

# Assessment of human body burdens of PBDEs at e-waste recycling sites in Taizhou, China, utilizing a one-compartment pharmacokinetic model

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## Introduction

The release of polybrominated diphenyl ethers (PBDEs) during poorly controlled e-waste recycling causes significant contamination of the surrounding environment, including animals that form a significant part of the diet of local people<sup>(1)</sup>. High daily PBDE intakes are of concern because these contaminants may cause adverse health effects in humans, particularly in children, including adverse growth and development effects, immunotoxicity, genotoxicity, and endocrine system disruption. The current study utilized estimated dietary PBDE intakes<sup>(1)</sup> (based on measured PBDE concentrations in locally sourced foods) and applied a one-compartment pharmacokinetic (PK) model to predict the body burden of PBDEs in adults and children from e-waste recycling areas in Taizhou, China, and compared these estimates with previously reported human body burdens at these locations.

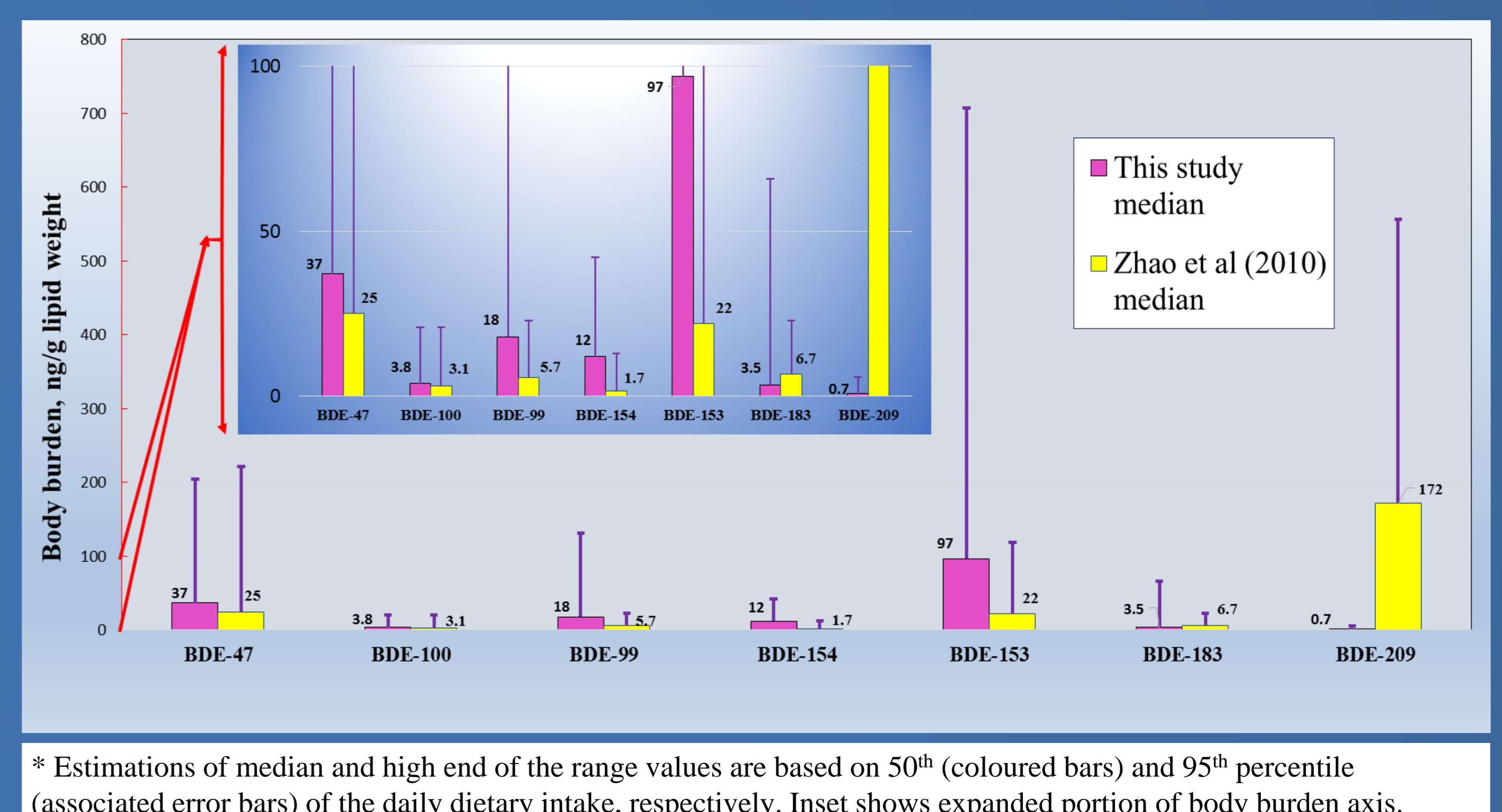
## Materials and Methods

PBDE body burdens were estimated as previously reported<sup>(2)</sup>. Daily adult BDE-209 intake via ingestion of dust was estimated based on concentration data from Ma et al.<sup>(3)</sup> and dust consumption rates of 0.03 g/day<sup>(4)</sup>. Daily consumption rates for various food products<sup>(5,6)</sup>, data on body weight and lipid content in Chinese adults<sup>(7)</sup> and Chinese children<sup>(8)</sup>, and human half-life values of most BDEs<sup>(7,8)</sup> were taken from previously published studies. Medians of available values for lower, and higher brominated congeners were assigned for those corresponding BDEs with unknown half-lives (i.e. BDE-66, 138, and 197).

