

Supporting Information

Urinary Levels of 14 Metal Elements in General Population: A Region-based Exploratory Study in China

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Table S1. Geometric means of urinary metal concentrations in different gender and age groups of participants.

Urinary elements	LOD (µg/L)	LOQ (µg/L)	GM (µg/L) (95%CI)						
			All	Male	Female	Young children	Children	Adolescents	Adults
Cr	0.63	2.09	1.13 (0.99,1.30)	1.19 (0.92, 1.54)	1.08 (0.94, 1.24)	1.27 (1.04, 1.55)	1.74 (0.94, 3.21)	1.00 (0.78, 1.29)	0.99 (0.86, 1.16)
Ni	0.25	0.85	1.96 (1.59, 2.40)	2.15 (1.56, 2.96)	1.80 (1.38, 2.34)	3.03 (1.83, 5.03)	3.38 (2.10, 5.44)	2.93 (1.89, 4.55)	1.23 (0.95, 1.62)
As	0.01	0.04	24.58 (21.82, 27.70)	25.26 (21.36, 29.87)	24.01 (20.27, 28.44)	29.56 (21.29, 41.03)	31.48 (24.92, 39.76)	26.68 (20.43, 34.86)	20.81 (17.60, 24.68)
Se	0.76	2.55	16.4 (14.11, 18.95)	17.30 (13.80, 21.68)	15.58 (12.84, 18.91)	27.19 (17.60, 42.01)	24.70 (17.78, 34.31)	17.01 (12.44, 23.27)	12.03 (10.10, 14.47)
Sr	0.02	0.07	267.6 (234.7, 305.1)	247.5 (202.6, 302.3)	286.3 (241.0, 340.2)	294.7 (231.4, 375.3)	370.7 (293.6, 467.9)	244.0 (168.3, 353.7)	242.8 (199.7, 293.5)
Cd	0.01	0.04	0.53 (0.46, 0.62)	0.53 (0.42, 0.66)	0.54 (0.44, 0.65)	0.50 (0.34, 0.72)	0.57 (0.40, 0.80)	0.51 (0.37, 0.70)	0.54 (0.44, 0.68)
Sb	0.14	0.47	-	-	-	-	-	-	-
Tl	0.04	0.14	0.11 (0.09, 0.12)	0.09 (0.08, 0.11)	0.12 (0.10, 0.15)	0.09 (0.06, 0.13)	0.08 (0.06, 0.11)	0.10 (0.07, 0.14)	0.13 (0.11, 0.16)
Pb	1.77	5.91	-	-	-	-	-	-	-
Al	2.39	8.00	34.69 (31.03, 38.77)	31.11 (25.84, 37.47)	38.11 (31.79, 45.69)	34.62 (25.52, 46.98)	33.85 (23.53, 48.69)	38.58 (28.19, 52.78)	33.69 (28.04, 40.40)
Fe	1.44	4.80	38.36 (30.43, 39.53)	36.82 (27.09, 50.03)	39.75 (32.51, 48.61)	35.24 (25.47, 48.76)	46.96 (24.91, 88.53)	41.40 (27.08, 63.29)	36.21 (28.58, 45.12)
Cu	0.16	0.53	9.02 (8.28, 9.83)	9.26 (8.09, 10.61)	8.82 (7.90, 9.84)	11.90 (9.94, 14.24)	9.81 (7.98, 12.05)	9.21 (7.49, 11.32)	7.99 (7.10, 9.03)
Zn	0.40	1.33	397.0 (353.4, 446.0)	459.2 (388.1, 543.2)	350.1 (299.6, 409.0)	599.40 (501.0, 717.1)	579.7 (493.1, 681.6)	458.0 (353.7, 593.1)	296.2 (248.9, 348.0)
Rb	0.05	0.17	850.0 (763.4, 946.4)	777.3 (654.8, 922.7)	918.4 (804.2, 1049)	990.8 (818.6, 1199)	830.2 (669.6, 1029)	756.9 (583.4, 982.1)	844.5 (719.7, 1009)

Table S2. Levels of urinary elemental concentrations published by US Centers for Disease Control and Prevention.

