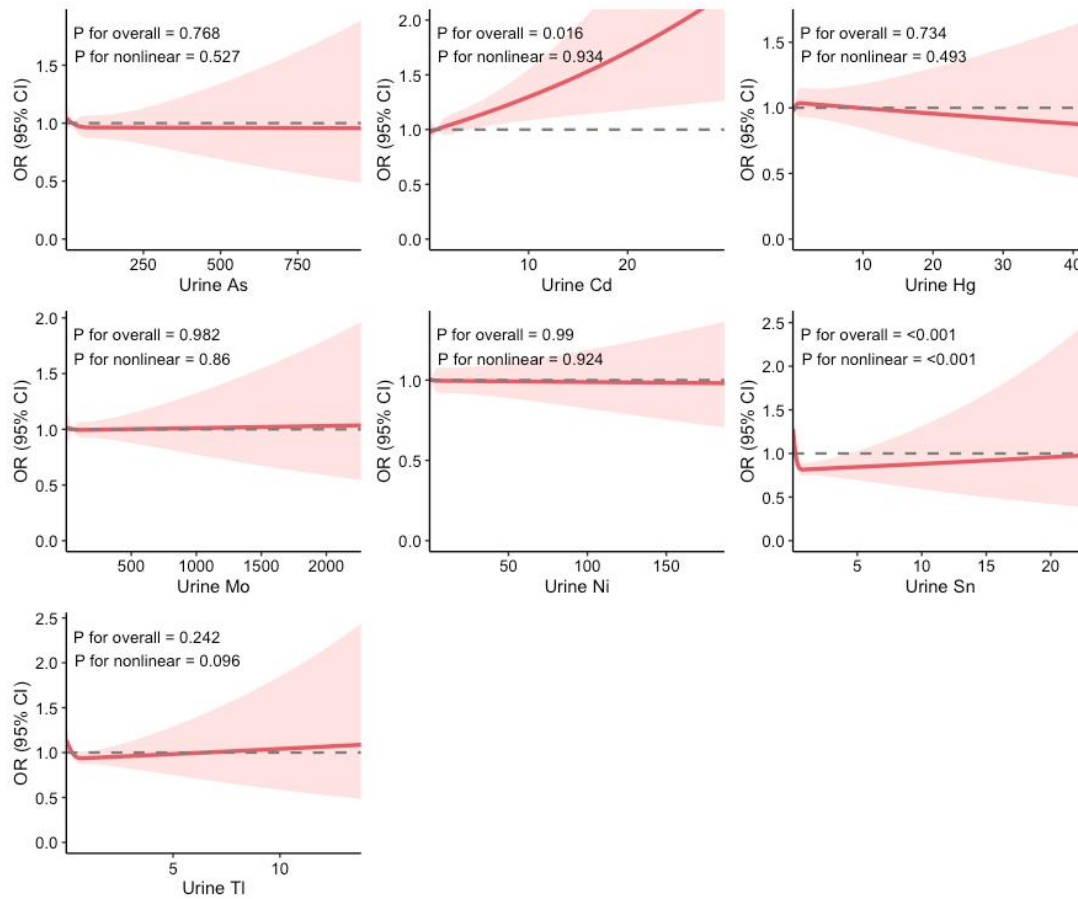
Note. Adjusted associations between health outcomes and potential risk factors, including age, gender, marriage, nationality, residence, education level, income, areas, smoking status, alcohol consumption, body mass index, TG, HDL-C, hypertension, diabetes, CKD and waist circumference. #: $P < 0.05$. Abbreviations: HMMs: heavy metals and metalloids; OR: Odds ratios; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; As: arsenic; Cd: cadmium; Hg: mercury; Mo: molybdenum; Ni: nickel; Sn: tin; Tl: thallium.