## Results and Discussion

Congener	Predicted PBDEs body burden, ng/g, lw							
	Adult				Child			
	median		range		median		range	
	male	female	male	female	boy	girl	boy	girl
BDE-47	40	33	4.2 - 200	3.5 - 170	60	62	5.8 - 300	5.9 - 300
BDE-66	0.5	0.43	0.03 - 8.6	0.02 - 7.2	0.78	0.81	0.05 - 13	0.05 - 13
BDE-100	4.1	3.5	0.36 - 21	0.3 - 18	6.1	6.3	0.5 - 31	0.52 - 32
BDE-99	19	16	4.1 - 130	3.4 - 110	32	33	6.9 - 210	7.1 - 220
BDE-85	0.16	0.13	0.04 - 3.8	0.04 - 3.2	0.25	0.26	0.07 - 6.4	0.07 - 6.6
BDE-154	13	11	1.8 - 42	1.6 - 35	20	20	2.8 - 61	2.9 - 63
BDE-153	110	88	7.6 - 710	6.4 - 600	180	180	13 - 1000	13 - 1000
BDE-138	3.7	3.1	0.05 - 11	0.04 - 9.5	6.4	6.6	0.08 - 17	0.08 - 18
BDE-183	3.8	3.2	0.19 - 66	0.16 - 56	6.6	6.8	0.31 - 98	0.32 - 100
BDE-197	0.51	0.43	0.02 - 10	0.02 - 8.6	0.86	0.88	0.03 - 15	0.03 - 16
BDE-207	0.73	0.61	0.03 - 6.1	0.03 - 5.2	1.2	1.26	0.05 - 9.1	0.05 - 9.4
BDE-209	0.7	0.59	0.04 - 5.7	0.03 - 4.8	1.1	1.17	0.06 - 8.6	0.06 - 8.9

Predicted\* and previously reported measured median adult body burdens of key PBDEs



\* Estimations of median and high end of the range values are based on 50<sup>th</sup> (coloured bars) and 95<sup>th</sup> percentile (associated error bars) of the daily dietary intake, respectively. Inset shows expanded portion of body burden axis.

Little or no significant gender-related differences in PBDEs body burden were observed (see Table above), which was consistent with previous studies. BDE-153 and BDE-47 were the dominant congeners contributing to estimated body burdens accounting, on average for all age groups, 56% and 20%, respectively, of  $\Sigma$ PBDE, followed by BDE-99 and BDE-154.

Comparison of predicted PBDE body burdens in adults from Taizhou e-waste recycling areas (Wenling village) with reported measured PBDEs concentrations in adults' blood from Taizhou<sup>(9)</sup> (see Figure above) supported the hypothesis that, other than for BDE-209, dietary intake is one of the most important sources of human exposure to PBDEs in the vicinity of informal e-waste recycling areas. Incorporating adult exposure to BDE-209 via both diet *and* dust ingestion into our PK model showed that predicted BDE-209 body burdens were still two orders of magnitude lower than those reported as being measured in adult blood. For children, median predicted body burdens of all BDE congeners exceeded those reported in children's blood<sup>(10)</sup> (no data exist for BDE-209 concentrations in children's blood) and also exceeded the corresponding maxima (e.g., two orders of magnitude for BDE-153).

We offer the following possible reasons for discrepancies between predicted and observed body burdens: scatter in the published estimates of PBDE half-lives; absence of data on PBDE half-lives for children; lack of PBDE monitoring data in cohorts representing e-waste-impacted populations; limitations of steady state modelling applied to dynamic processes taking place at e-waste recycling areas that may result in misrepresentation of actual patterns of exposure to some congeners; absence of data on differences between human populations in preferential metabolic PBDE pathways and accumulation.

## Summary

- For adults, predicted body burdens for *most* PBDEs based on dietary intake agree well with those measured by others in blood of an e-waste-impacted population. This confirms our hypothesis that intake of locally produced foods is the primary pathway of exposure of such populations to PBDEs;
- There are two main discrepancies between predicted & measured PBDE body burdens:
  1. substantially lower predicted BDE-209 concentrations than those measured in adult blood;
  2. in the case of children, substantially higher predicted concentrations of all considered PBDEs (no data for BDE-209) compared to those measured in children's blood.

**Note:** the list of references cited here is available on request: Iryna.Labunska@greenpeace.org