Environmental Contamination: Causes and Solutions
https://www.sciltp.com/journals/eccs

Article

Risk Assessment of Dermal Exposure to Tris(2-chloroethyl) Phosphate and Tris(1,3-dichloroisopropyl) Phosphate via Contact with Indoor Dust

Banan Baqer Hashim [1], Layla Salih Al-Omran [1,2,*], William A. Stubbings [2] and Stuart Harrad [2]

[1] Department of Chemistry, College of Science, University of Basrah, Basrah 61004, Iraq
[2] School of Geography, Earth, and Environmental Sciences, University of Birmingham, Birmingham B15 2TT, UK
* Correspondence: layla.al-omran@uobasrah.edu.iq

Supplementary Information

Table S1. Statistical summary of TCEP and TDCIPP concentrations (ng/g) in home and car dust samples (Al-Omran et al., 2021; 2025).

Dust Samples	Parameter	TCEP	TDCIPP
Home (elevated surface) n = 20	Average	1660	1080
	Median	1250	742
	Min	371	183
	Max	4500	2870
	STD	1217	780
Home (floor) n = 20	Average	865	545
	Median	824	507
	Min	89.9	39.3
	Max	2460	1680
	STD	621	423
car n= 24	Average	4520	8040
	Median	2520	3510
	Min	653	696
	Max	28100	68100
	STD	5740	15200

Table S2. Parameters used in Equation (1) for EDI dermal (US EPA, 2011; Pawar et al., 2017; Cristale et al., 2018; Hashim and Al-Omran, 2023).

Parameter	Adults	Toddler
Age	> 18 years	2-3 years
Body weight (bw)	80 kg	13.8 kg
Exposed body surface area (ESA)	4615 cm^2	2564 cm^2
Dust adhered to skin (DA)	0.01	0.04
Absorbed fraction (AF)	28% for TCEP and 13% for TDCIPP	
Fraction of time spent indoors (FT-house)	63.8%	86.1%
Fraction of time spent indoors (FT-car)	4.1%	4.1% (27.9% for professional driver)

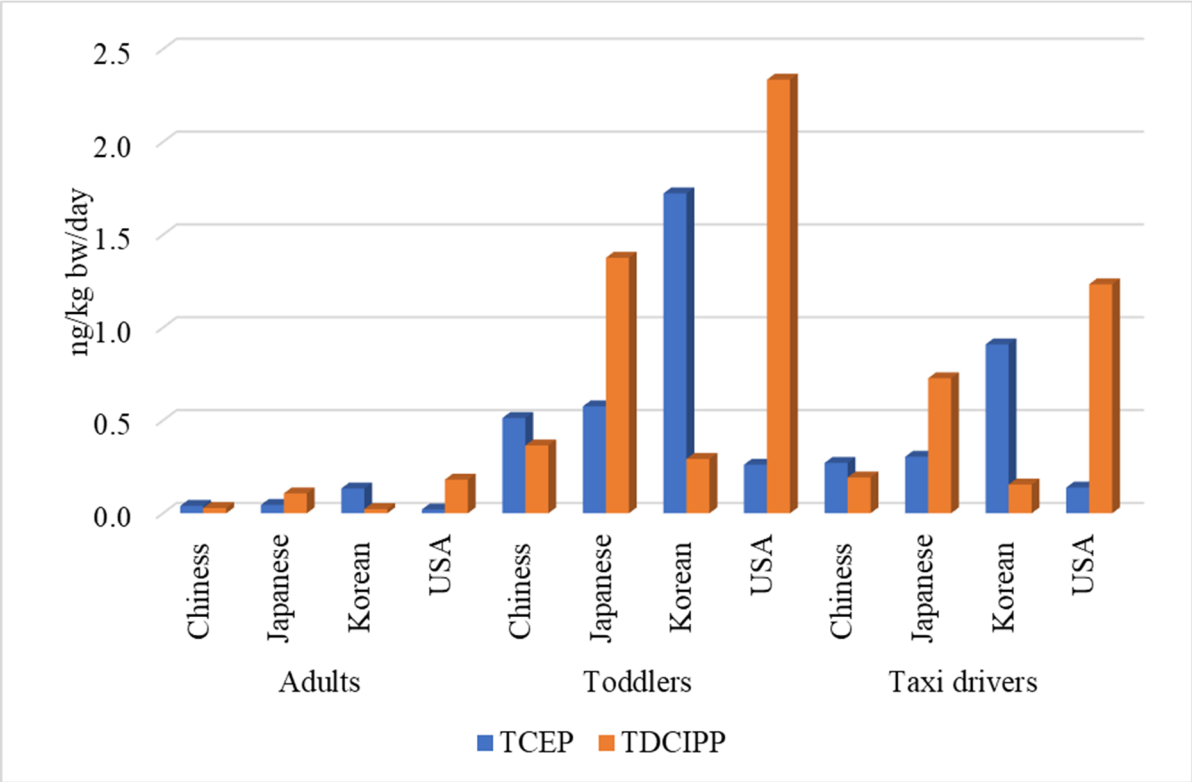

Figure S1. High-end EDI dermal values (95th percentile) for the three population groups across vehicle types.

References

1. Al-Omran, L. S.; Gbadamosi, M. R.; Stubbings, W. A.; Drage, D. S.; Abou-Elwafa Abdallah, M.; Harrad, S. Organophosphate esters in indoor and outdoor dust from Iraq: Implications for human exposure. *Emerging Contaminants* **2021**, 7, 204–212.
2. Al-Omran, L. S.; Hashim, B. B.; Stubbings, W. A.; Harrad, S. Levels, distribution profiles and risk assessment of chlorinated organophosphate esters in car and road dust from Basrah, Iraq. *Emerging Contaminants* **2025**, 11 (1), 100435.
3. Cristale, J.; Aragão Belé, T. G.; Lacorte, S.; Rodrigues de Marchi, M. R. Occurrence and human exposure to brominated and organophosphorus flame retardants via indoor dust in a Brazilian city. *Environmental Pollution* **2018**, *237*, 695–703.
4. Hashim, B.B. and Al-Omran, L.S. 'Human Exposure Assessment of Tris (1-chloro-2-propyl) phosphate (TCIPP) via Dermal Contact with Car Dust', *Journal of Basrah Researches* **2023**, 49(1).
5. Pawar, G.; Abdallah, M. A.-E.; de Sáa, E. V.; Harrad, S. Dermal bioaccessibility of flame retardants from indoor dust and the influence of topically applied cosmetics. *Journal of Exposure Science & Environmental Epidemiology* **2017**, 27 (1), 100–105.
6. U.S. Environmental Protection Agency (EPA), Exposure Factors Handbook: 2011 Edition (EPA/600/R-09/052F). Washington, DC: National Center for Environmental Assessment, Office of Research and Development, U.S. Environmental Protection Agency, **2011**. Available at: https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252 (Accessed 29 July 2025).