Human Health Review (con't)

Flame Retardant Stakeholder Advisory Committee - September 28, 2018

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Washington State Department of Health

Updated summaries on six flame retardants

- Added new toxicology and exposure studies – through August 2018.
- Added CDR 2016 manufacturing and use reporting
- Added a summary of environmental fate and transport
- Regulatory info. (incomplete)

Please review and comment!

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Chart of Uses*

	2015 U.S. production volume (million lbs/yr)	Home furniture	Electronic enclosures, cables, wires	Children's products	Vehicles	other	Non-FR uses
TBPH	1-10	X	X	X	X	Textiles, leather Foam bedding	a
TBB	CBI	X		X	X	Foam bedding	
TCPP	50-100	X	X	X	X	Textiles, leather Building insulation	c,f,h
TPHP	1-10	X	X	X	X	Textiles, leather	a,b,d,e,f,g
IPTPP	6	X		X		Paints, coatings	a,c,d,e
V6	CBI	X		X	X	Tents, fabrics	

* Reported by manufacturer or detected in product testing

a. Plasticizer
b. Solvents
c. Adhesives and sealants
d. Lubricants, greases
e. Photo chemicals and supplies
f. Paints and coatings
g. Cosmetics (nail polish)
h. Engineered wood products

Where detected?

	indoor dust (homes, daycares, schools)	Indoor air	Ambient air	vehicle dust, air	food	Drinking water	biomonitoring
TBPH	X	X	X	X	fish		Serum, hair, nails, handwipes, breastmilk
TBB	X	X	X	X	fish		Serum, handwipes, breastmilk
TCPP	X	X	X	X	X	X	Urine, handwipes breastmilk
TPHP	X	X	X	X	X	X	Urine, handwipes, breastmilk
IPTPP	X						Urine, handwipes
V6	X			X			

RCW 70.240.035 - For each chemical…

(c) Quantitative estimates of the potential human and environmental exposures associated with the use and release of the chemical;

(d) An assessment of the potential impacts on human health and the environment resulting from the quantitative exposure estimates referred to in (c) of this subsection;

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Literature review - quantitative information

- Reviewed literature and government evaluations to identify available hazard screening values
  - No robust health-based values.
  - Screening level and provisional references doses (RfDs) for TBPH, TBB, TCPP, TPHP.
  - Derived no effect levels (DNELs) in ECHA database for IPTPP, V6.
- Reviewed peer-reviewed literature for human exposure estimates
  - Focused on US and Canadian studies. Also used studies from countries that are likely to have similar consumer products and patterns of use.
  - Many estimated intake from just 1-2 pathways (e.g. ingestion of house dust, inhalation of air, no comprehensive aggregate assessments.

Poma et al, 2018
Phosphate flame retardants in Belgian dietary study

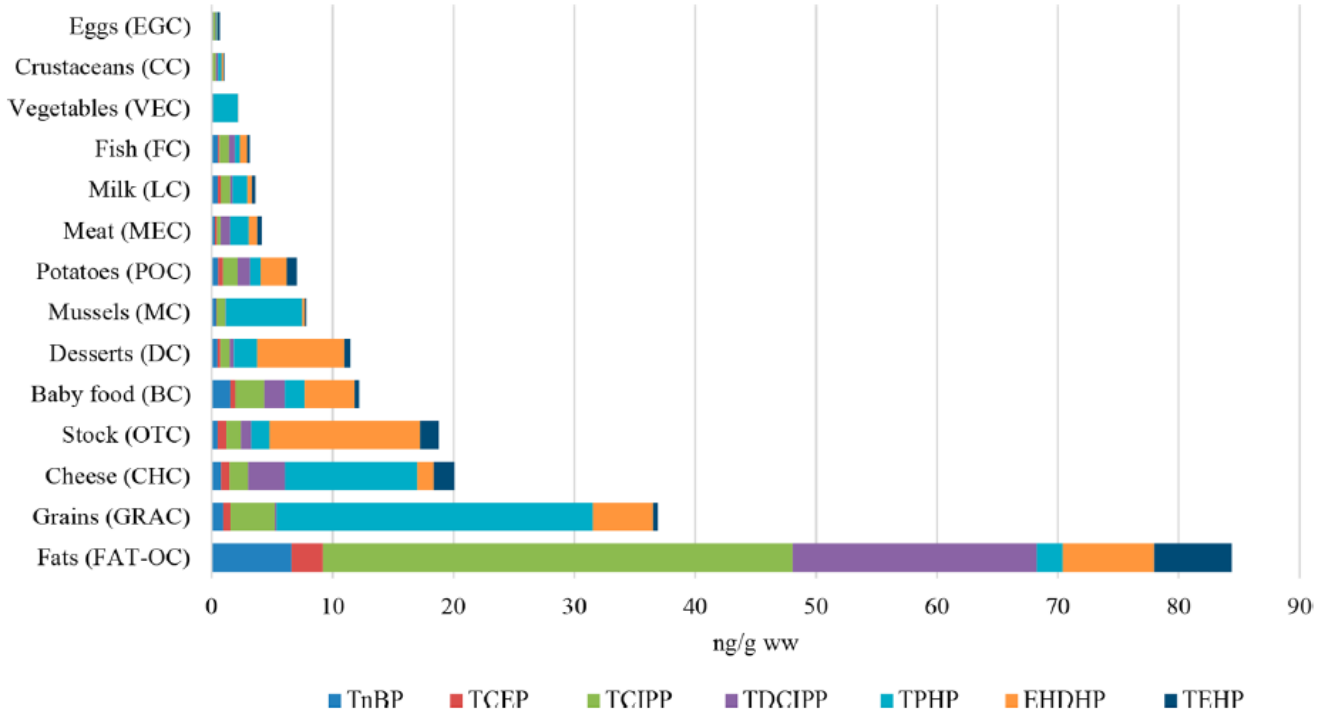

Figure 1. Mean PFR contamination (nanograms per gram of ww MB) in the different food groups and contributions of individual PFRs to the overall contamination.

