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WHAT ARE THE BEST METRICS OF INDOOR HUMAN EXPOSURE TO SVOCs?

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HOW BEST TO MONITOR EXPOSURE VIA CONTACT WITH INDOOR AIR

- **Monitoring indoor air for SVOCs can occur by a variety of methods:**
- ***Personal* (to date only active, but could be passive)**
- ***Fixed point active* (high volume or low volume)**
- ***Fixed point passive***

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PERSONAL MONITORING

ADVANTAGE

- Provides most accurate measure of exposure

DISADVANTAGES

- Intrusive
- Only reflects comparatively short-term exposure
- Comparatively expensive
- Likely samples less air, so detection limits higher, and
- Unless participants only wear it indoors, then doesn't distinguish outdoor from indoor exposure

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ACTIVE VS PASSIVE FIXED POINT MONITORING

Sampling Method	Advantage	Disadvantage
Active (high and low volume)	Air sampling rates well-defined, hence enhanced accuracy	Higher sampling rates (~0.2-1 m^3 min^{-1}) can mean volume of room exceeded, hence underestimation of concentrations (high volume only)
	Higher sampling rates result in lower detection limits (high volume only)	Noisy, obtrusive (less so for low volume), and require power supply, hence less versatile with respect to microenvironments in which they can be deployed (e.g. cars)
	Higher sampling rates facilitate study of short-term source-related concentration variations (high volume only)	Expensive (especially high volume)
Passive	Inexpensive	Air sampling rates less well-defined, hence less accurate
	Quiet, comparatively inobtrusive, and do not require power supply, hence can be deployed in nearly all microenvironments	Air sampling rates derived from a non-trivial calibration experiment
	Supply time weighted average concentrations that are suited ideally to monitoring chronic exposure	

DOES IT MATTER IN WHICH ROOM & WHERE IN THE ROOM WE SAMPLE?

- In other words, *Within-building* and *Within-room* spatial variation
- To my knowledge, nothing known about the latter, but
- Within-building variation can be substantial
- PCB concentrations shown to be significantly higher (over 9 monthly samples) in one room c.f. another in same house and likewise PBDEs significantly different between 2 offices in same building
- Variation between PCBs & PBDEs in single samples taken simultaneously from 4 different offices in same building shown on next slide