Urinary metal	Demographic Categories	Sampling Time (years)	N	GM (µg/L)	95 th Percentile (µg/L)
As	Total population	2009-2010	2860	9.28	85.6
Cd	Total population	2017-2018	2808	0.132	0.832
Cr	Total population	2017-2018	2791	-	0.930
Pb	Total population	2015-2016	3061	0.284	1.26
Ni	Total population	2017-2018	2791	1.11	4.23
Sr	Total population	2015-2016	3061	85.5	299
Tl	Total population	2017-2018	2808	0.164	0.473

Table S3. The distributions of urinary essential elements concentrations in other studies.

Location	Subjects	N	Sampling Time (years)	Unit	Ni	Se	Fe	Cu	Zn	Rb
Guangzhou, Guangdong, China ^a	General population	480	2018	GM (µg/L)	2.25	35.4	—	—	—	—
Yunlin,Taiwan, China ^b	General population	2417	2009-2012, 2014-2015	GM (µg/gcreatinine)	11.63	—	—	18.13	—	—
Gongcheng Guangxi,China ^c	General population	2766	—	GM (µg/gcreatinine)	—	29.71	—	19.74	578.1	—
Shenzhen Guangdong, China ^d	General population	215	2011-2012, 2013-2014, 2015-2016	Median (µg/L)	—	26.1	65.1	31.3	617	—
Wuhan, Hubei, China ^e	Pregnant woman	598	2014-2015	Median (µg/L)	3.82	17.75	—	14.71	332.9	1878
Wuhan, Hubei, China ^f	Pregnant woman	113	2011-2012	GM (µg/L)	0.77	2.57	10.7	4.64	53.3	—
China ^j	Adults	11037	2017-2018	Median (µg/L)	1.74	16.08	—	—	—	—
China ^h	Children	456	—	GM (µg/gcreatinine)	2.87	24.57	31.81	9.37	484.2	1690
China ⁱ	Children	1061	2019	Mean (µg/g)	2.303	9.015	8.486	7.339	255.3	—
Berlin,German ^j	General population	77	—	GM (µg/gcreatinine)	1.4	—	—	—	288	—
Gothenburg,Swed en ^k	General population	60	—	GM (µg/gcreatinine)	0.86	13.2	2.55	5.13	207	—
Ethiopian ^l	General population	386	2015-2016	GM (µg/L)	6.95	—	—	5.21	283	494

^a [1]; ^b [2]; ^c [3]; ^d [4]; ^e [5]; ^f [6]; ^j [7]; ^h [8]; ⁱ [9]; ^j [10]; ^k [11]; ^l [12]

Table S4. The distributions of urinary non-essential elements concentrations in other studies.

Location	Subjects	N	Sampling Time (years)	Unit	Cd	Sr	Sb	Tl	Pb	Al	As	Cr
Guangzhou, Guangdong, China ^a	General population	480	2018	GM (µg/L)	1.05	—	—	—	0.96	—	41	—
Yunlin,Taiwan, China ^b	General population	2417	2009-2012, 2014-2015	GM (µg/gcreatinine)	1.01	283.8	—	0.23	1.44	—	98.86	5.74
Gongcheng Guangxi,China ^c	General population	2766	—	GM (µg/gcreatinine)	—	114.0	—	—	—	—	41.39	—
Shenzhen Guangdong, China ^d	General population	215	2011-2012, 2013-2014, 2015-2016	Median (µg/L)	1.03	—	—	—	2.71	—	36.6	3.67
Wuhan, Hubei, China ^e	Pregnant woman	598	2014-2015	Median (µg/L)	0.79	239.7	—	0.54	—	40.76	24.98	1.38
Wuhan, Hubei, China ^f	Pregnant woman	113	2011-2012	GM (µg/L)	0.97	—	—	0.07	0.44	—	4.91	0.4
China ^j	Adults	11037	2017-2018	Median (µg/L)	0.64	—	0.05	0.27	1.05	—	20.8	57
China ^h	Children	456	—	GM (µg/gcreatinine)	0.087	68.62	0.136	0.095	0.462	13.89	21.45	0.307
China ⁱ	Children	1061	2019	Mean (µg/g)	0.32	108.1	—	—	1.5	26.08	—	0.61
Berlin,German ^j	General population	77	—	GM (µg/gcreatinine)	0.15	—	—	0.19	0.56	—	8.7	—
Göteborg,Swe den ^k	General population	60	—	GM (µg/gcreatinine)	0.071	—	0.047	—	0.29	—	28.3	0.066
Ethiopian ^l	General population	386	2015-2016	GM (µg/L)	0.61	79.4	—	1.44	—	25	20.9	—