Environ. Sci. Technol. 2018, 52, 2331−2338

Poma et al 2017
Phosphate flame retardants in Swedish dietary study

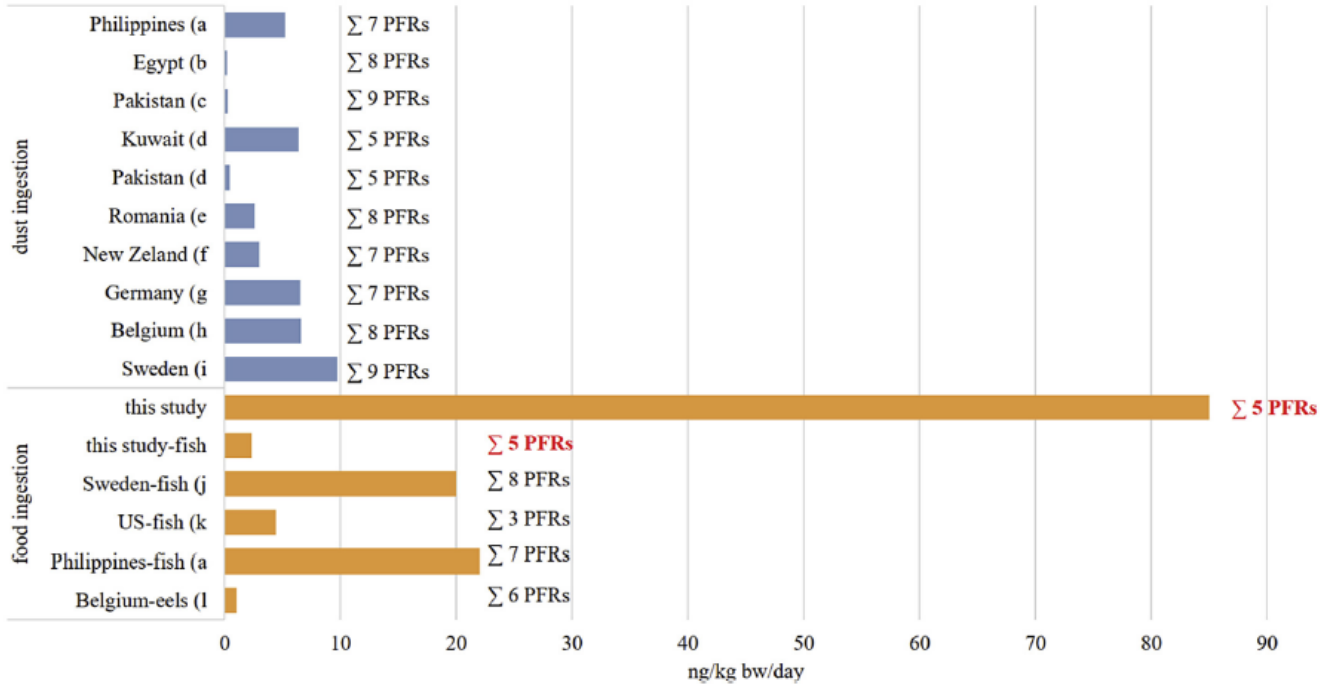

Fig. 2. Typical exposure to ∑PFRs *via* dust ingestion and maximum estimated exposure to ∑PFRs *via* food ingestion (ng/kg bw/day). a) Kim et al., 2013; b) Abdallah and Covaci, 2014; c) Ali et al., 2012b; d) Ali et al., 2013; e) Dirtu et al., 2012; f) Ali et al., 2012a; g) Brommer et al., 2012; h) Van de Eede et al., 2011; i) Luongo and Ostman, 2016; j) Sundkvist et al., 2010; k) Gunderson, 1988; l) Malarvannan et al., 2015. Please note that ∑PFRs is composed of different PFRs in the mentioned studies.

G. Poma et al. / Food and Chemical Toxicology 100 (2017) 1–7

Available screening values (RfDs, DNELs)

Sources

- Hayes and Kirman, 2017 (TBB)
- EPA Chemistry Dashboard (TBPH)
- EPA Superfund p-RfD 2012 (TCPP)
- Björnsdotter et al., 2018 (TPHP)
- ECHA, DNELs (V6, IPTPP)

Limitations

- Based on rodent response
- Based on limited data and proxy chemicals.
- Variable isomers in commercial mixtures
- Newer information may drive down levels of concern.

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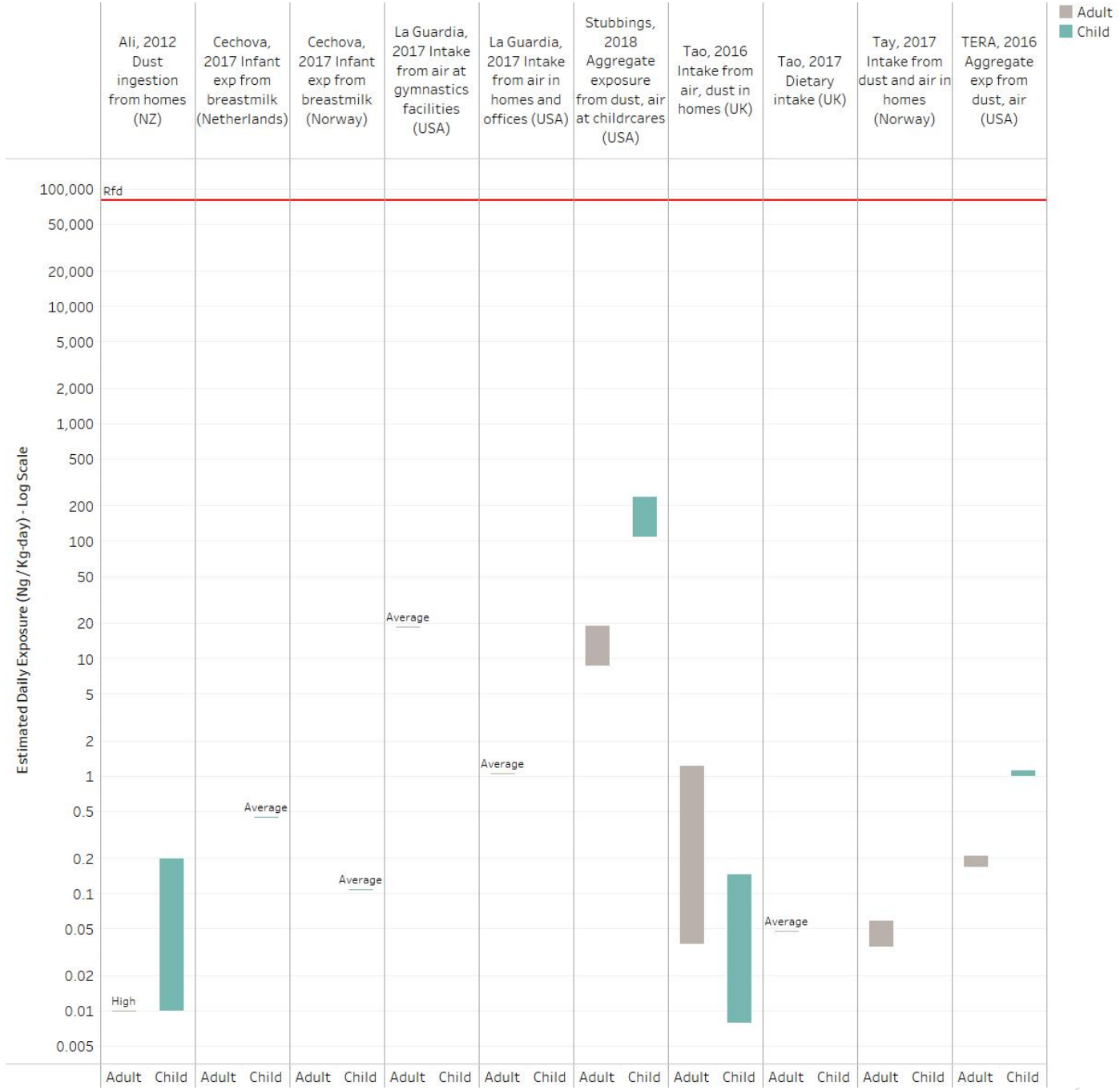
TBB