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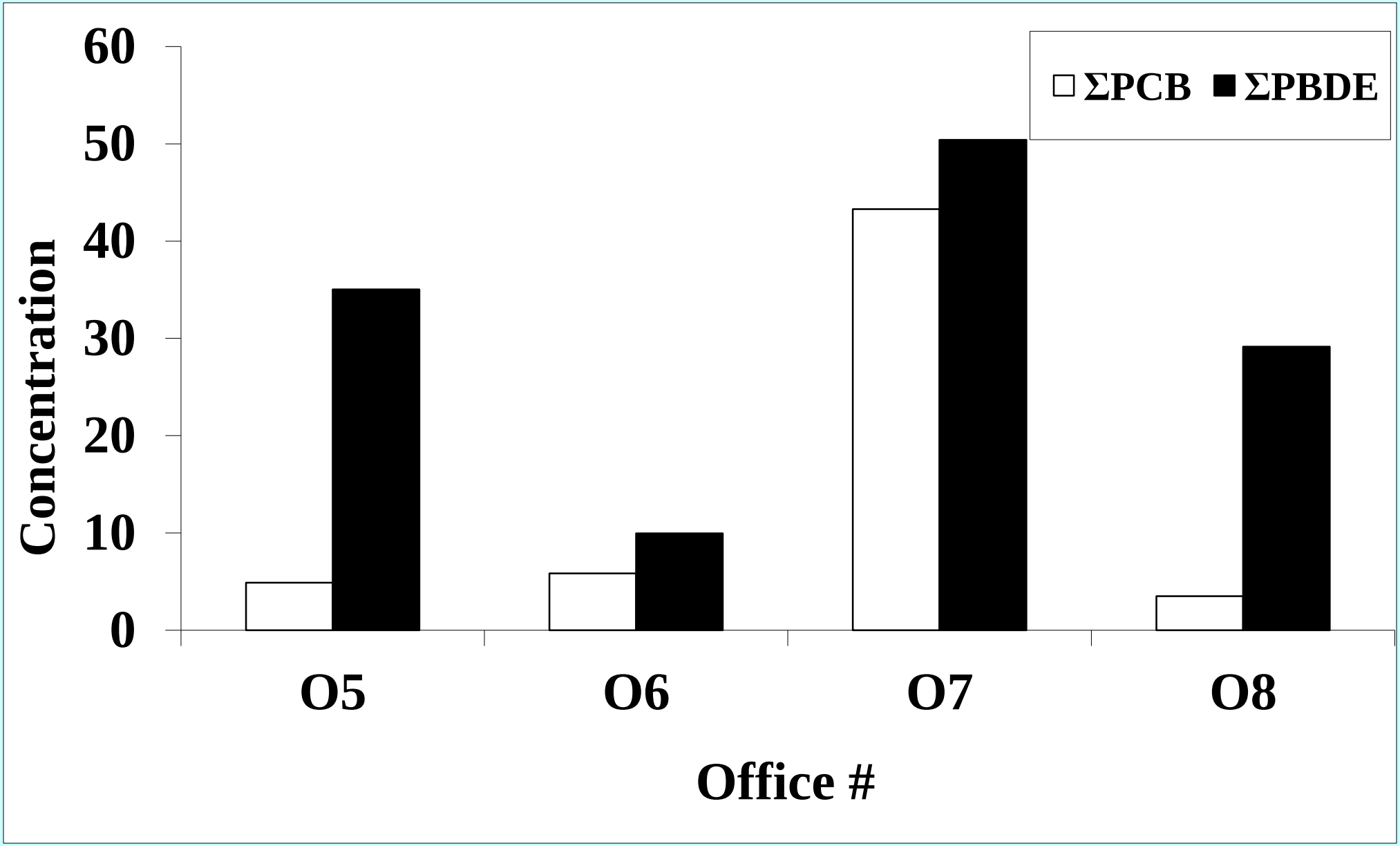
WITHIN-BUILDING VARIATION



DOES IT MATTER WHEN WE SAMPLE?

- In other words, *temporal/seasonal* variation
- For seasonal variation answer is a tentative yes
- However, while summer/spring concentrations>autumn/winter, seasonal variation less strong (not always significant) than for outdoor air
- Indoor air temperatures vary less seasonally than those outdoors. Furthermore, any temperature-induced increases in PCB and PBDE concentrations in indoor environments may be offset by increased ventilation in summer
- Temporal variation due to source changes can be large (next slide)

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WITHIN-ROOM TEMPORAL VARIATION

HOW BEST TO MONITOR EXPOSURE VIA CONTACT WITH INDOOR DUST

- Monitoring indoor dust for SVOCs can occur by a variety of methods:
- *Vacuum cleaner contents* (provided by home-owner)
- *Researcher-collected*
  - Whole room
  - Part room
  - Floor
  - Elevated surfaces
- PBDEs measured in vacuum cleaner bag dust not well correlated with researcher collected dust in a US study of 20 homes – underscores importance of sampling method without providing insight into which is best

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VACUUM CLEANER CONTENTS

Advantages

- Possibly less intrusive
- Gives an excellent time and area weighted average of contamination
- Less expensive

Disadvantages

- Doesn't account for influence of within-building variability. If substantial, then vacuum cleaner bag contents won't reflect exposure if there is substantial discrepancy between proportion of time an occupant spends in different rooms and proportion of time that the cleaner was used in those rooms.
- Susceptible to problems with post-sampling contamination (vacuum cleaner components may contain target SVOCs), and/or loss due to volatilisation and/or degradation);
- Vacuum cleaner may have been used outside the home;
- Differences in "sampling rates" between vacuum cleaners, and sampling periods represented by each sample

hamper true comparison across samples

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RESEARCHER-COLLECTED

Advantages

- Ensures standardisation of sample collection
- Minimises sample contamination/loss issues by use of pre-extracted sample receptacles (e.g. soxhlet thimbles/"socks"/filters placed within the "sampling train" (furniture attachment), that are replaced before taking each sample