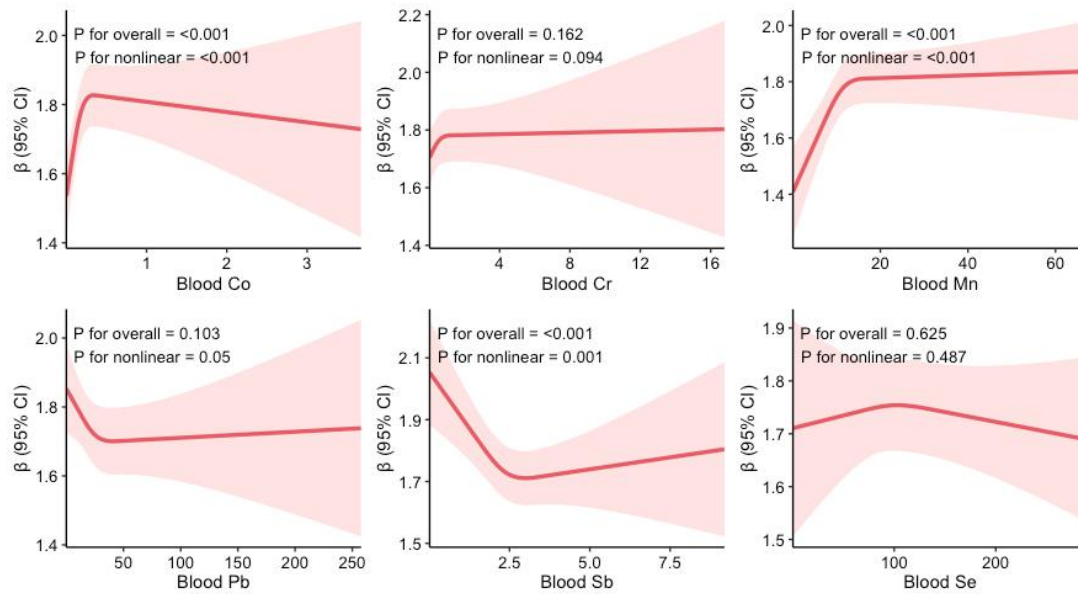
Supplementary Figure S1. Correlation matrix of blood and urine HMMs.