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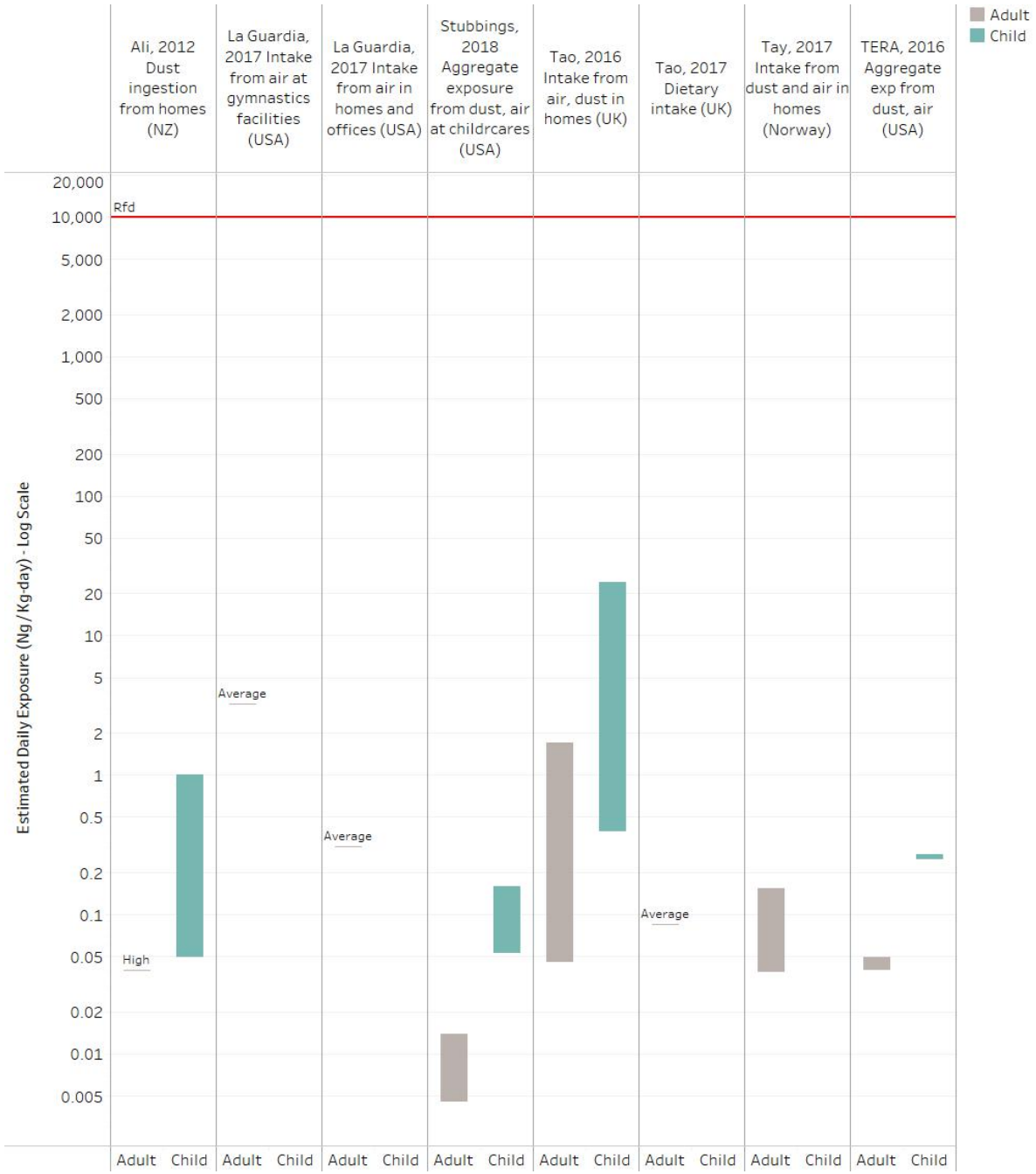
TBPH



