

Evaluating PFAS Exposure From Fluorinated Waxes Among US Snow Sport Participants

The Science of PFAS: Public Health & The Environment

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The Need for Speed

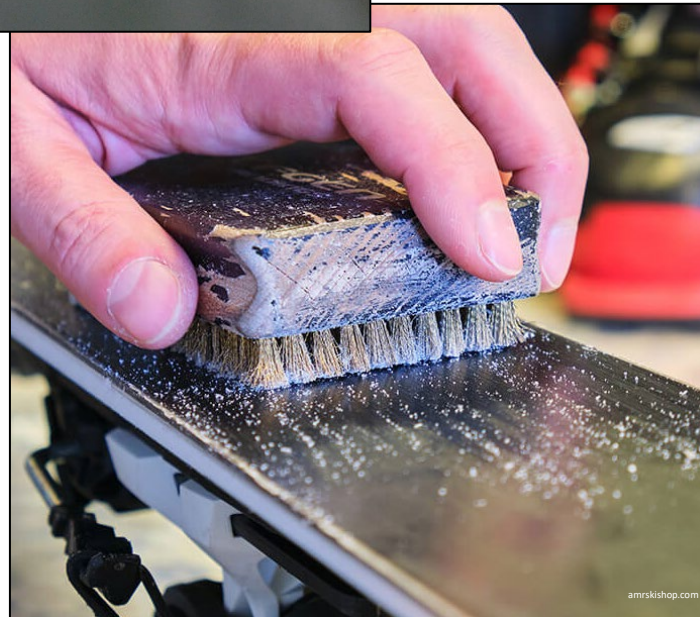


<https://www.si.com/olympics/2019/12/11/mikaela-hiffrin-historic-2019-season-dominance>

