

Supporting Information

Assessment of children's metals exposure via hand wipe, outdoor soil and indoor dust, and their associations with blood biomarkers: comparison of different evaluation campaigns

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Table S1. Instrument and method detection limits for different metals in the study

Metals	Detection limit ($\mu\text{g}\cdot\text{kg}^{-1}$)	RSD%	Recovery%
Pb	8.0	2.65	94.81
Cr	10.0	3.01	96.43
Cd	5.0	2.18	95.34
Mn	15.0	2.31	97.32
Ni	10.0	1.56	104.51
Cu	10.0	4.11	106.31
Zn	20.0	2.81	102.52
As	4.0	3.62	101.36

Table S2. The value of parameters in exposure assessment via different sampling and evaluation strategies.

arameters	values	reference
Q_{hw} , C_{dust} , C_{soil}	personalized	According to the sampling and measurement
$H_{contact-area}$	0.1	Stapleton et al. (2008)
TE	0.5	kissel et al. (1998)
f_{hm}	personalized	According to questionnaire results
t_{exp}	12	Ma et al. (2018)
BW	personalized	According to questionnaire results
IR_{dust}	72 mg/day (3-6)	Lin et al. (2017)
	103 mg/day (7-12)	Wang et al. (2018)
IR_{soil}	72 mg/day (3-6)	Lin et al. (2017)
	103 mg/day (7-12)	Wang et al. (2018)
f	0.5	Liu et al. (2018)
SD	0.099 mg/cm ²	Kissel et al. (1996)
DA	0.011 mg/cm ²	Holmes et al. (1999)
f_{hs}	personalized	According to questionnaire results
ABS	As: 0.03	U.S.EPA 2004
	Others: 0.001	
SA	personalized	According to questionnaire results

Table S3. Summary of toxicity factors used for risk assessment

Contaminant of potential concern	Oral RfD (mg·kg ⁻¹ day ⁻¹)	Dermal RfD (mg·kg ⁻¹ day ⁻¹)	Oral SF (mg·kg ⁻¹ day ⁻¹) ⁻¹	Dermal SF (mg·kg ⁻¹ day ⁻¹) ⁻¹
Pb	3.50E-03	5.25E-04	NA	NA
Cr	3.00E-03*	3.00E-03*	5.01E-01	2.00E+01
Cd	1.00E-03	1.00E-05	NA	NA
Mn	1.40E-01	2.33E-02	NA	NA
Ni	2.00E-02	5.40E-03	1.70E+00	4.25E+01
Cu	4.00E-02	1.20E-02	NA	NA
Zn	3.00E-01	6.00E-02	NA	NA
As	3.00E-04	1.23E-04	1.50E+00	3.66E+00

NA—not applicable

*—the RfD is for Cr (VI)

Table S4. The non-carcinogenic risk from exposure to metals in hand wipes through hand to mouth contact and dermal absorption pathway.

Metals	hand to mouth contact			Dermal absorption			Total		
	Median	P5	P95	Median	P5	P95	Median	P5	P95
Cr	1.5E-01	3.9E-02	5.5E-01	4.4E-04	1.5E-04	1.8E-03	1.5E-01	3.9E-02	5.6E-01
Mn	4.9E-03	9.7E-04	3.2E-02	9.6E-05	2.0E-05	3.2E-04	5.0E-03	9.9E-04	3.2E-02
Ni	2.8E-03	7.0E-04	9.6E-03	2.6E-05	8.8E-06	1.3E-04	2.9E-03	7.1E-04	9.7E-03
Cu	2.5E-03	6.1E-04	1.3E-02	2.2E-05	9.2E-06	1.0E-04	2.6E-03	6.2E-04	1.3E-02
Zn	1.5E-03	4.4E-04	7.7E-03	2.3E-05	5.6E-06	8.2E-05	1.5E-03	4.4E-04	7.7E-03
As	7.6E-02	7.1E-03	4.4E-01	2.7E-02	8.0E-03	1.4E-01	1.0E-01	1.5E-02	5.8E-01
Cd	1.9E-03	4.7E-04	6.1E-03	5.2E-04	1.6E-04	1.8E-03	2.4E-03	6.3E-04	7.9E-03
Pb	4.3E-02	1.2E-02	3.1E-01	1.1E-03	2.6E-04	5.1E-03	4.4E-02	1.2E-02	3.1E-01
Sum	2.8E-01	6.1E-02	1.4E+00	2.9E-02	8.6E-03	1.4E-01	3.1E-01	7.0E-02	1.5E+00

Table S5. The cancer risk from exposure to metals in hand wipes through hand to mouth contact and dermal absorption pathway.

