

Introduction

- Organophosphate Flame Retardants (OPFRs) are used as **additives** in many commercial and industrial products, such as furniture and electronics, to meet fire resistance standards.⁽¹⁾
- **Issues:** Neurotoxic, carcinogenic, bioaccumulative, acutely toxic to some organisms, and persistent.^(2,3)
- Still **widely used** – assessing exposure is important.

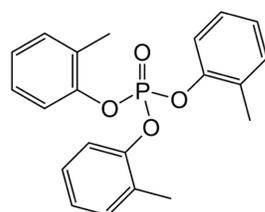


Figure 1: The structure of tricresyl phosphate (TCP) – one of the OPFRs examined in this study.

- OPFRs can **volatilize** off of surfaces to enter the air.⁽⁴⁾
- **Passive sampling** can be used to assess exposure to OPFRs through **silicone wristbands** – OPFRs partition between air and the wristband to reflect equilibrium exposure levels.
- Higher concentrations have been linked to electronics use in previous research.⁽⁴⁾

Figure 2: The silicone wristbands used in this study.



Hypothesis

- If electronics are a significant source of OPFRs, individuals who spend more time using electronics should show **higher exposure to OPFRs**.

Methods

- Wristbands were **conditioned** in an oven at 300°C to remove surface impurities, allowing for cleaner analysis.⁽⁵⁾
- Wristbands were **given to participants** to wear for seven days.
- Information about time spent in different **locations** (home, work, school), time spent on **electronics**, and characteristics of **different environments** (number of electronics, number of furniture items) were acquired via survey.
- The wristbands were spiked with an **internal standard** and then extracted using **ethyl acetate** in a wrist-action shaker.⁽⁶⁾
- Extracts were reduced in a **nitrogen evaporator** to concentrate the compounds.⁽⁷⁾
- Wristband extracts were analyzed using a **selective ion GC-MS method (SIM)**.