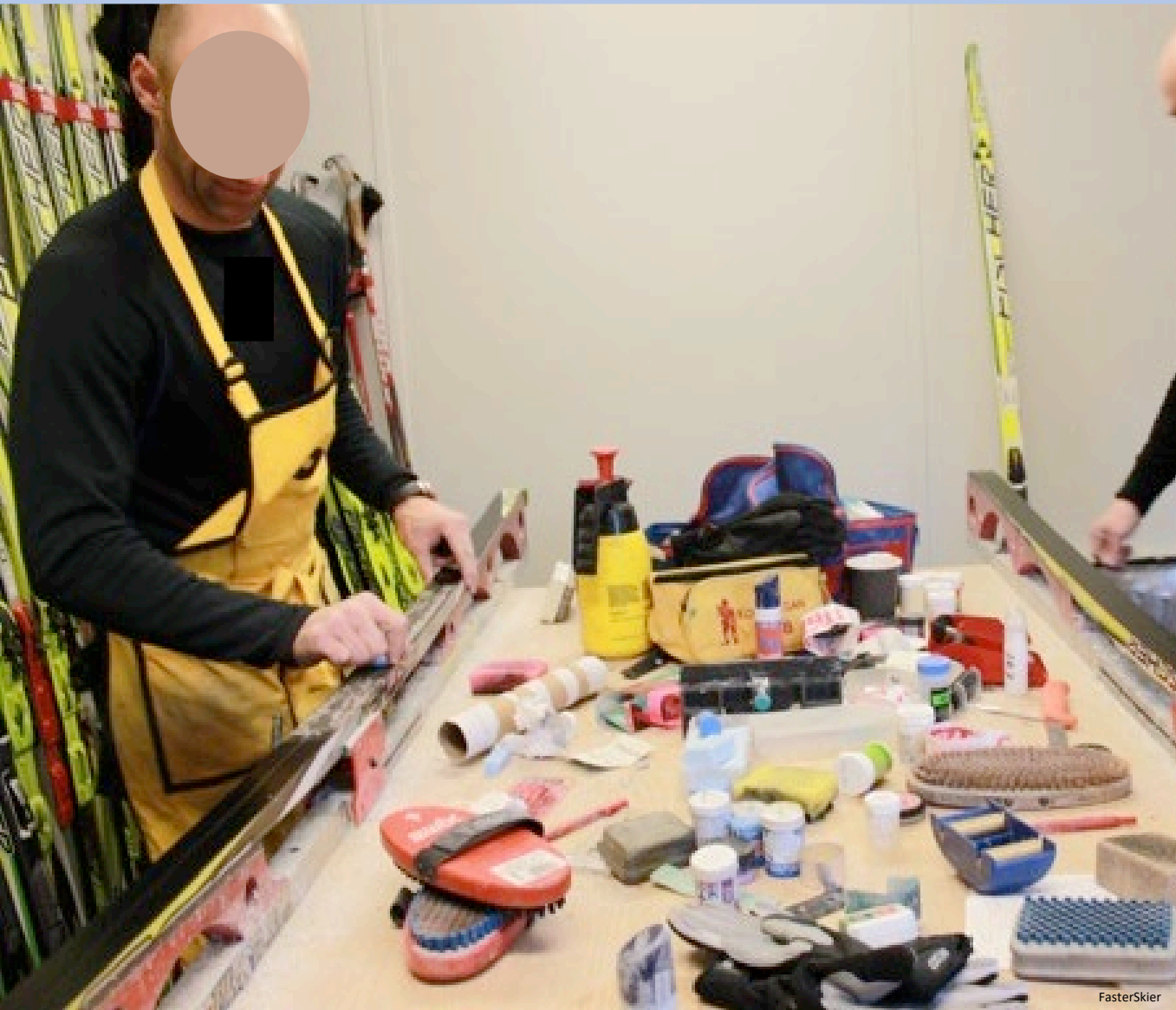


<https://www.outsideonline.com/outdoor-gear/snow-sports-gear/how-buy-cross-country-skis/>