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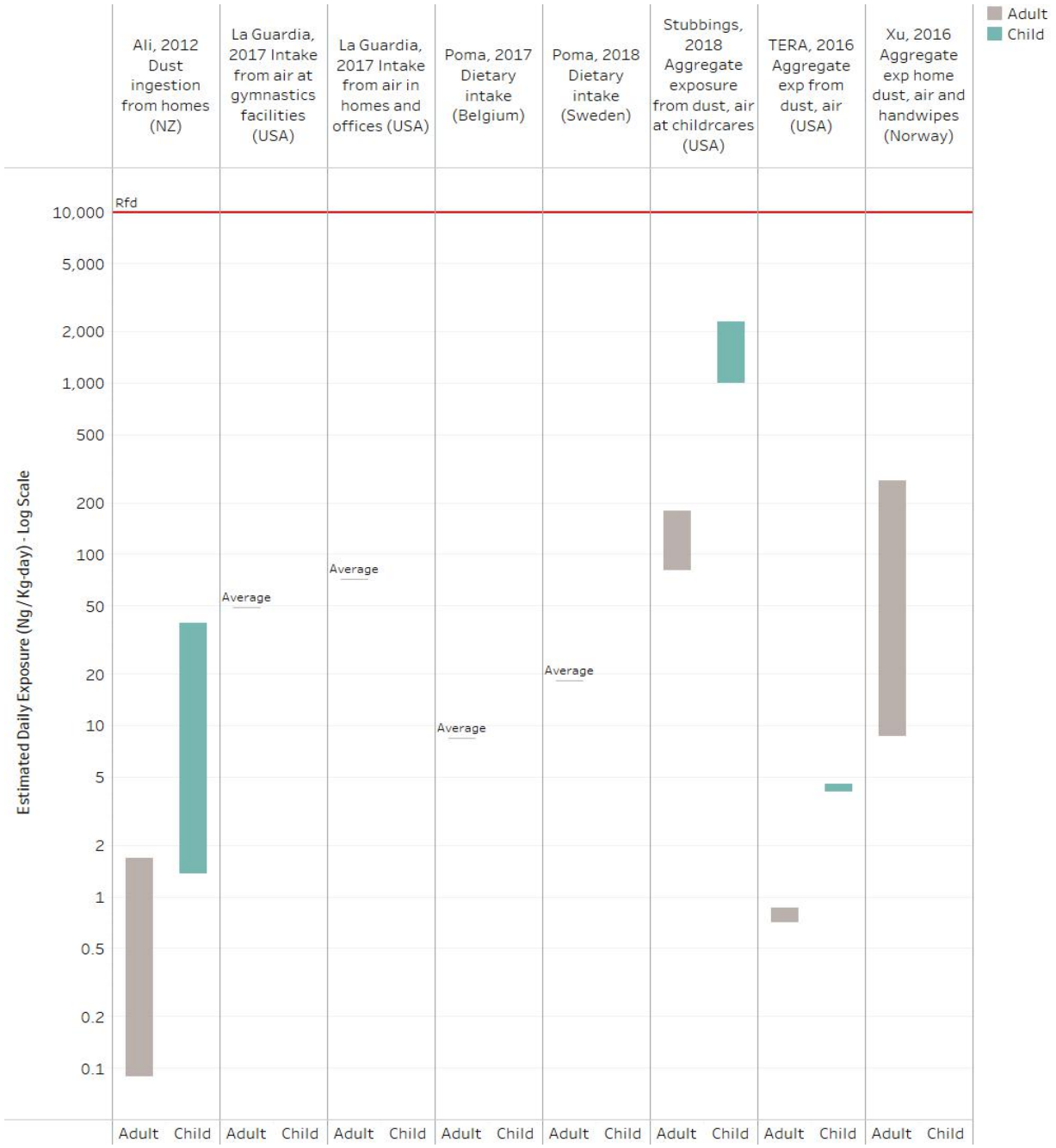
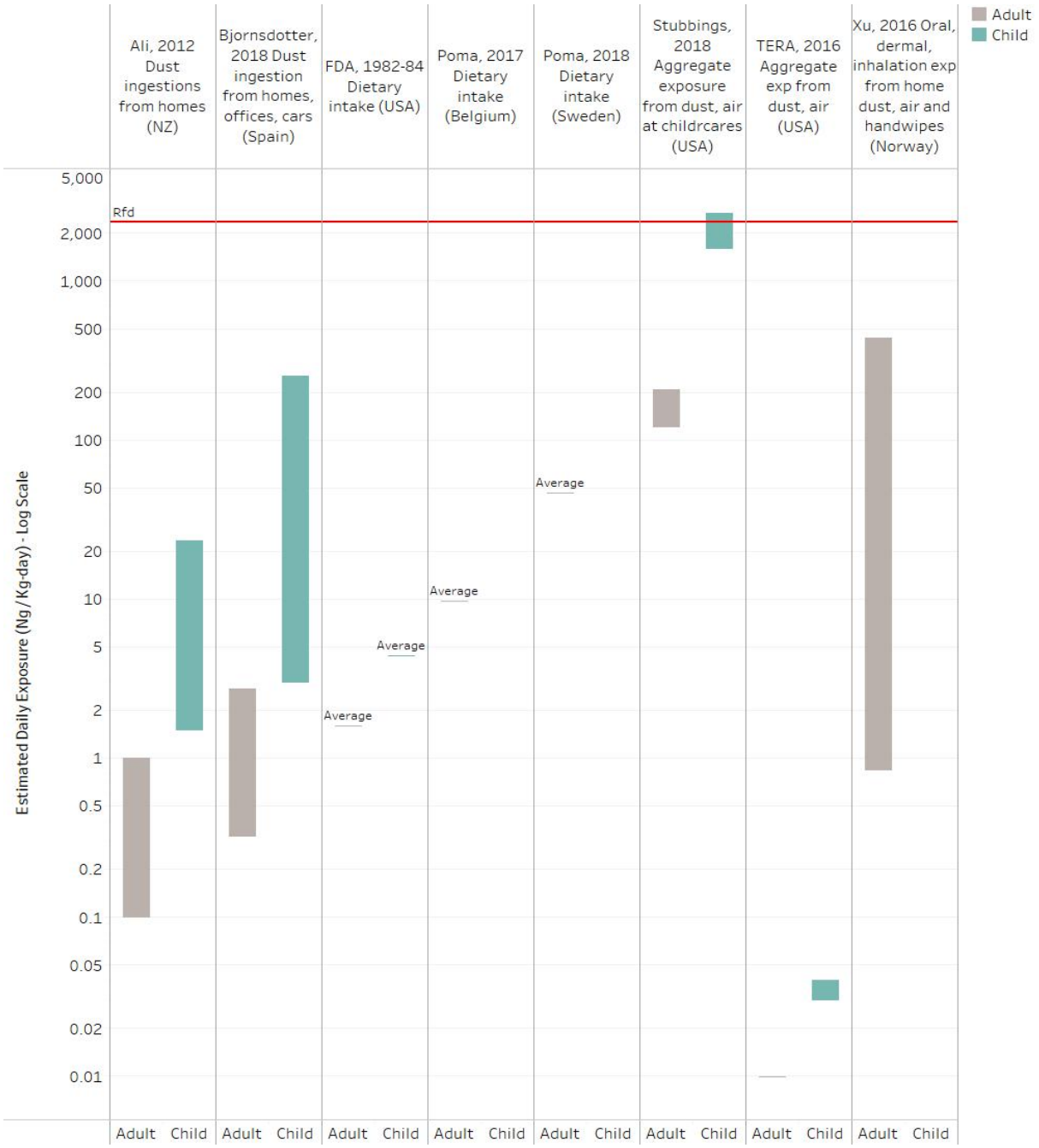
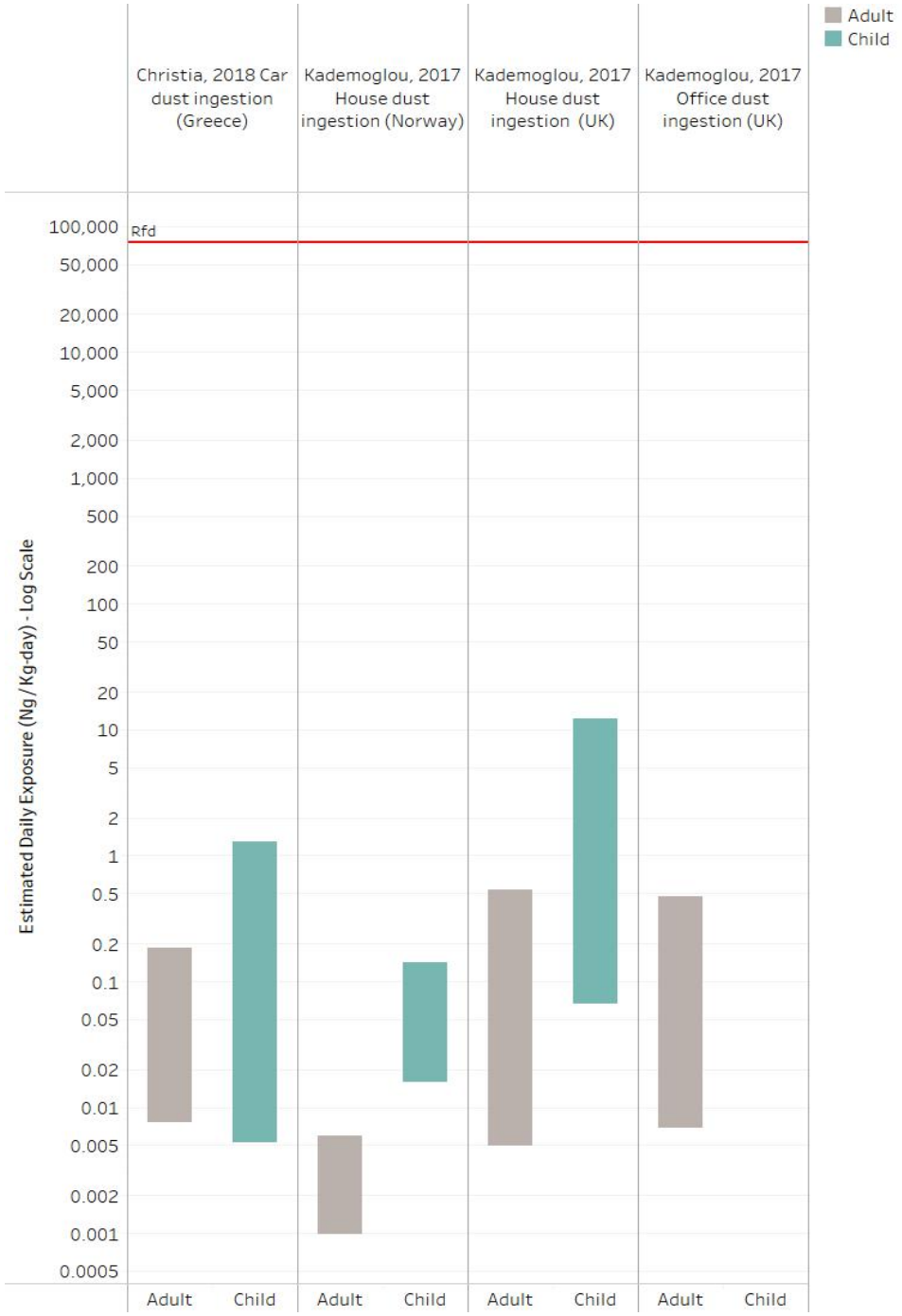
TCPP