Metals	Hand to mouth contact			Dermal absorption			Total		
	Median	P5	P95	Median	P5	P95	Median	P5	P95
Cr	2.3E-04	5.9E-05	8.3E-04	2.6E-05	8.8E-06	1.1E-04	2.5E-04	6.7E-05	9.4E-04
Ni	9.6E-05	2.4E-05	3.3E-04	5.9E-06	2.0E-06	3.1E-05	1.0E-04	2.6E-05	3.6E-04
As	3.4E-05	3.2E-06	2.0E-03	1.2E-05	3.6E-06	6.1E-04	4.6E-05	6.8E-06	2.6E-03
Sum	3.6E-04	8.6E-05	3.1E-03	4.4E-05	1.4E-05	7.5E-04	4.0E-04	1.0E-04	3.9E-03

Table S6. The non-carcinogenic risk form exposure to metals in outdoor soil through ingestion and dermal absorption pathway.

Metals	Soil ingestion			Dermal absorption			Total		
	Median	P5	P95	Median	P5	P95	Median	P5	P95
Cr	2.4E-02	8.7E-03	4.2E-02	1.0E-04	4.5E-05	1.9E-04	2.4E-02	8.7E-03	4.2E-02
Mn	4.5E-03	1.6E-03	7.4E-03	1.3E-04	5.0E-05	2.0E-04	4.6E-03	1.6E-03	7.6E-03
Ni	2.1E-03	7.1E-04	2.9E-03	3.2E-05	1.4E-05	5.5E-05	2.1E-03	7.3E-04	2.9E-03
Cu	8.5E-04	3.3E-04	1.2E-03	1.1E-05	6.3E-06	2.0E-05	8.7E-04	3.4E-04	1.2E-03
Zn	3.8E-04	1.5E-04	5.3E-04	7.6E-06	4.7E-06	1.4E-05	3.9E-04	1.5E-04	5.4E-04
As	4.1E-02	1.6E-02	7.5E-02	1.3E-02	5.9E-03	2.2E-02	5.4E-02	2.2E-02	9.7E-02
Cd	4.7E-04	2.1E-04	7.5E-04	2.0E-04	9.3E-05	3.2E-04	6.7E-04	3.1E-04	1.1E-03
Pb	8.0E-03	3.2E-03	1.9E-02	2.3E-04	1.1E-04	5.6E-04	8.2E-03	3.3E-03	2.0E-02
Sum	8.2E-02	3.1E-02	1.5E-01	1.4E-02	6.3E-03	2.3E-02	9.5E-02	3.7E-02	1.7E-01

Table S7 The cancer risk form exposure to metals in outdoor soil through ingestion and dermal absorption pathway.

Metals	Soil ingestion			Dermal absorption			Total		
	Median	P5	P95	Median	P5	P95	Median	P5	P95
Cr	3.7E-05	1.3E-05	6.3E-05	6.1E-06	2.7E-06	1.2E-05	4.3E-05	1.6E-05	7.5E-05
Ni	7.0E-05	2.4E-05	9.8E-05	7.3E-06	3.1E-06	1.3E-05	7.7E-05	2.7E-05	1.1E-04
As	1.8E-05	7.1E-06	3.4E-05	5.8E-06	2.7E-06	1.0E-05	2.4E-05	9.8E-06	4.4E-05
Sum	1.3E-04	4.4E-05	1.9E-04	1.9E-05	8.5E-06	3.4E-05	1.4E-04	5.3E-05	2.3E-04

Table S8. The non-carcinogenic risk form exposure to metals in indoor dust through ingestion and dermal absorption pathway.

Metals	Dust ingestion			Dermal absorption			Total		
	Median	P5	P95	Median	P5	P95	Median	P5	P95
Cr	3.4E-02	7.6E-03	7.2E-02	1.7E-05	5.3E-06	3.2E-05	3.4E-02	7.6E-03	7.2E-02
Mn	3.3E-03	4.7E-04	1.3E-02	1.2E-05	2.6E-06	3.7E-05	3.3E-03	4.7E-04	1.3E-02
Ni	2.0E-03	4.5E-04	4.2E-03	3.7E-06	1.2E-06	6.8E-06	2.0E-03	4.5E-04	4.2E-03
Cu	8.5E-04	1.9E-04	2.3E-03	1.7E-06	4.7E-07	3.6E-06	8.5E-04	1.9E-04	2.3E-03
Zn	5.3E-04	8.6E-05	1.2E-03	1.4E-06	3.3E-07	4.0E-06	5.3E-04	8.6E-05	1.2E-03
As	1.1E-01	2.7E-02	2.4E-01	3.9E-03	1.1E-03	7.8E-03	1.2E-01	2.8E-02	2.5E-01
Cd	8.5E-04	1.2E-04	2.3E-03	4.5E-05	1.0E-05	1.6E-04	9.0E-04	1.3E-04	2.4E-03
Pb	1.2E-02	5.3E-03	6.2E-02	6.4E-05	2.1E-05	1.1E-04	1.2E-02	5.3E-03	6.2E-02
Sum	1.7E-01	4.1E-02	3.9E-01	4.1E-03	1.2E-03	8.2E-03	1.7E-01	4.3E-02	4.0E-01