Ski & Snowboard Waxing

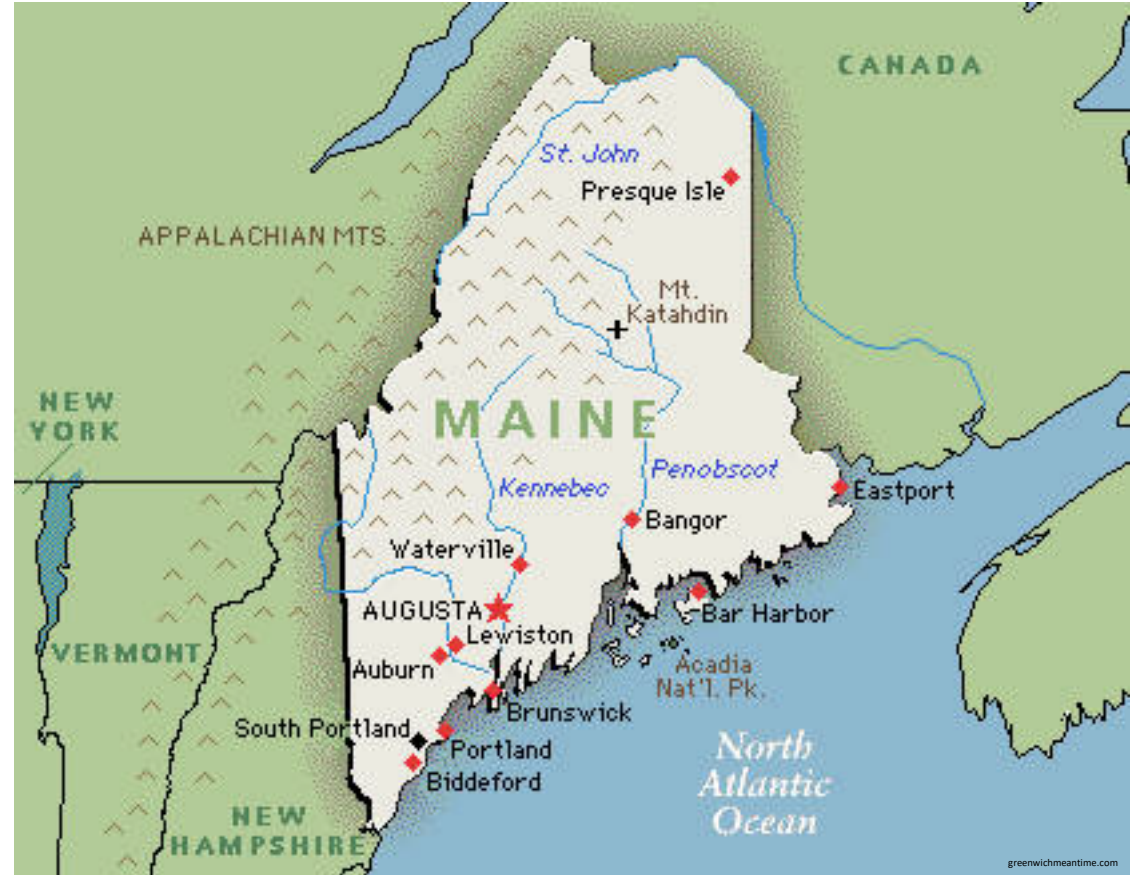


Inside A Waxroom



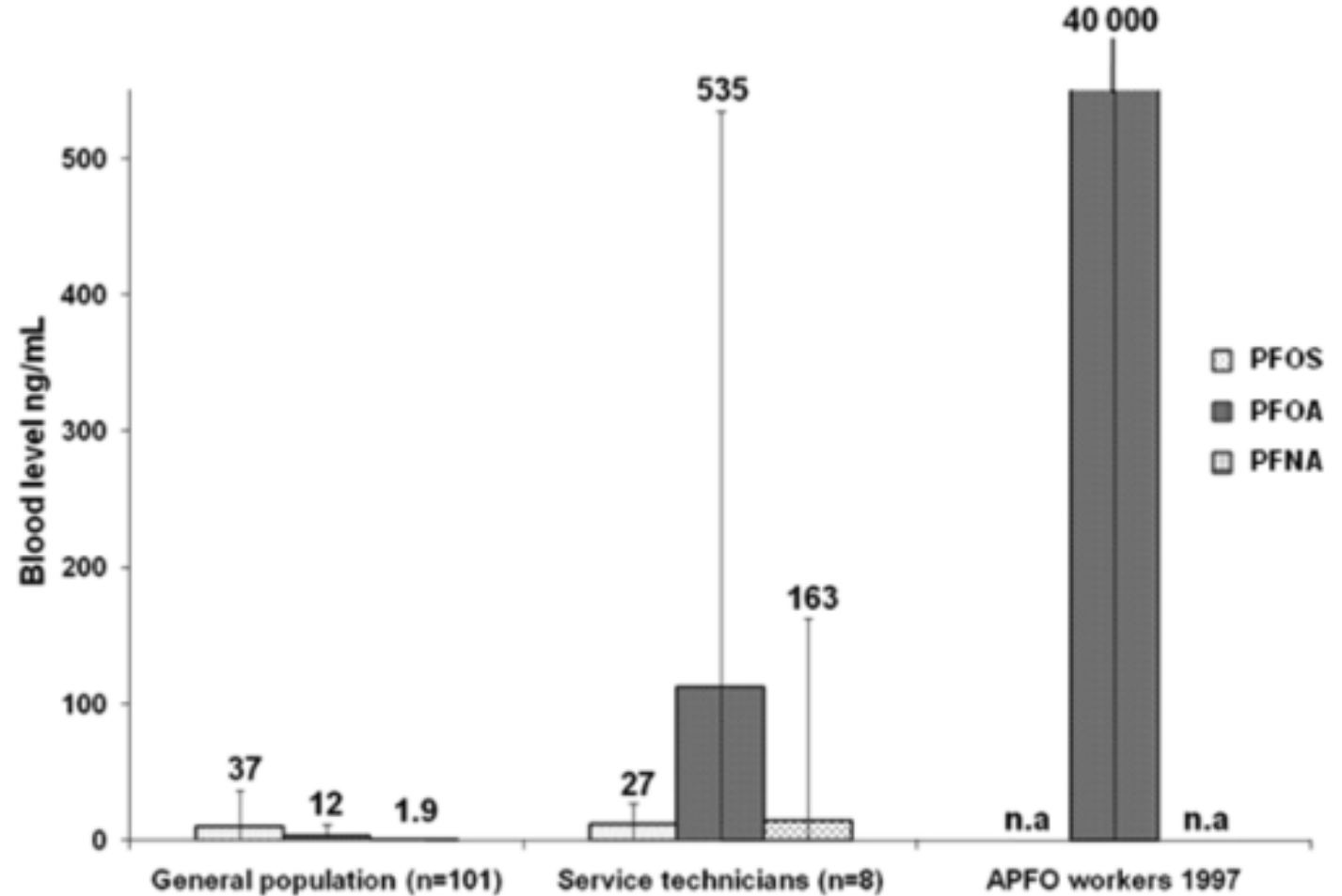
PFAS Release to the Environment from Wax