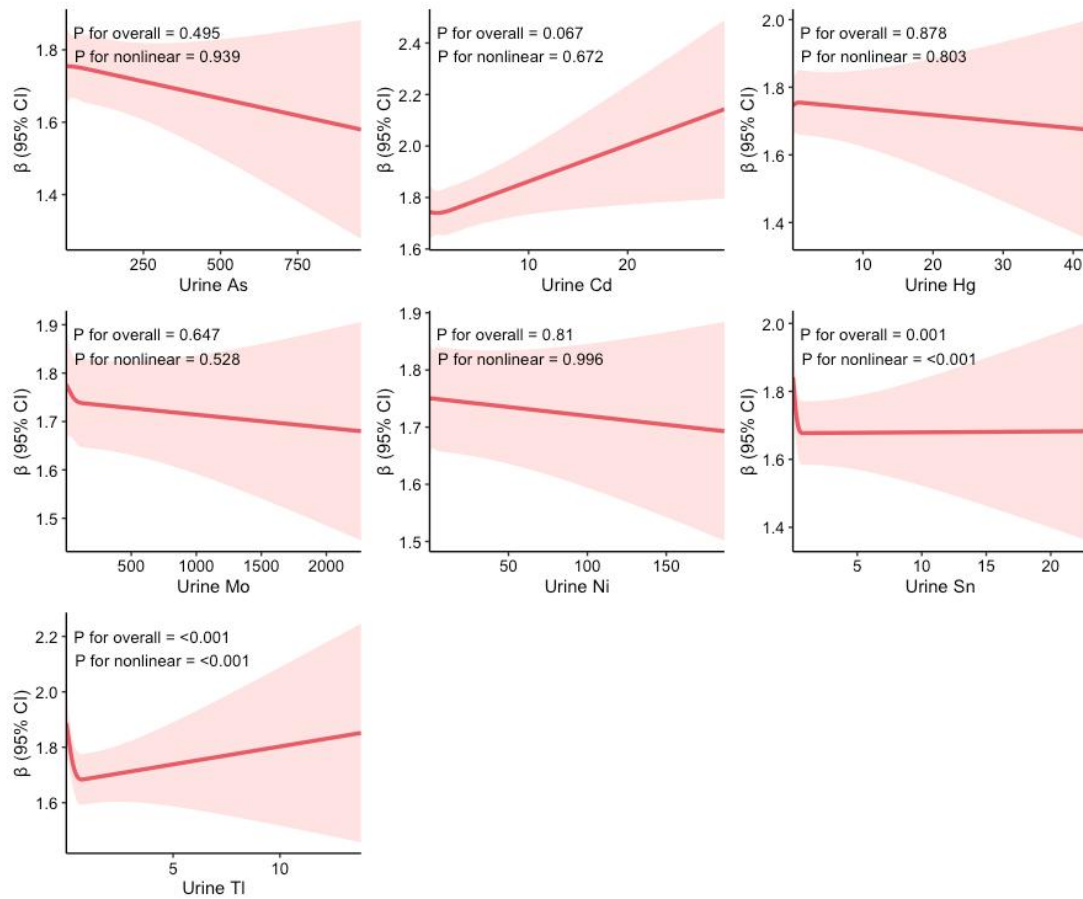
Supplementary Figure S2. Dose-response relationship between levels of blood HMMs and hepatic fibrosis risk evaluated using restricted cubic spline analysis. Adjusted associations between health outcomes and potential risk factors, including age, gender, marriage, nationality, residence, education level, income, areas, smoking status, alcohol consumption, body mass index, TG, HDL-C, hypertension, diabetes and CKD. Abbreviations: HMMs: heavy metals and metalloids; OR: Odds ratios; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; Co: cobalt; Cr: chromium; Mn: manganese; Pb: lead; Sb: antimony; Se: selenium.



Supplementary Figure S3. Dose-response relationship between levels of urine HMMs and hepatic fibrosis risk evaluated using restricted cubic spline analysis. Adjusted associations between health outcomes and potential risk factors, including age, gender, marriage, nationality, residence, education level, income, areas, smoking status, alcohol consumption, body mass index, TG, HDL-C, hypertension, diabetes and CKD. Abbreviations: HMMs: heavy metals and metalloids; OR: Odds ratios; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; As: arsenic; Cd: cadmium; Hg: mercury; Mo: molybdenum; Ni: nickel; Sn: tin; Tl: thallium.



Supplementary Figure S4. Dose-response relationship between levels of blood HMMs and FIB-4 evaluated using restricted cubic spline analysis. Adjusted associations between health outcomes and potential risk factors, including age, gender, marriage, nationality, residence, education level, income, areas, smoking status, alcohol consumption, body mass index, TG, HDL-C, hypertension, diabetes and CKD. Abbreviations: HMMs: heavy metals and metalloids; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; Co: cobalt; Cr: chromium; Mn: manganese; Pb: lead; Sb: antimony; Se: selenium.



Supplementary Figure S5. Dose-response relationship between levels of urine HMMs and FIB-4 evaluated using restricted cubic spline analysis. Adjusted associations between health outcomes and potential risk factors, including age, gender, marriage, nationality, residence, education level, income, areas, smoking status, alcohol consumption, body mass index, TG, HDL-C, hypertension, diabetes and CKD. Abbreviations: HMMs: heavy metals and metalloids; CI: confidence interval; HDL-C: high density lipoprotein cholesterol; TG: triglyceride; CKD: chronic kidney disease; As: arsenic; Cd: cadmium; Hg: mercury; Mo: molybdenum; Ni: nickel; Sn: tin; Tl: thallium.

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