Adult
Child
Ali, 2012 Dust ingestion from homes (NZ)
La Guardia, 2017 Intake from air at gymnastics facilities (USA)
La Guardia, 2017 Intake from air in homes and offices (USA)
Poma, 2017 Dietary intake (Belgium)
Poma, 2018 Dietary intake (Sweden)
Stubbings, 2018 Aggregate exposure from dust, air at childrcares (USA)
TERA, 2016 Aggregate exp from dust, air (USA)
Xu, 2016 Aggregate exp home dust, air and handwipes (Norway)
Rfd
10,000
5,000
2,000
1,000
500
200
100
50
20
10
5
2
1
0.5
0.2
0.1
Average
Estimated Daily Exposure (Ng/Kg-day) - Log Scale
Adult
Child

TPHP


Ali, 2012 Dust ingestions from homes (NZ)
Bjornsdotter, 2018 Dust ingestion from homes, offices, cars (Spain)
FDA, 1982-84 Dietary intake (USA)
Poma, 2017 Dietary intake (Belgium)
Poma, 2018 Dietary intake (Sweden)
Stubbings, 2018 Aggregate exposure from dust, air at childrcares (USA)
TERA, 2016 Aggregate exp from dust, air (USA)
Xu, 2016 Oral, dermal, inhalation exp from home dust, air and handwipes (Norway)
Adult
Child
Estimated Daily Exposure (Ng / Kg-day) - Log Scale
5,000
2,000
1,000
500
200
100
50
20
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
Rfd
Average
Adult
Child