- PFAS detected in environmental media around ski venues (Grønnestad et al., 2019; Carlson & Tupper, 2020; Wang et al., 2021)
- Concentrations in snow highest at start (Carlson & Tupper, 2020)
- Dominated by carboxylic acids (Grønnestad et al., 2019; Carlson & Tupper, 2020; Wang et al., 2021)
- PFAS bioaccumulate in wildlife near ski race venues (Grønnestad et al., 2019)



Human Exposure to PFAS from Wax

- Limited evaluation of occupational PFAS exposure from ski wax (e.g., Nilsson et al., 2010 and 2013; Freberg et al., 2010 and 2013)
- Documented high exposures, acute health effects
- Wax professionals' blood PFAS concentrations within range of 3M workers



Research Objectives

1. Evaluate wax utilization among US skiers and snowboarders to evaluate: (a) duration, (b) intensity, and (c) frequency of exposure to fluorinated waxes among recreational, amateur, and professional participants.
2. Determine use of exposure interventions to reduce wax-related exposures among study participants.

Survey Development (Fall 2020)

Survey Development

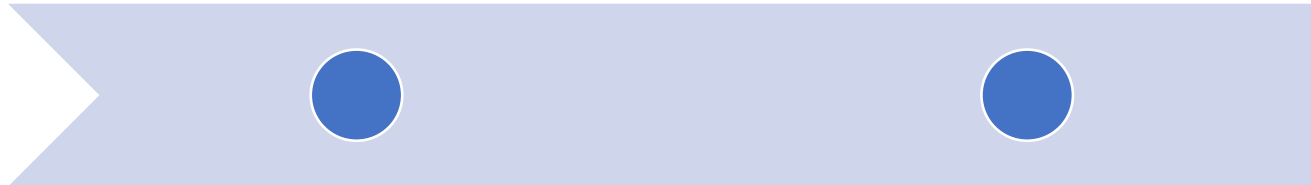
- Pilot with Stakeholders



Survey Development (Fall 2020)

Survey Development

- Pilot with Stakeholders



Survey Questions

- Demographics
- Sport Affiliation
- Role and History in Sport
- Wax Use

Participant Recruitment (Winter 2020-2021)

Survey Development

- Pilot with Stakeholders

Recruitment

- Professional Membership Organizations
- Industry Groups
- Snowball Sampling

Survey Questions

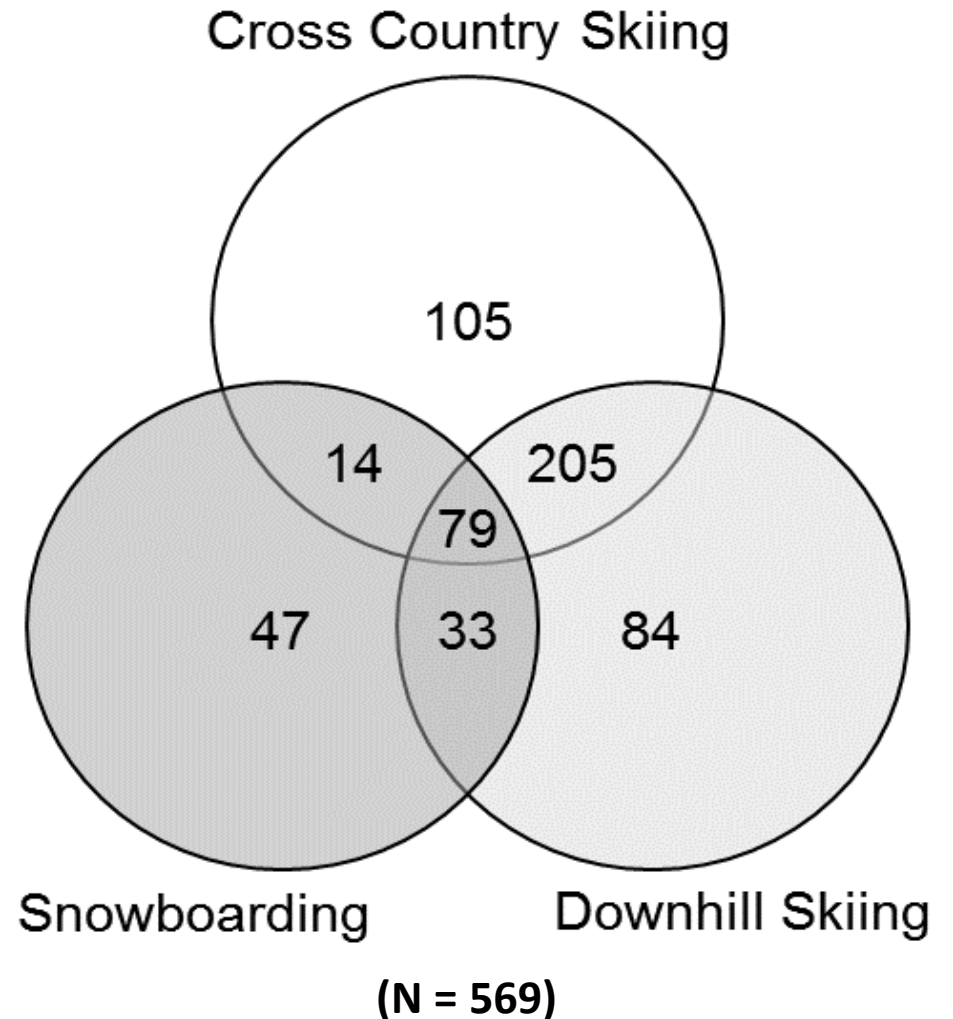
- Demographics
- Sport Affiliation
- Role and History in Sport
- Wax Use

