The Women Workers Biomonitoring Collaborative
PFAS, flame retardants, and biomarkers of effect

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Policy Committee
December 14, 2020
Outline

I. Introduction to the WWBC
II. Study participant characteristics
III. Flame retardants and PFAS chemicals in firefighters and office workers
IV. Exposure associations with biomarkers of effect
V. Q&A
Research questions

- Are women firefighters in San Francisco exposed to toxic chemicals linked to breast cancer?
- Are their levels higher than their non-firefighter counterparts?
- Is there evidence for biological changes associated with exposure?
Data collection: Interview and biospecimen samples
## Study demographics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Firefighters</th>
<th>Office workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of participants</td>
<td>86</td>
<td>84</td>
</tr>
<tr>
<td>Age (years ± SD)</td>
<td>48 (± 4.6)</td>
<td>47 (± 10.5)</td>
</tr>
<tr>
<td>Time with job (years ± SD)</td>
<td>17 (± 9.2)</td>
<td>14 (± 10.1)</td>
</tr>
<tr>
<td>Firefighter position in the fire department</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driver</td>
<td>25%</td>
<td>--</td>
</tr>
<tr>
<td>Firefighter</td>
<td>45%</td>
<td>--</td>
</tr>
<tr>
<td>Officer</td>
<td>30%</td>
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</tbody>
</table>
Environmental chemicals

Perfluoralkyl substances (PFAS)
- Mammary tumors in animal studies
- Hormone disruption (thyroid, sex hormones and growth hormones in children)
- Immune suppression, metabolic effects, decreased kidney function

Flame retardants
- Mammary tumor development in animal and human studies
- Hormone disruption (thyroid)
- Developmental effects

Flame retardants
Flame retardant metabolite levels in WFBC compared to U.S. women (NHANES)
PFAS

PFAS levels in WFBC compared to U.S. women (NHANES)
PFAS

PFAS levels in WFBC compared to U.S. women (NHANES)
Biomarkers of effect

**Thyroid hormones**
- Thyroid stimulating hormone (TSH) and thyroxine (T\(_4\))
- Multiple downstream health effects

**Telomere Length**
- Telomeres are caps on the ends of chromosomes that protect DNA
- Relevance for cancer
Thyroid hormone

Flame retardants:
• Increased BDCPP and DBuP negatively associated with thyroxine in firefighters.
  • No association observed among office workers
• No association with thyroid stimulating hormone for either firefighters or office workers.

PFAS:
• No effects observed between PFAS and Thyroid hormone (T4 or TSH)
Telomere length

Flame Retardants:
• BDCPP was associated with longer telomeres in office workers, but not firefighters.
• BCEP was associated with shorter telomeres in firefighters, but not office workers.

PFAS:
• PFAS associated with longer telomeres
  • Larger effects were seen among firefighters (vs office workers) for PFOA, PFOS, PFDA, and PFNA.
Conclusions

• Exposure to multiple toxic environmental chemicals

• Evidence of biological perturbations through biomarkers of effect

• Exposure prevention measures can be enacted to limit exposure to toxic chemicals while at work
Our WFBC Team

UC Berkeley: Rachel Morello-Frosch, Jessica Trowbridge, Cassidy Clarity
Silent Spring Institute: Ruthann Rudel, Vincent Bessonneau
United Fire Service Women, San Francisco: Heather Buren
SF Firefighter Cancer Prevention Foundation: Tony Stefani
UC San Francisco: Roy Gerona
Commonweal: Sharyle Patton
Breast Cancer Prevention Partners: Sharima Rasanayagam, Connie Engel, Nancy Buermeyer

Contact Us

Women Workers Biomonitoring Collaborative
https://www.biomonitoringcollaborative.org/

Our Funders

California Breast Cancer Research Program #19BB-2900 & #23BB-1700 & 1701 & 1702
San Francisco Firefighter Cancer Prevention Foundation
International Association of Firefighters, Local 798
NIOSH Targeted Research Training Program
Biomonitoring flame retardants: a firefighter’s perspective

Captain Heather Buren, SFFD
SF Policy Committee Meeting – 12/14/2020
Mounting concern in SF firefighters about high rates of premenopausal breast cancer among the women in their ranks.
MY STUDY RESULTS
Results Summary

We found chemicals in every person we tested. Some people may want to make changes to reduce their chemical levels. We hope these results will help you make informed decisions.

Chemicals We Found In You

Your sample had one of the highest levels of a flame retardant in the study.

Learn about actions that could help reduce your exposure

Your sample had a higher level of a PFAS than most others in the study. Your levels of other PFASs were lower or similar to others in the study.

Learn about actions that could help reduce your exposure

All your results: Flame retardants / PFASs

Health Concerns

The Women Firefighters Biomonitoring Collaborative is studying exposures to chemicals in firefighters and office workers to learn more about how women are exposed to chemicals in the workplace. If your level of a chemical is higher than other people’s, you may be able to reduce your level.