V6



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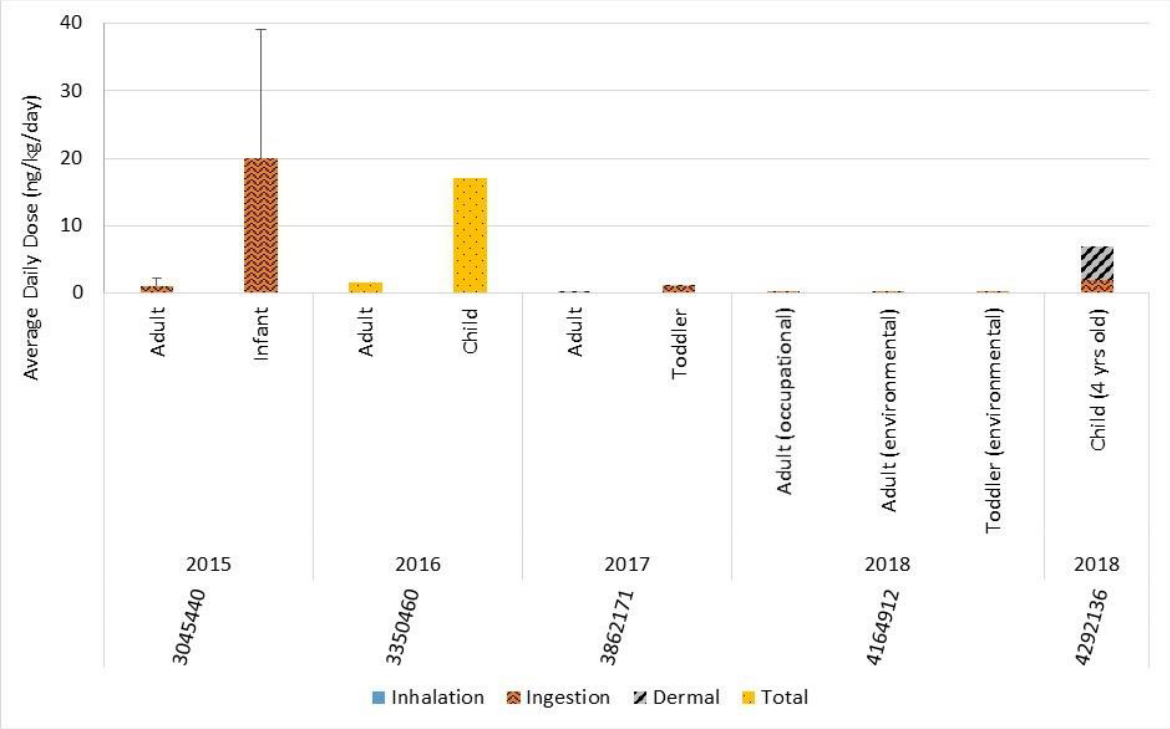
EPA, 2018 TSCA exposure estimates for IPTPP (based on TPHP)

DNEL – 40,000 ng/kg-day



Estimated average daily dose (ng/kg/day)

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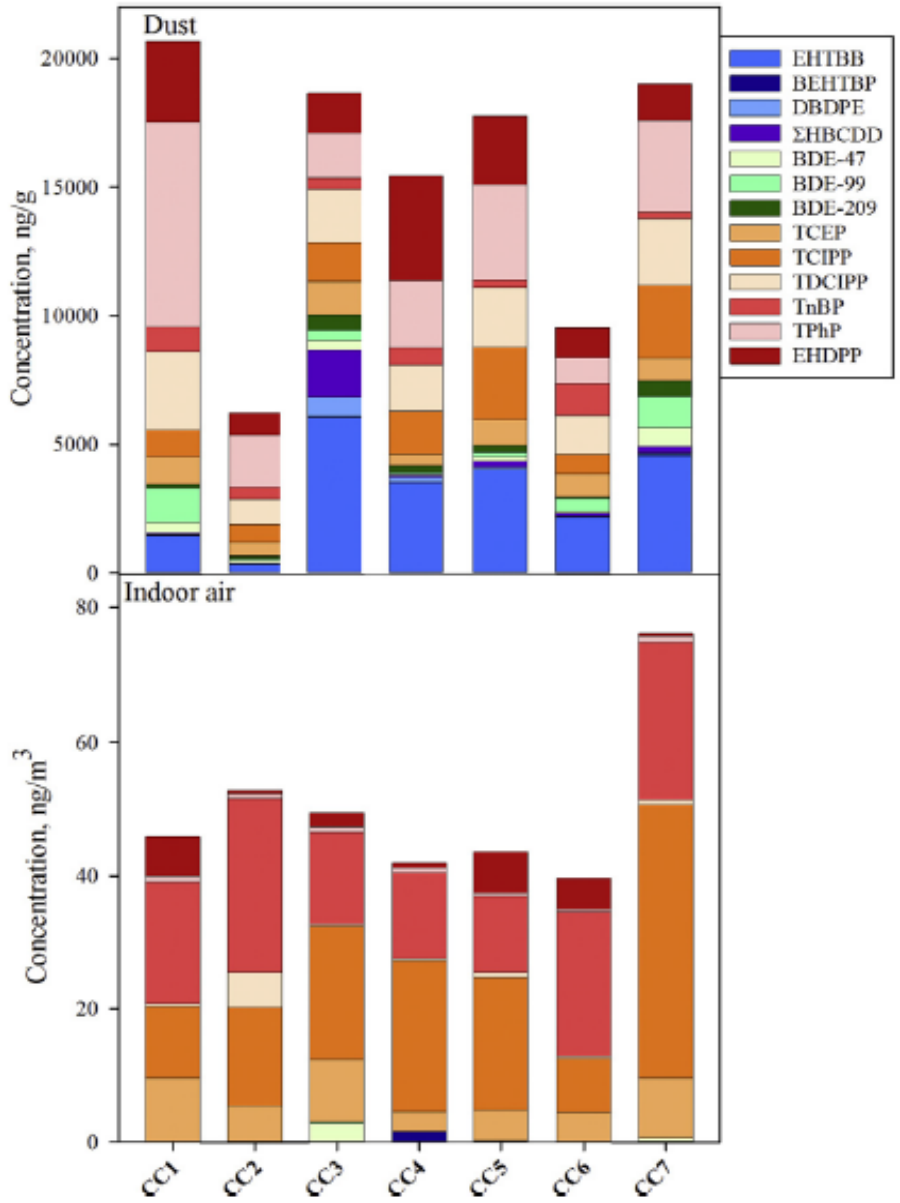

Fig. 1. Selected OPE and BFR median dust (ng/g) and indoor air (ng/m^3) concentrations in childcare centres (CC).