Inclusion Criteria

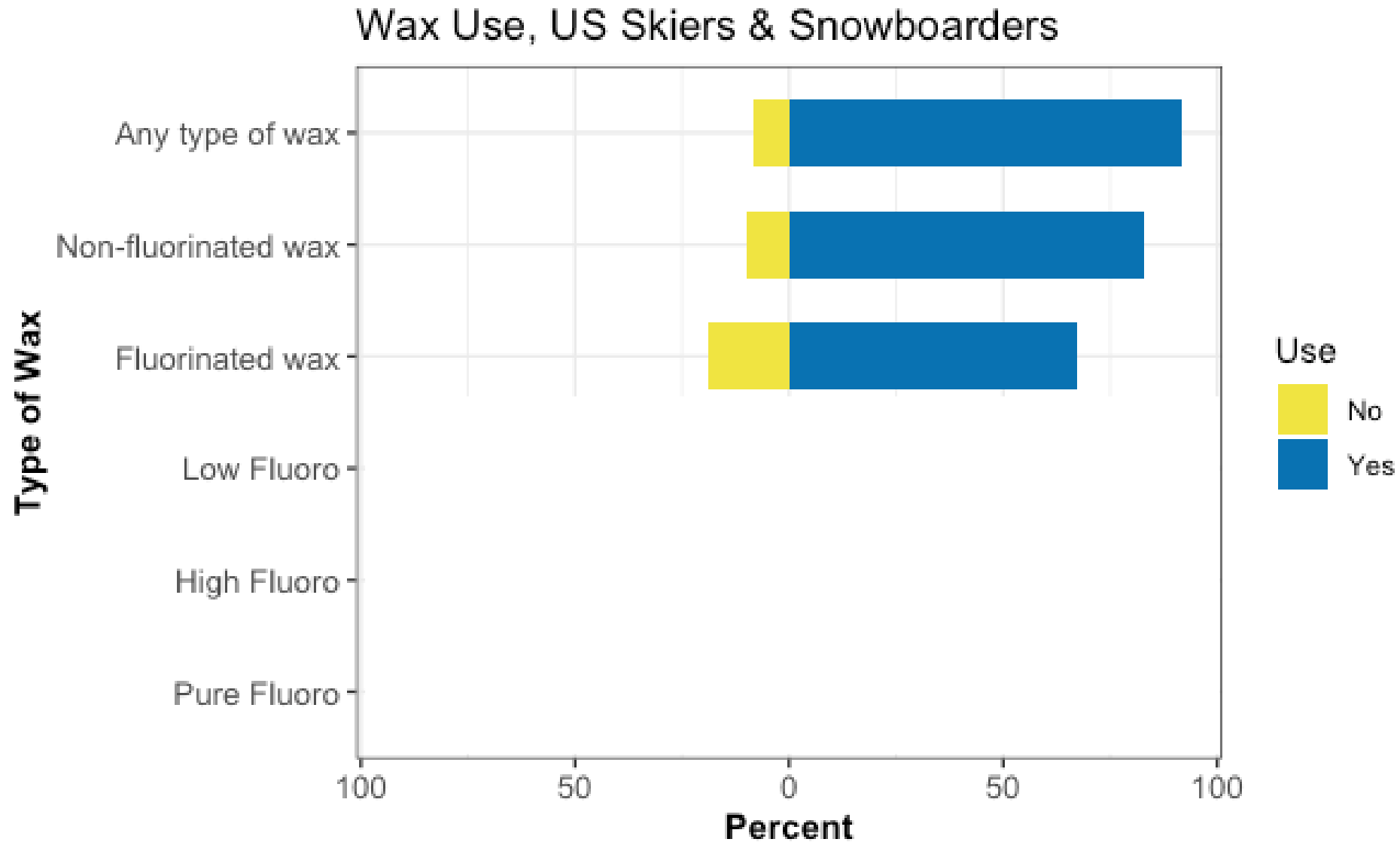
- Lived in the US at time of study
- Affiliated with snow sport