Overall Study Results

The WFBC tested for 8 flame retardants. Firefighters had higher levels of flame retardants than office workers. For one chemical, BDCPP, firefighters’ levels were five times higher on average. This chemical is listed as a carcinogen on California’s Proposition 65 program. Read more

Firefighters may be exposed to some chemicals on-the-job. Firefighters who were recently engaged in fire suppression had somewhat higher levels of flame retardants than those who were not. Read more

Flame retardants can interfere with thyroid hormones. Participants who had higher levels of BDCPP tended to have lower levels of thyroid hormone. Thyroid hormones can affect metabolism and brain development. Read more

WFBC also did a broad screen of blood samples for over 700 chemicals to look for exposures to emerging chemicals that have not been measured in many studies before. Read more

We previously provided you with results for per- and polyfluoroalkyl substances (PFASs) in the first report.
Firefighters had higher levels of flame retardant than most women in the United States

We compared the levels of flame retardants in WFBC participants (measured in 2014-2015) with levels reported for a representative sample of U.S. women 18-65 years old (measured in 2013-2014) from the National Health and Nutrition Examination Survey (NHANES) (Figure 2). We show results for three flame retardant metabolites that we found most often in WFBC participants (BDCPP, BECP and DBuP). We found that:

- Firefighters’ median exposure levels for all three chemicals are higher than those reported in NHANES.
- Office workers’ median levels are similar to those reported in NHANES for BDCPP and lower than NHANES for BECP and DBuP.

![Graph showing median and 95th percentile levels of flame retardant metabolites for firefighters and office workers compared to U.S. women aged 18-65 measured in NHANES. Results are presented for BCEP, BDCPP, and DBuP.](image)
Positive Change in the SFFD

- A turnout cleaning system AND turnout washers in most firehouse
- A wet wipes policy
- A gross decontamination on the fireground policy
- Awareness + Education
**Senate Bill 1044**, authored by Sen. Ben Allen (D-Santa Monica), bans the manufacture, sale and use of firefighting foam containing PFAS from use in most applications by January 1, 2022

co-sponsored by BCPP, CAPFF, Clean Water Action, NRDC and EWG
Impact – Rigor, Relevance and Reach

**Rigor: Advance biomonitoring science in new directions**
- First study to examine the range of exposures to potential breast carcinogens and other EDCs among women firefighters compared to female controls
- Measuring biomarkers potentially relevant to breast cancer risk.
- Use of non-targeted biomonitoring techniques in a firefighter population

**Relevance: Potential to extend to other female occupational groups**
- Future recruitment of women from other occupations, such as nursing, nail salon workers, teachers, etc.

**Reach: Disseminate results to diverse audiences**
- Leverage research results to inform policy change
- Report-back to study participants
Taking Action on PFASs & Flame Retardants

Jen Jackson, Toxics Reduction & Healthy Ecosystems Program Manager
85,000 Chemicals in Commerce
How to tackle such a big problem?

**THE SIX CLASSES APPROACH**

1. Highly Fluorinated
2. Antimicrobials
3. Flame Retardants
4. Bisphenols + Phthalates
5. Some Solvents
6. Certain Metals

Graphic courtesy of Green Science Policy Institute, www.sixclasses.org
How to tackle such a big problem?

The Six Classes Approach

1. Highly Fluorinated
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Graphic courtesy of Green Science Policy Institute, www.sixclasses.org
Persistent
Highly Mobile
Local Environmental Impacts
Taking Action
Electronics – EPEAT Certification (FRs)
Citywide Ban on Sales of Furniture with FRs (2018)

NOTICE

THIS ARTICLE MEETS THE FLAMMABILITY REQUIREMENTS OF CALIFORNIA BUREAU OF ELECTRONIC AND APPLIANCE REPAIR, HOME FURNISHINGS AND THERMAL INSULATION TECHNICAL BULLETIN 117-2013. CARE SHOULD BE EXERCISED NEAR OPEN FLAME OR WITH BURNING CIGARETTES.

The upholstery materials in this product:

[ ] contain added flame retardant chemicals
[ ] contain NO added flame retardant chemicals

The State of California has updated the flammability standard and determined that the fire safety requirements for this product can be met without adding flame retardant chemicals. The State has identified many flame retardant chemicals as being known to, or strongly suspected of, adversely impacting human health or development.
City Purchasing – Suggested Specifications

PFAS-Free
Flame Retardant-Free
Antimicrobial-Free
PVC-free (phthalates)
No Heavy Metals
FSC Certified
Low VOC
City Purchasing – Foodware Contract

PFAS-Free
Compostable or Recyclable
New PFAS-Free Certification (2020)
PFAS-Free Compostable or Recyclable
City Purchasing – Carpet Regulation (2018)

PFAS-Free
Flame Retardant-Free
Antimicrobial-Free
PVC-Free
City Purchasing - Firefighting Foam (in progress)

PFAS-Free
Future initiatives?