^a [1]; ^b [2]; ^c [3]; ^d [4]; ^e [5]; ^f [6]; ^j [7]; ^h [8]; ⁱ [9]; ^j [10]; ^k [11]; ^l [12]

Table S5. Correlation (Spearman) matrix for levels of 14 tested metals in Jingyuan County subjects.

	Cr	Ni	As	Se	Sr	Cd	Sb	Tl	Pb	Al	Fe	Cu	Zn	Rb
Cr	1													
Ni	0.511**	1												
As	0.330**	0.484**	1											
Se	0.303**	0.441**	0.389**	1										
Sr	0.318**	0.282**	0.312**	0.194**	1									
Cd	0.316**	0.323**	0.328**	0.288**	0.297**	1								
Sb	0.515**	0.257**	0.195**	0.196**	0.273**	0.250**	1							
Tl	-0.087	-0.081	0.015	-0.024	-0.147*	-0.022	0.132	1						
Pb	0.634**	0.493**	0.363**	0.391**	0.270**	0.280**	0.491**	0.0160	1					
Al	0.272**	0.174*	0.184*	0.116	0.149*	0.116	0.491**	0.218**	0.340**	1				
Fe	0.447**	0.260**	0.152**	0.106	0.160*	0.142	0.467**	0.255**	0.426**	0.678**	1			
Cu	0.441**	0.438**	0.460**	0.428**	0.252**	0.408**	0.412**	0.177*	0.512**	0.405**	0.382**	1		
Zn	0.295**	0.372**	0.463**	0.497**	0.371**	0.357**	0.283**	-0.040	0.401**	0.257**	0.253**	0.568**	1	
Rb	0.308**	0.220**	0.325**	0.337**	0.003	0.371**	0.168*	0.339**	0.266**	0.263**	0.252**	0.464**	0.301**	1

*. Correlation is significant at the 0.05 level (2-tailed); **. Correlation is significant at the 0.01 level (2-tailed).

Table S6. Different age groups urinary median concentrations (µg/L) of metals including Ni, As, Se, Tl, Sr, Pb, Cu and Zn

Group	Ni (µg/L)	As (µg/L)	Se (µg/L)	Tl (µg/L)	Sr (µg/L)	Pb (µg/L)	Cu (µg/L)	Zn (µg/L)
Young children (1-8 years)	4.34	32.43	27.65	0.10	329.0	2.40	10.17	541.9
Children (6-11 years)	3.77	32.62	30.96	0.08	361.6	2.03	9.21	616.3
Adolescents (12-18 years)	3.36	26.27	20.00	0.12	270.3	2.27	10.19	507.1
Adults (>18 years)	1.56	22.71	13.87	0.13	266.1	1.56	7.38	285.6
<i>p</i>	<0.001	0.007	<0.001	0.023	0.046	0.014	0.001	<0.001