Cumulative Exposure

Stubbings et al., 2018
Environ Pollut 238:1056-1068

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Besis et al 2017 Environ Pollut 230:871-881

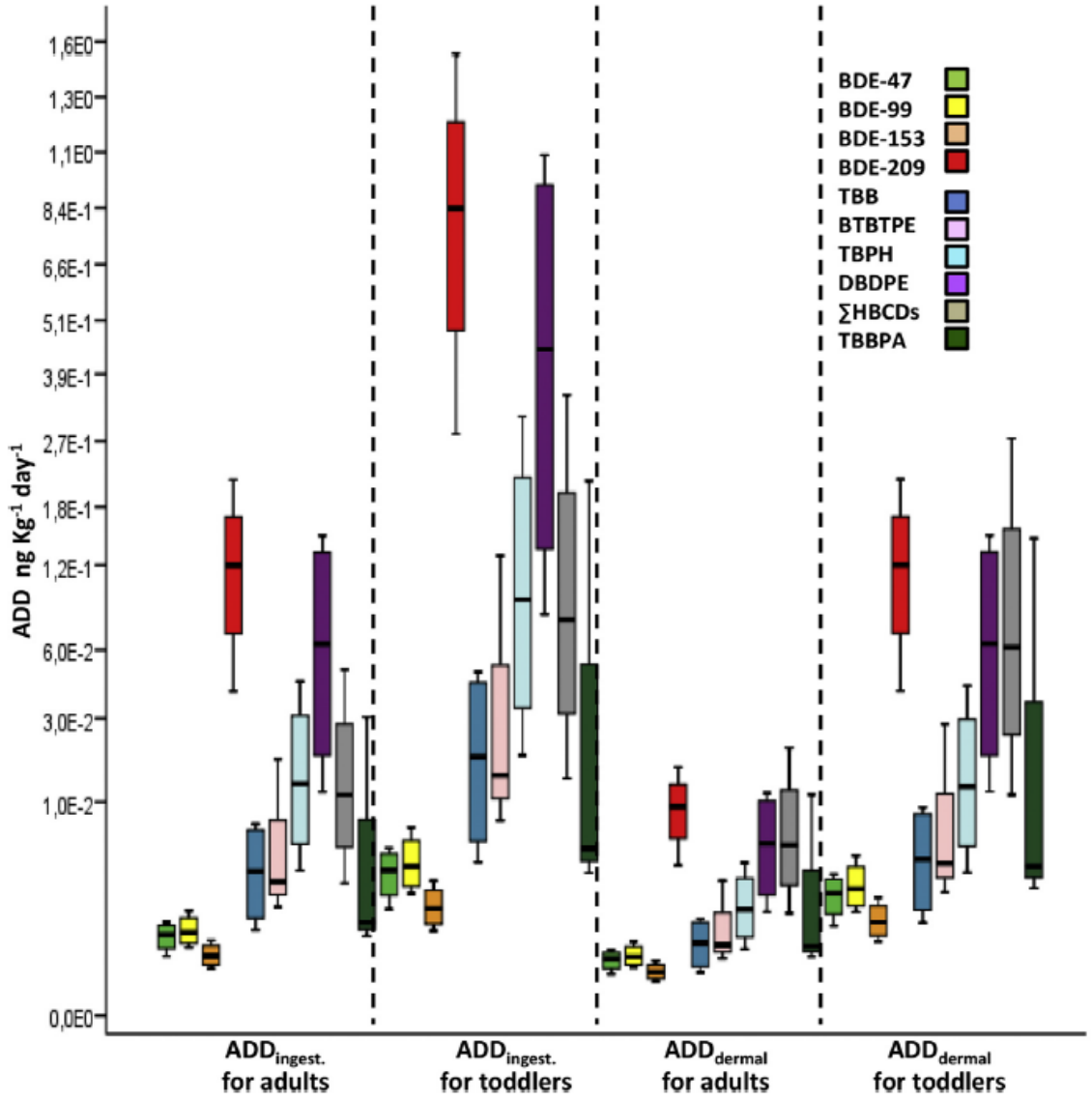

Fig. 5. Average daily amounts of exposure (ng kg^{-1} day^{-1}) to BDE-47, -99, -153 -209, ea84eb2a2d33a1c0461a319b528270cf ($ADD_{ingest.}$) and dermal contact (ADD_{dermal}) for adults and toddlers (box: 25–75%; (–) mean; (⊺⊺) min-max).

Daily intake still includes historic FRs that have been phased out of use

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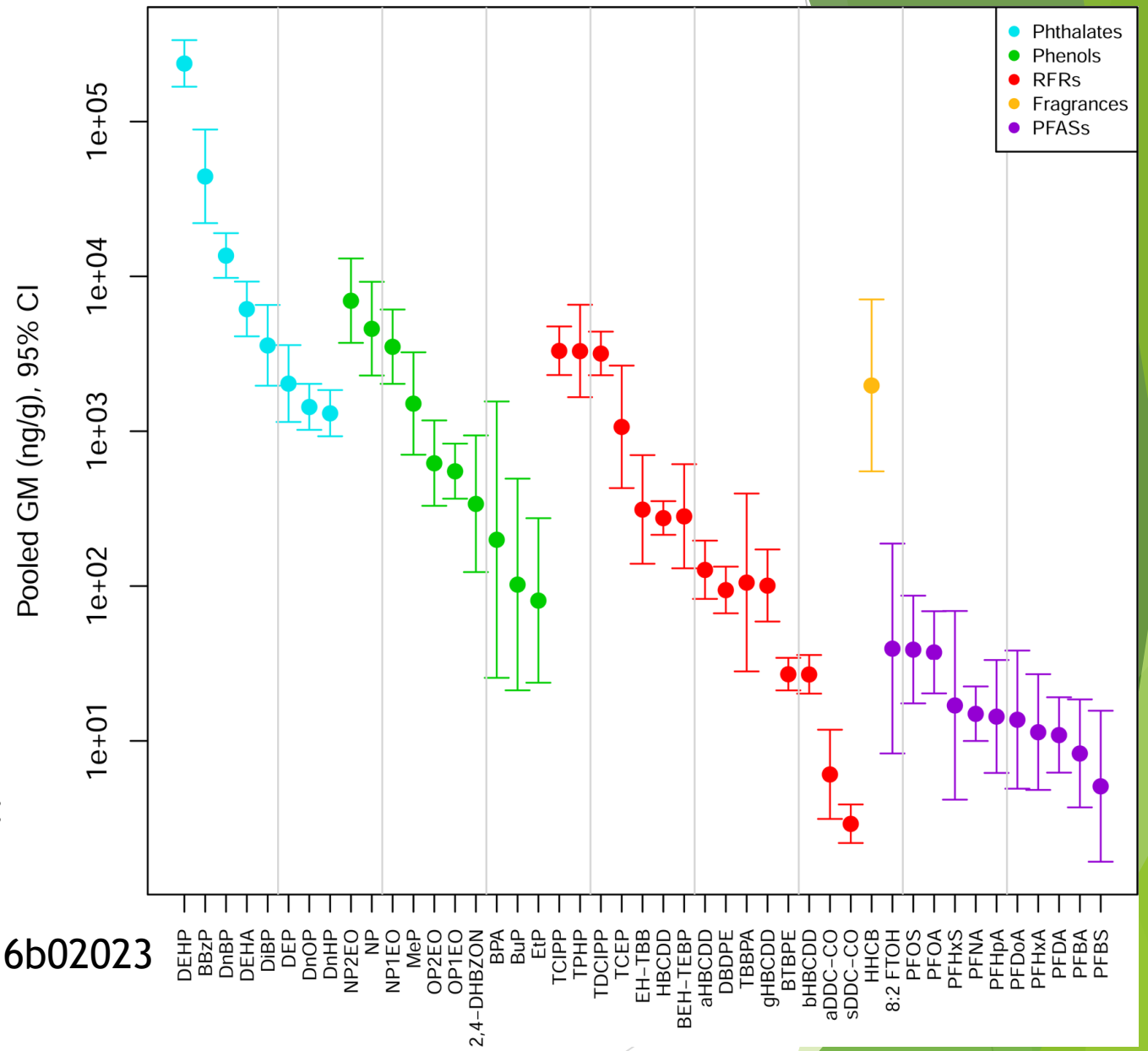
Flame retardants in US House Dust