Study Participants (N = 569)

- Median (range) age = 45 (7-82) years
- Resided in 33 states
- 84% had a Bachelor's degree or higher
- 60% had an annual household income of at least \$100,000
- Median (IQR) body mass index = 24 (22, 26)
- 35% exercised at least 12 hours per week

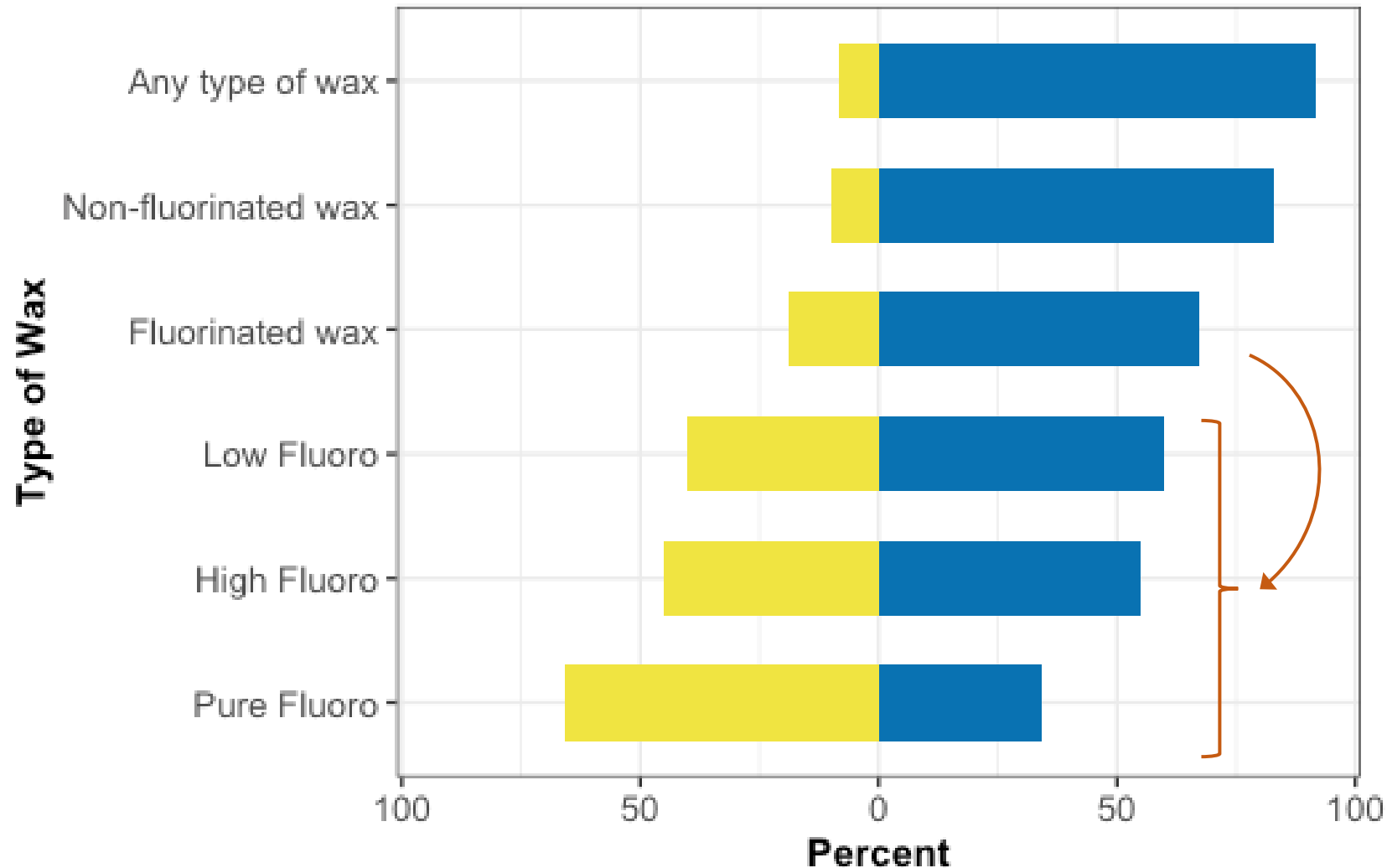


Wax Use Among Study Participants



Wax Use Among Study Participants

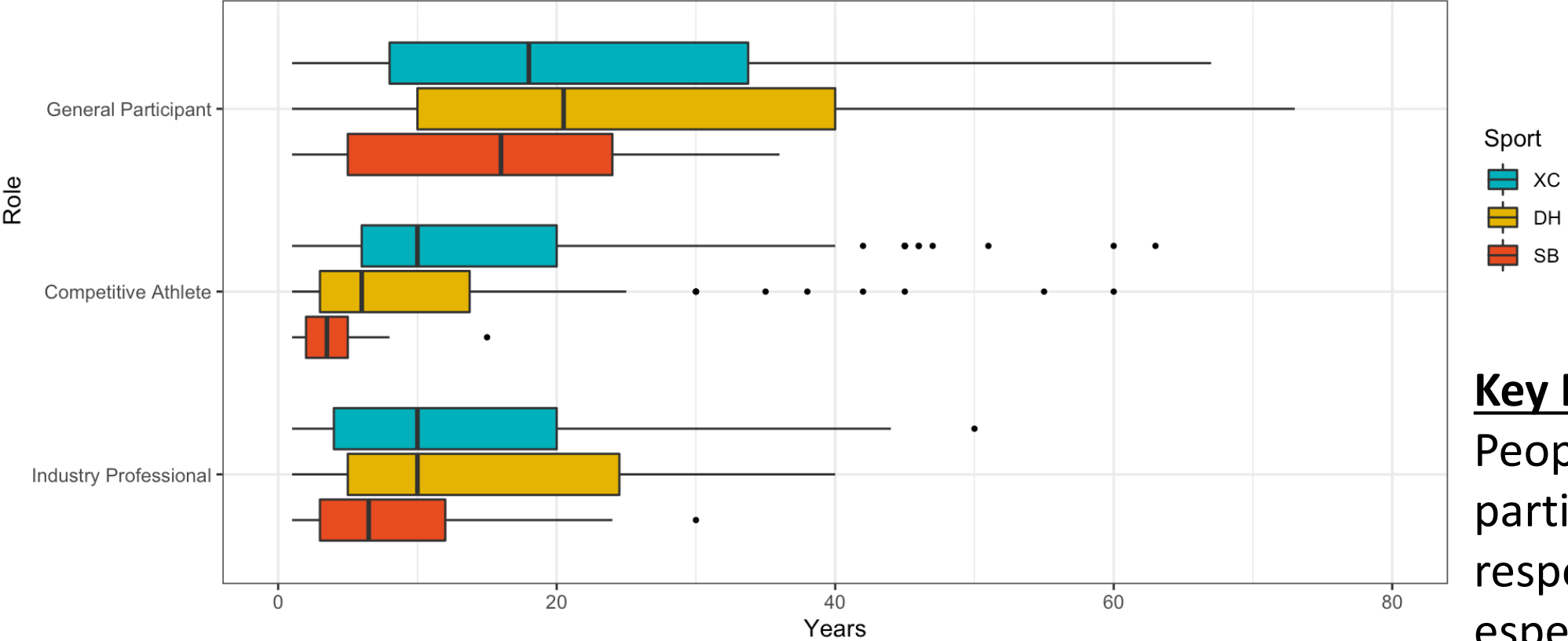
Wax Use, US Skiers & Snowboarders



Key Finding: Most US skiers and snowboarders surveyed apply fluorinated waxes.