Disadvantages

- Possibly more intrusive
- More expensive (sampling team time)

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WHOLE-ROOM VERSUS PART-ROOM

WHOLE-ROOM

- Ensures nothing missed, but oversample less-frequented parts of a room

PART-ROOM

- Misses some dust, but can (not necessarily) focus on most-frequented parts of room
- There are no data comparing contamination present in "whole-room" as opposed to "specific-area" dust samples
- Won't matter if there are no within-room spatial variations in contamination, but there are

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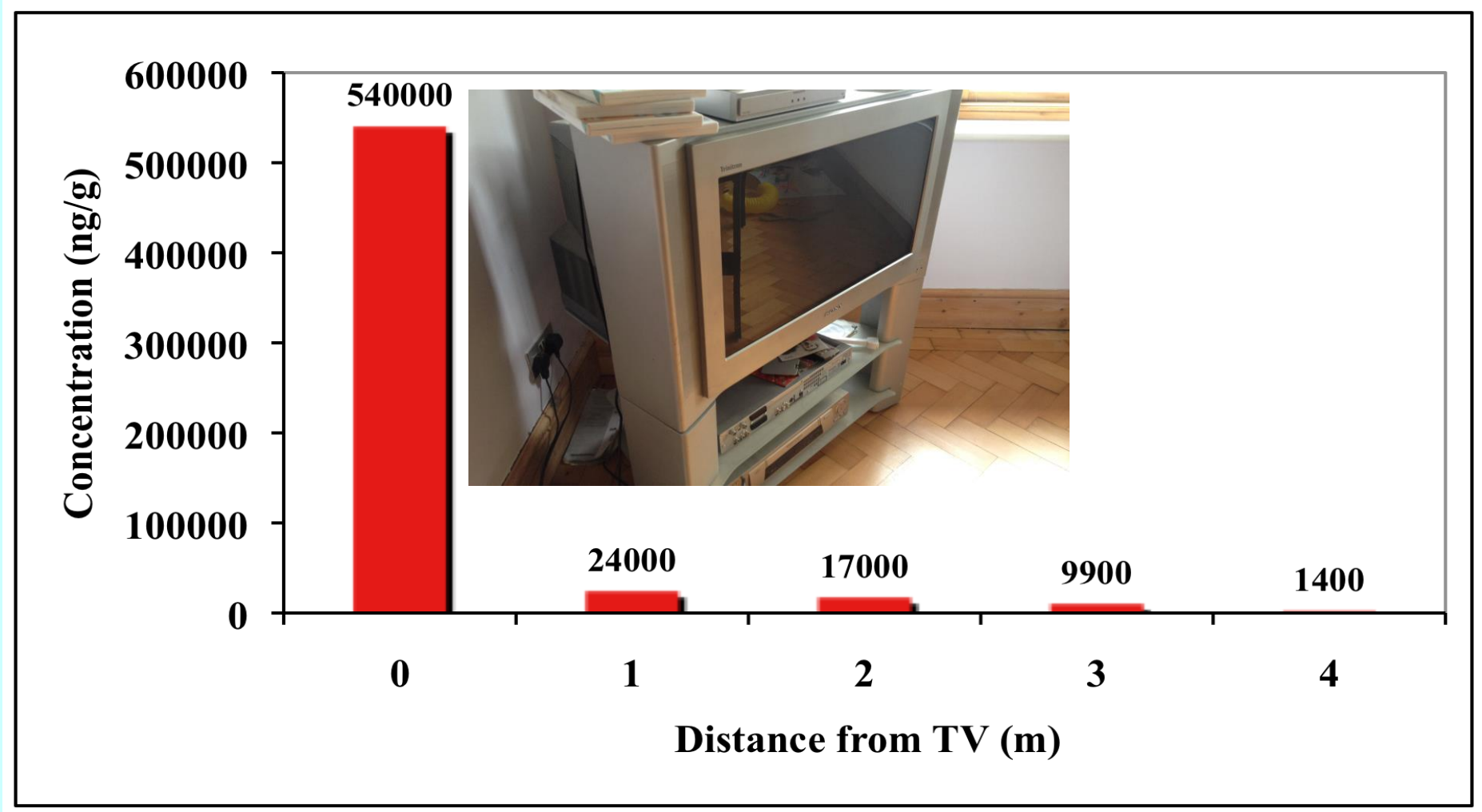
WITHIN-ROOM SPATIAL VARIATION