Mitro, SD et al. 2016
Consumer Product Chemicals in Indoor Dust:
A Quantitative Meta-analysis
of U.S. Studies.
Environ. Sci. Technol. DOI: 10.1021/acs.est.6b02023

Findings from the literature

- Additive flame retardants are escaping products and are widespread pollutants in surface water, certain foods, indoor and outdoor air, indoor dust.
- Human exposure is also widespread. Estimated and measured levels are typically highest in toddlers.
- Most human exposure estimates in the published literature did not exceed available screening values.
- Limited toxicological data lowers confidence in the preliminary health screening values available. Comprehensive aggregate exposure estimates were not available.
- A wide array of flame retardants are found in house dust, indoor air and biomonitoring studies. Many have similar structures and are likely to overlap in their biological activities.
- The impact of cumulative exposure has not been assessed but likely to be important.

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Questions?

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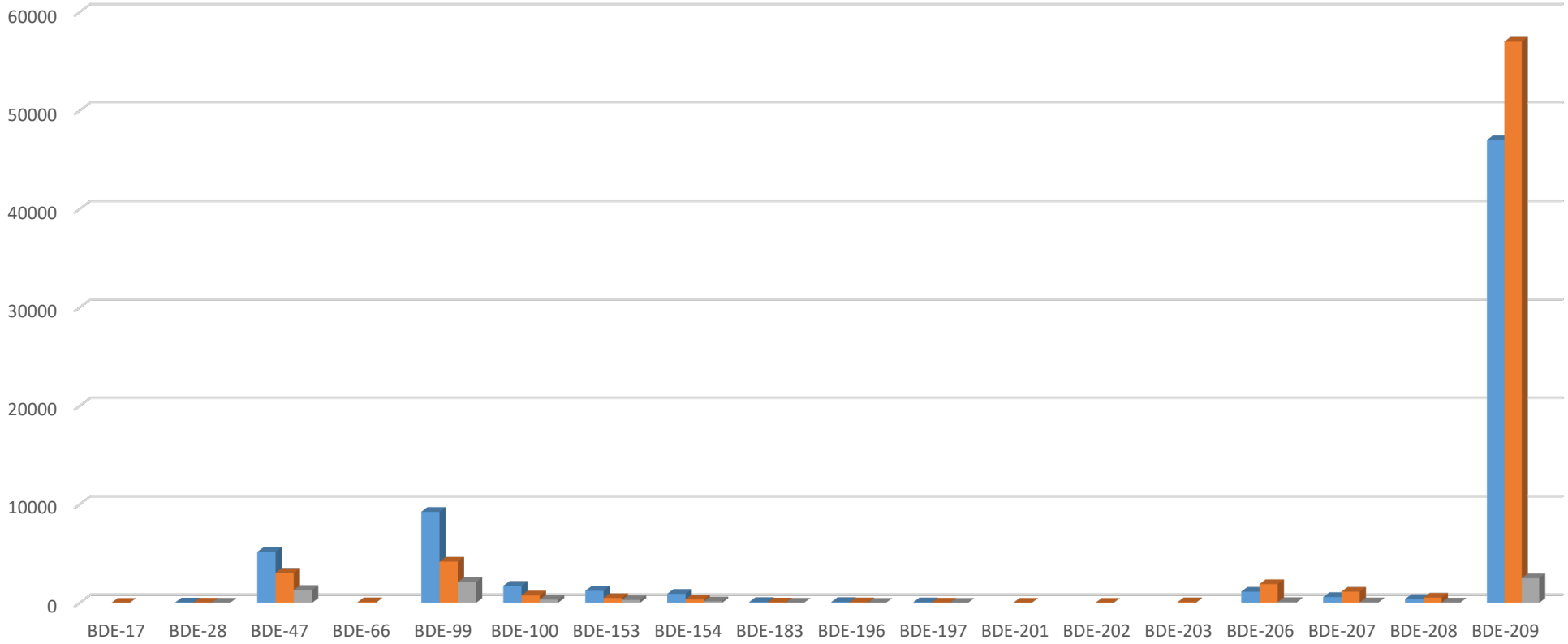
References – Exposure Estimates

- Ali et al. 2012. Chemosphere 88: 1276–1282
- Björnsdotter et al. 2018. Environment International 112: 59–67
- Cechová et al. 2017. Environment International 108: 137–145
- Christia et al. 2018. Chemosphere 196: 231-239EPA, 2018
- EPA June 2018. Document EPA-740-R1-8002. Peer review Draft.
- Kademoglou et al. 2017. Environment International 102: 48–56
- La Guardia et al. 2017. Int. J. Environ. Res. Public Health 14: 507
- Poma et al. 2017. Food and Chemical Toxicology 100:1-7
- Poma et al. 2018. Environ. Sci. Technol. 52: 2331−2338
- Stubbings et al. 2018. Environmental Pollution 238: 1056-1068
- Tay et al. 2017. Environ. Sci. Technol. 51: 8176−8184
- Tao et al. 2017. Environment International 105: 95–104
- TERA 2016 report for CPSC “Flame Retardant Exposure Assessment” September 28, 2016
- Xu et al. 2016. Environ. Sci. Technol. 50: 7752−7760

PBDEs in Fire Station Dust

Median dust levels (ng/g)



Source: Sten et al (2018) Environ Int 112:41-48

- Fire Station Dust Study, 26 stations in 5 U.S. states, collected 2015,
- Fire station dust in FOX study, 20 stations in Southern CA, collected 2010-11
- California residential dust study, n=203 collected 2010 (Whitehead et al. 2013)