Table S9. The cancer risk form exposure to metals in indoor dust through ingestion and dermal absorption pathway.

Metals	Dust ingestion			Dermal absorption			Total		
	Median	P5	P95	Median	P5	P95	Median	P5	P95
Cr	5.1E-05	1.1E-05	1.1E-04	1.0E-06	3.2E-07	1.9E-06	5.2E-05	1.2E-05	1.1E-04
Ni	6.7E-05	1.5E-05	1.4E-04	8.4E-07	2.7E-07	1.6E-06	6.8E-05	1.6E-05	1.4E-04
As	5.1E-05	1.2E-05	1.1E-04	1.8E-06	5.1E-07	3.5E-06	5.3E-05	1.3E-05	1.1E-04
Sum	1.7E-04	3.9E-05	3.6E-04	3.6E-06	1.1E-06	7.0E-06	1.7E-04	4.0E-05	3.6E-04

Table S10. Spearman's Rank Correlations coefficient of metals concentrations in blood and in external exposure concentration.

Metals	blood VS hand wipe	blood VS outdoor soil	blood VS indoor dust
Cr	0.416*	0.264	0.214
Mn	0.339*	0.327	0.055
Ni	0.05	0.391	0.267
Cu	0.195	0.445	0.233
Zn	0.016	0.109	0.393
As	0.064	0.375	0.427
Cd	0.023	0.173	0.035
Pb	0.534**	0.152	0.154

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

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

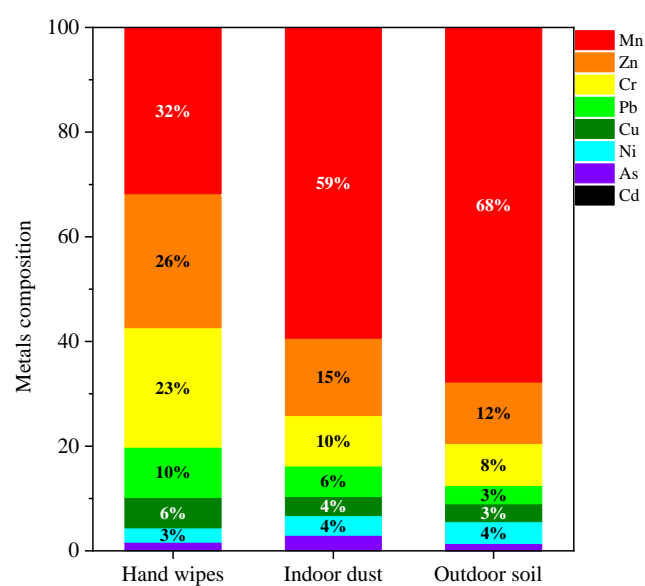


Figure S1. Comparison of metals concentration profile in hand wipes, indoor dust and outdoor soil

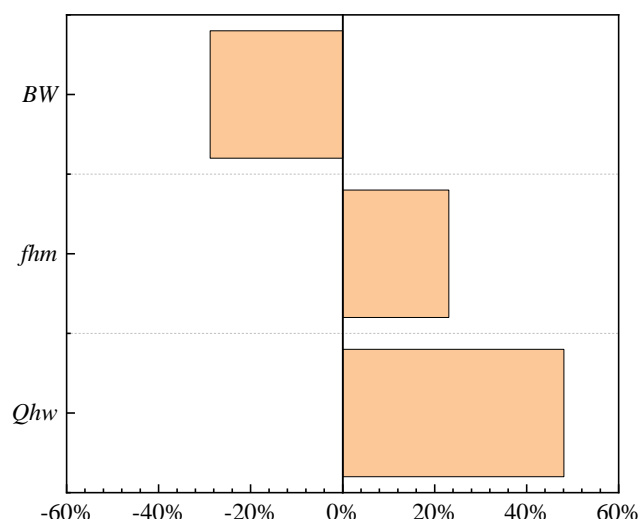


Figure S2 the Sensitivity analysis of Cr oral exposure from hand wipe via hand to mouth pathway.

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