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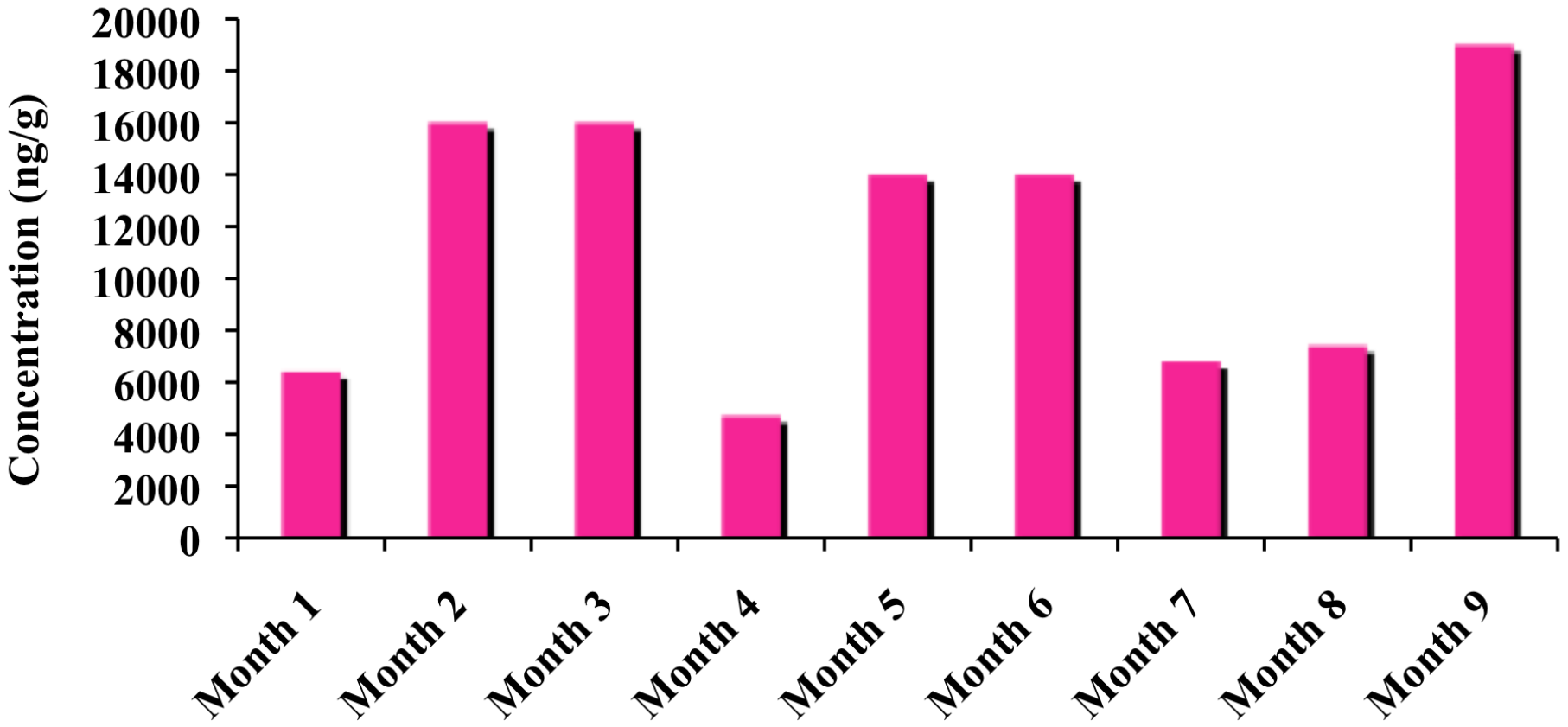
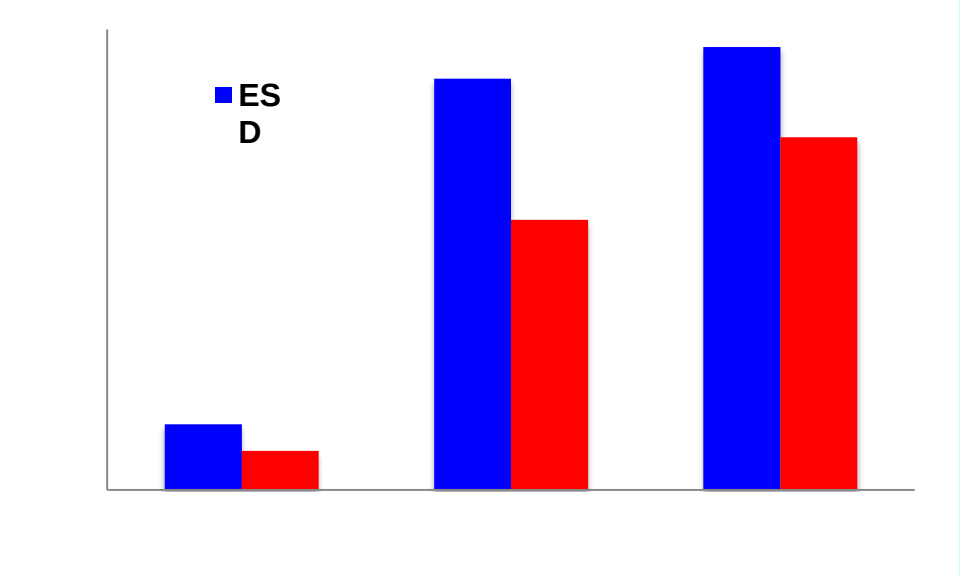
WHEN AND HOW OFTEN SHOULD WE SAMPLE?