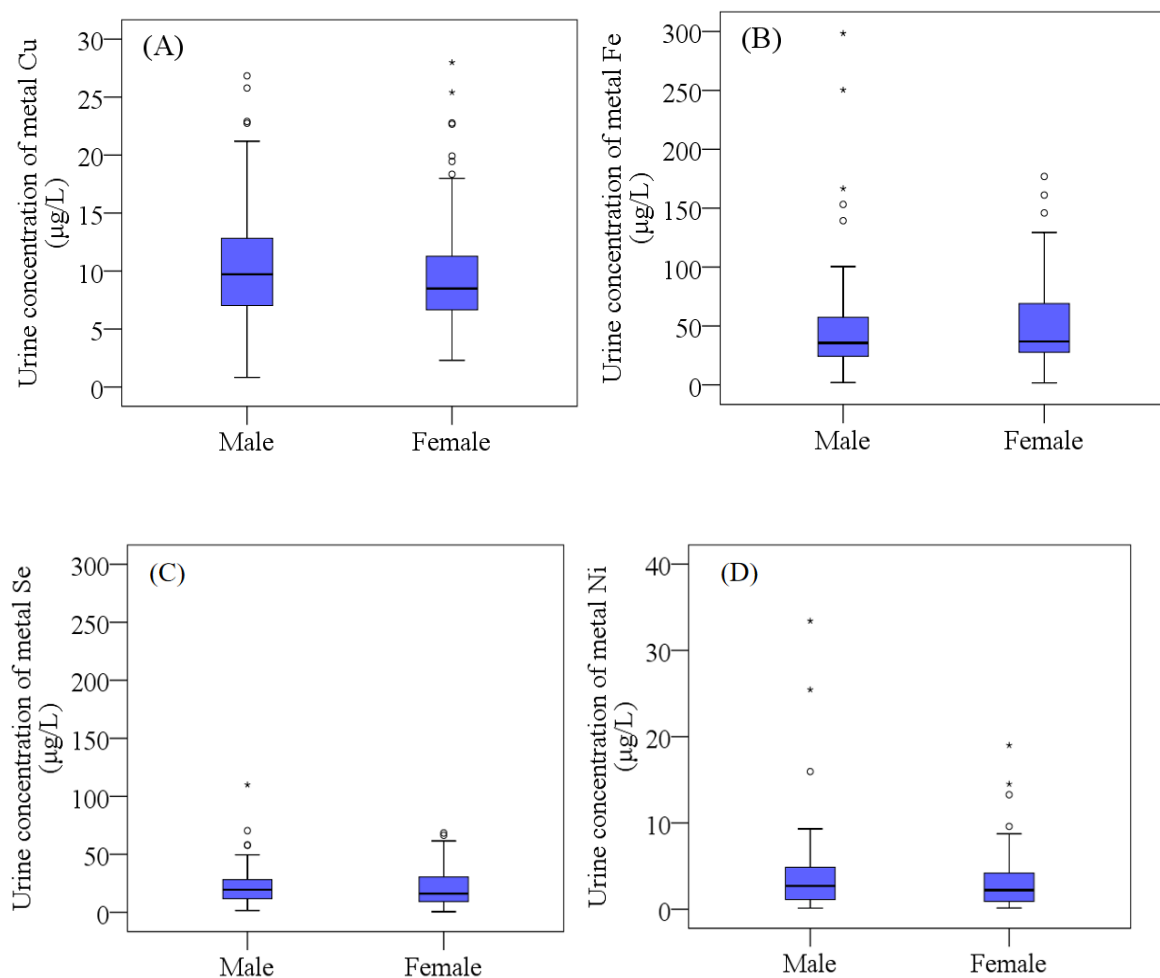


Figure S1. The difference in urinary concentrations (μg/L) of essential metals (Cu: A, Fe: B, Se: C and Ni: D) between male and female (There were no statistically significant difference between the above elements in each group; $p > 0.05$). \perp : Range within 1.5 IQR. —: Median line. \circ : Outliers. *: Extreme cases.