Results

Concentrations of OPFRs on Individual Wristbands

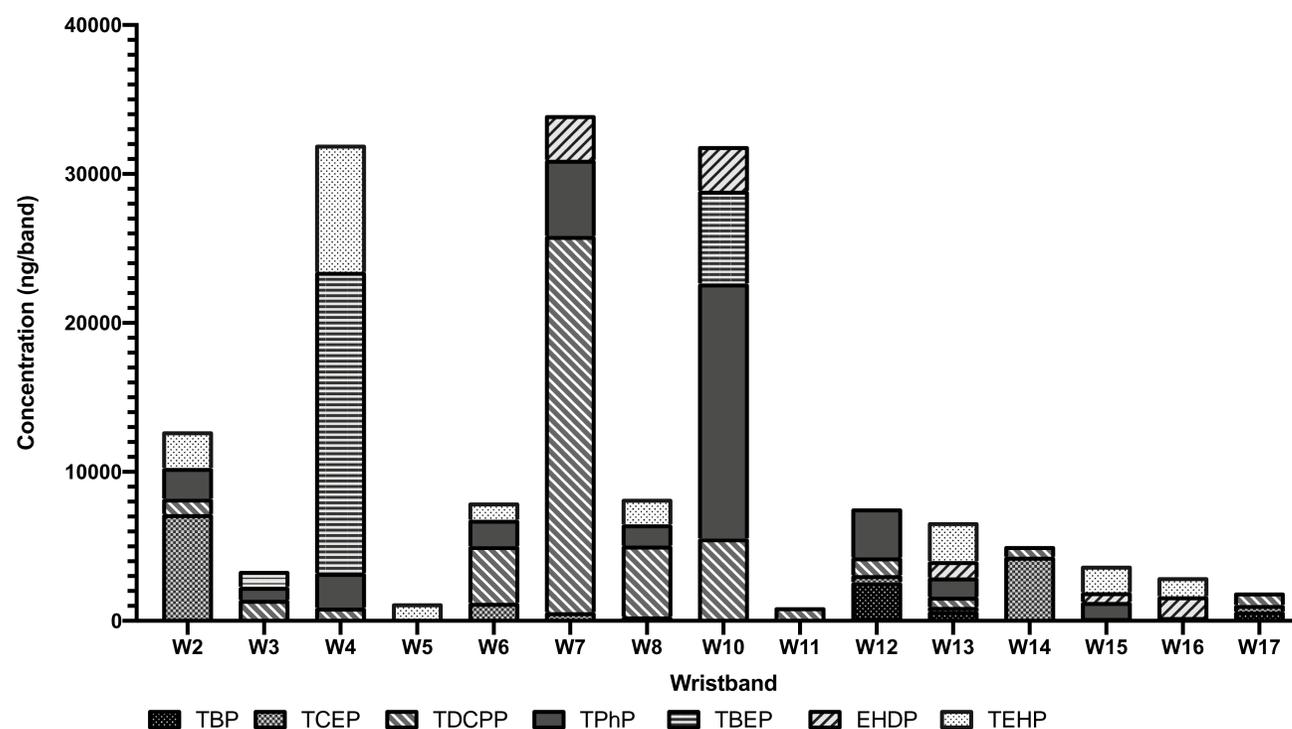


Figure 3: An overview of the concentrations of OPFRs found on each of the participant wristbands. Exposure to OPFRs (ng/day) was proportionate to the concentrations observed.

Average Concentrations of OPFRS in Silicone Wristbands

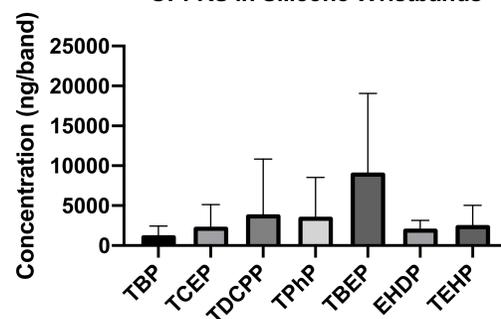


Figure 5: The average concentrations of each OPFR observed on all participant wristbands.

Average OPFRs as a function of Hours spent on Electronics

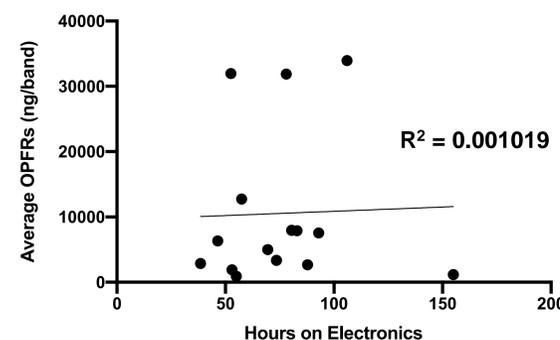


Figure 6: The average concentrations of OPFRs on wristbands as a function of hours participants spent on electronics.

- Three wristbands (W4, W7, and W10) contained very high levels of OPFRs, while two (W5 and W11) contained very low levels.
- The average concentration of OPFRs on all participant wristbands was 10546 ng/band, and the median was 6328 ng/band.
- **High variability** in concentration and types of OPFRs was observed between wristbands, and profile of OPFRs detected also varied significantly between participants.
- Exposure levels of OPFRs were proportionate to the concentrations observed. The average exposure was 1521 ng/day, and the median was 945 ng/day.
- **No correlation** was observed between concentration of OPFRs and hours of electronics use. ($R^2 = 0.001019$)

Discussion

- High variability in OPFR concentration and detection on each wristband is likely due to differences in daily routine and activities of the participants.
- **No correlation was observed** between electronics use and OPFR concentrations - likely due to the broad scope of the study and the variety of sources of OPFRs.
- Further analysis must be done to determine the source of the high OPFR levels in W4, W7, and W10, as well as any other potential correlations between participant activities and OPFR exposure.
- Low levels on W5 and W11 was due to poor response of one of the internal standards on these wristbands, and therefore limited ability to quantify certain OPFRs

Conclusions

- Silicone wristbands were used as personal passive samplers to address individual exposure to OPFRs over time.
- OPFRs were found on all participant wristbands, and concentrations varied significantly between participants.
- Like concentrations, exposure levels (ng/day) were highly variable between participants.

References

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