- How representative is a single sample taken at a single point in time? *Within-room temporal variation*



FLOOR OR ELEVATED SURFACE DUST?

- Floor dust more relevant for crawling children, elevated surface for older children and adults
- Relevant as concentrations differ between the two



- This may be compounded by the greater proportion of finer particles in elevated surface dust (more adherence to hands particle adherence drops off when particles>250 µm) – significantly higher proportions of particles <125 µm in ESD

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WHAT PARTICLE SIZE?

- Will not matter if there are no particle-size variations in SVOC concentrations
- Evidence for outdoor airborne particles and limited data for settled indoor dust suggests there are (smaller particles = higher concentrations)
- Hence, we need to focus on particle sizes that will adhere to skin (important both for ingestion and dermal uptake)

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SO…WHAT'S THE BEST DUST SAMPLING METHOD?

- Depends…
- It appears more important that the sampling method deployed is "fit-for-purpose" with respect to the specific aims of the study, and that as much detail as possible should be provided when reporting study results
- To assess which method is most relevant for human exposure (i.e. most "biologically-relevant") need to examine existence and strength of correlation between external exposure metric and internal biomarker for a human cohort

OTHER IMPORTANT CONSIDERATIONS

- ***Contact rates/exposure factors*** **– especially for dust ingestion**
- ***Bioaccessibility/bioavailability of SVOC*** **(compound- and particle-size variations) – indications from both *in vitro* gut and dermal bioaccessibility tests suggest uptake <100% and that it decreases with increasing molecular weight**
- **Not yet fully clear what the influence of SVOC concentrations, particle size and organic carbon content is on bioaccessibility/bioavailability**
- **Indoor degradation – we've observed photolytic dehydrobromination of HBCDD in indoor dust**

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QUESTIONS?

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