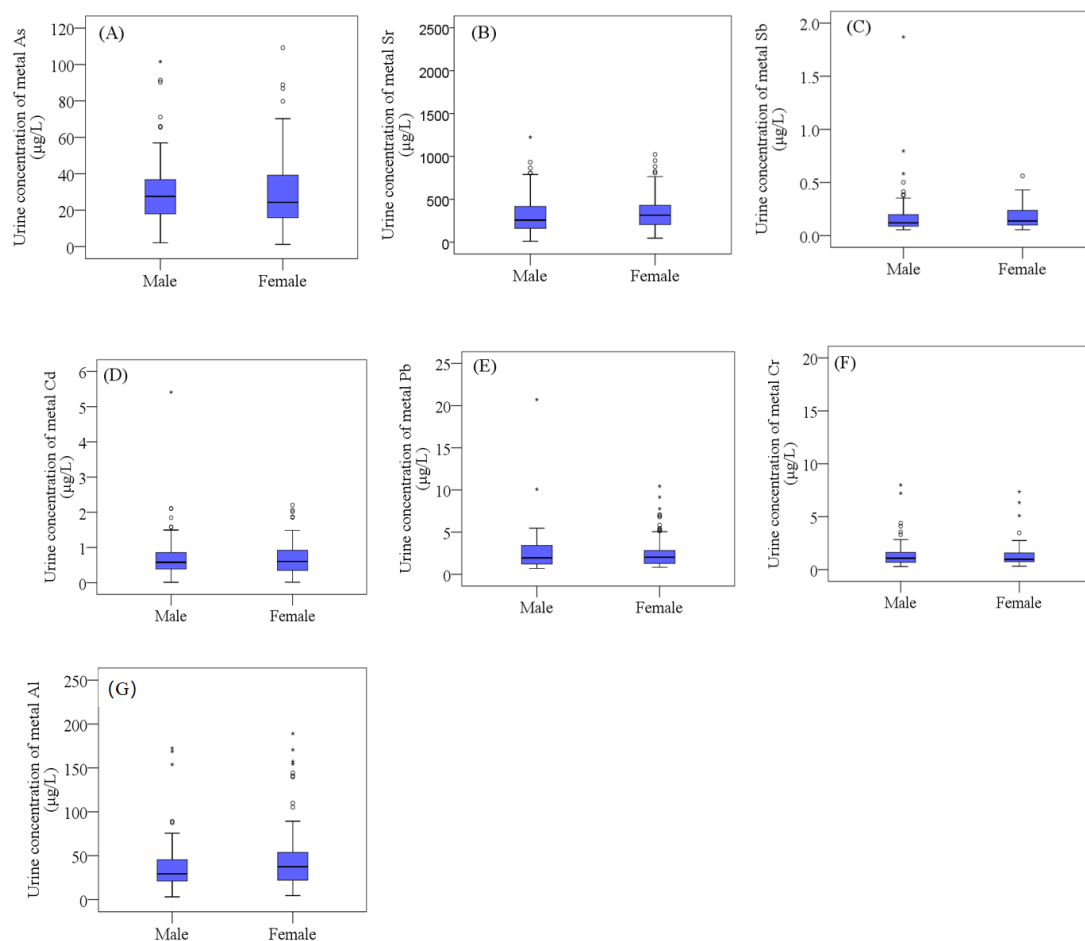


Figure S2. The difference in urinary concentrations (μg/L) of non-essential metals (As: A, Sr: B, Sb: C, Cd: D, Pb: E, Cr: F, and Al: G) between male and female (There were no statistically significant difference between the above elements in each group; $p > 0.05$). \perp : Range within 1.5 IQR. —: Median line. \circ : Outliers. *: Extreme cases.

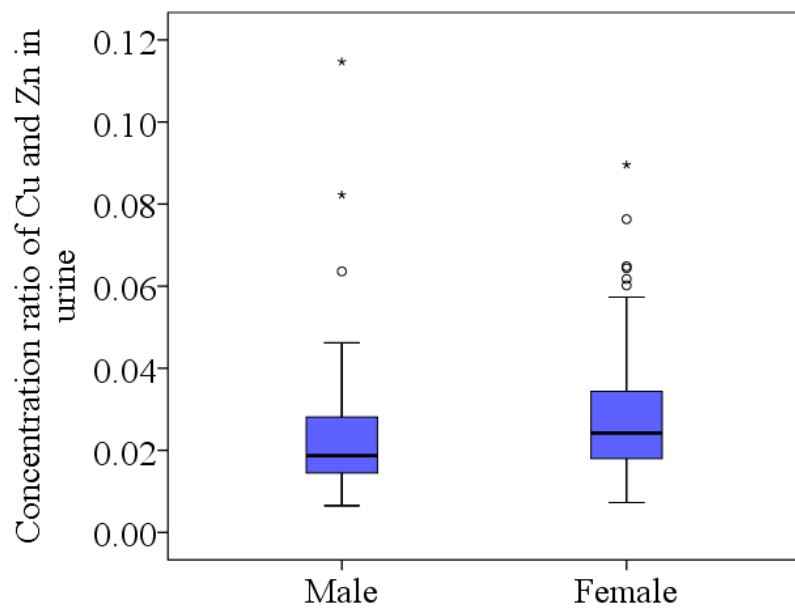


Figure S3. The difference in concentration ratio of Cu and Zn in urine between male and female ($p < 0.05$). I: Range within 1.5 IQR. —: Median line. ○: Outliers. *: Extreme cases.

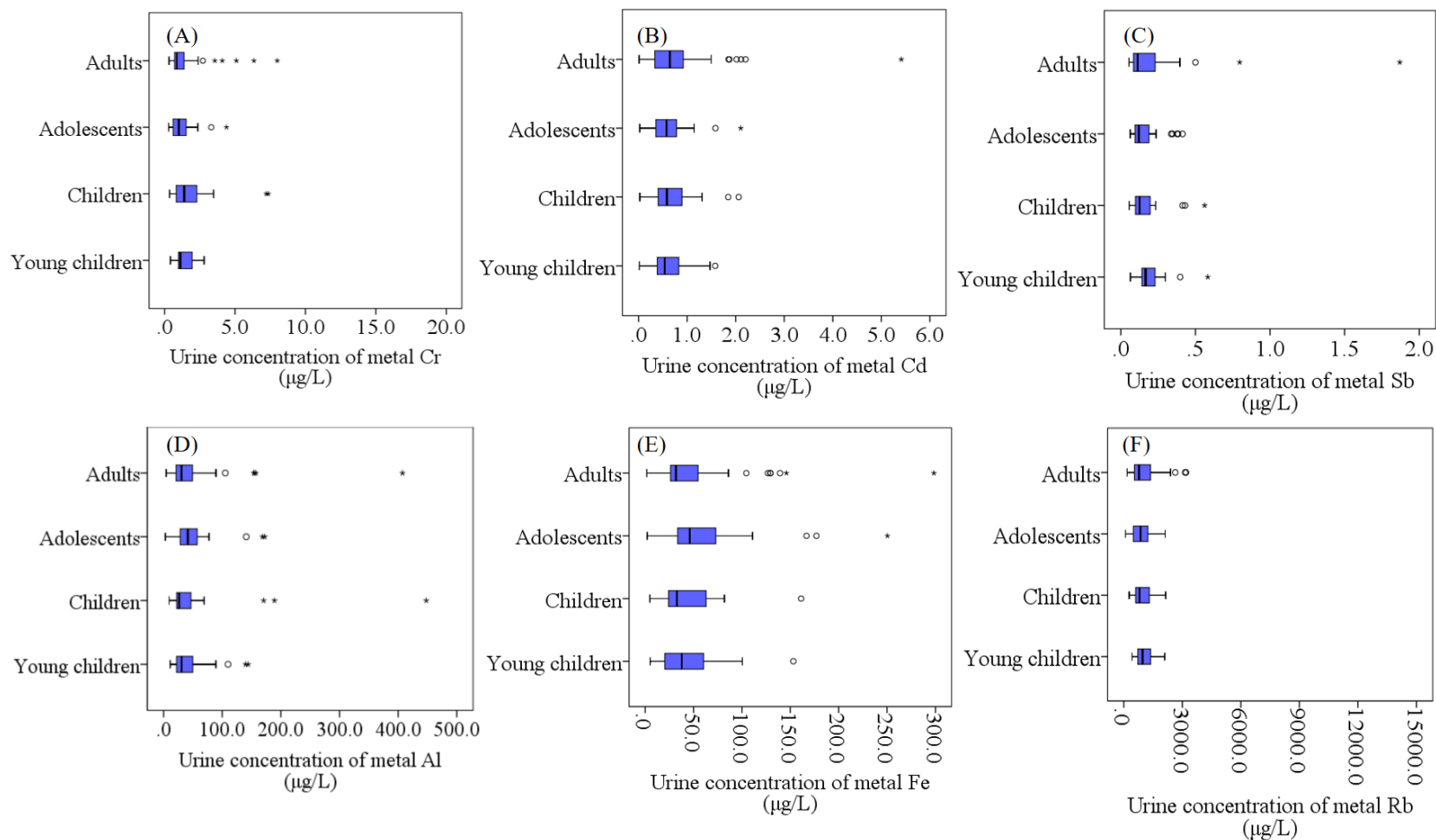


Figure S4. The difference in concentration of Cr (A), Cd (B), Sb (C), Fe (D), Al (E) and Rb (F) in urine between different age groups (There were no statistically significant difference between the above elements in each group; $p > 0.05$).

┌: Range within 1.5 IQR. —: Median line. ○: Outliers. *: Extreme cases.

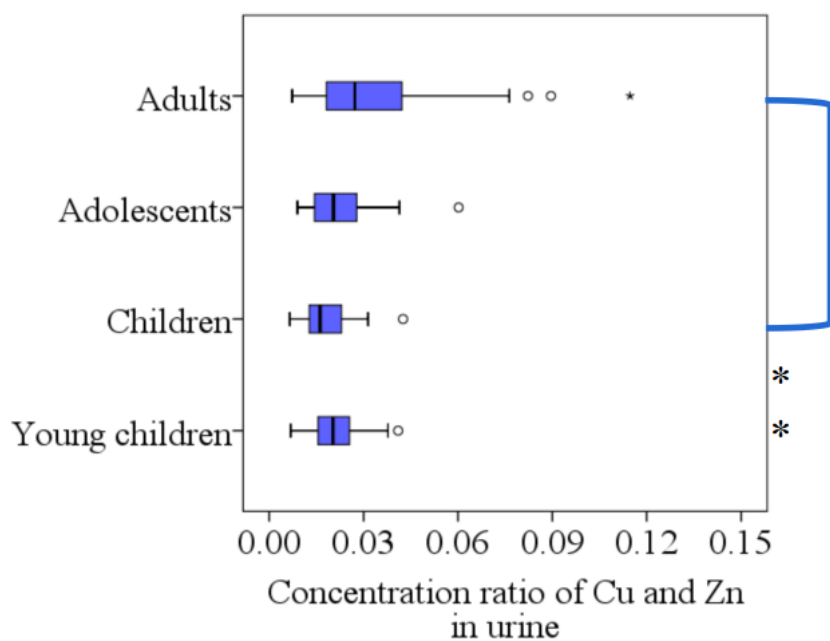


Figure S5. The difference in concentration ratio of Cu and Zn in urine between different age groups ($p < 0.001$). Inside boxplots: \perp : Range within 1.5. Interquartile range (IQR).—: Medianline. \circ : Outlier. *: Extreme cases. Outside boxplots:]: Significant differences between the two groups. **: $p < 0.01$.

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