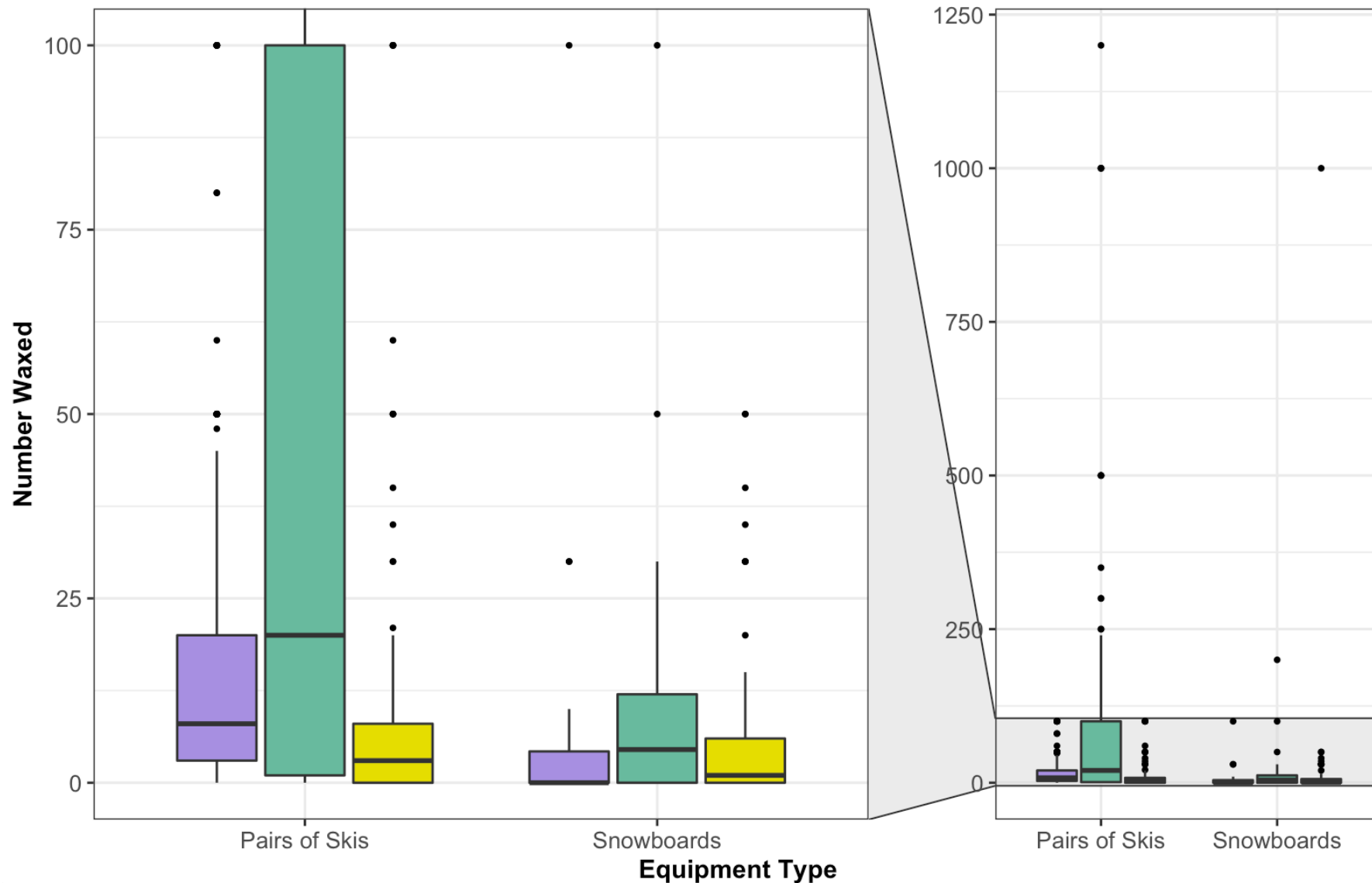
Use
No
Yes

Duration of Participation by Sport-Role



Key Findings:
People are long-term participants in their respective sports, especially as a general participant

Frequency of Fluorinated Wax Use



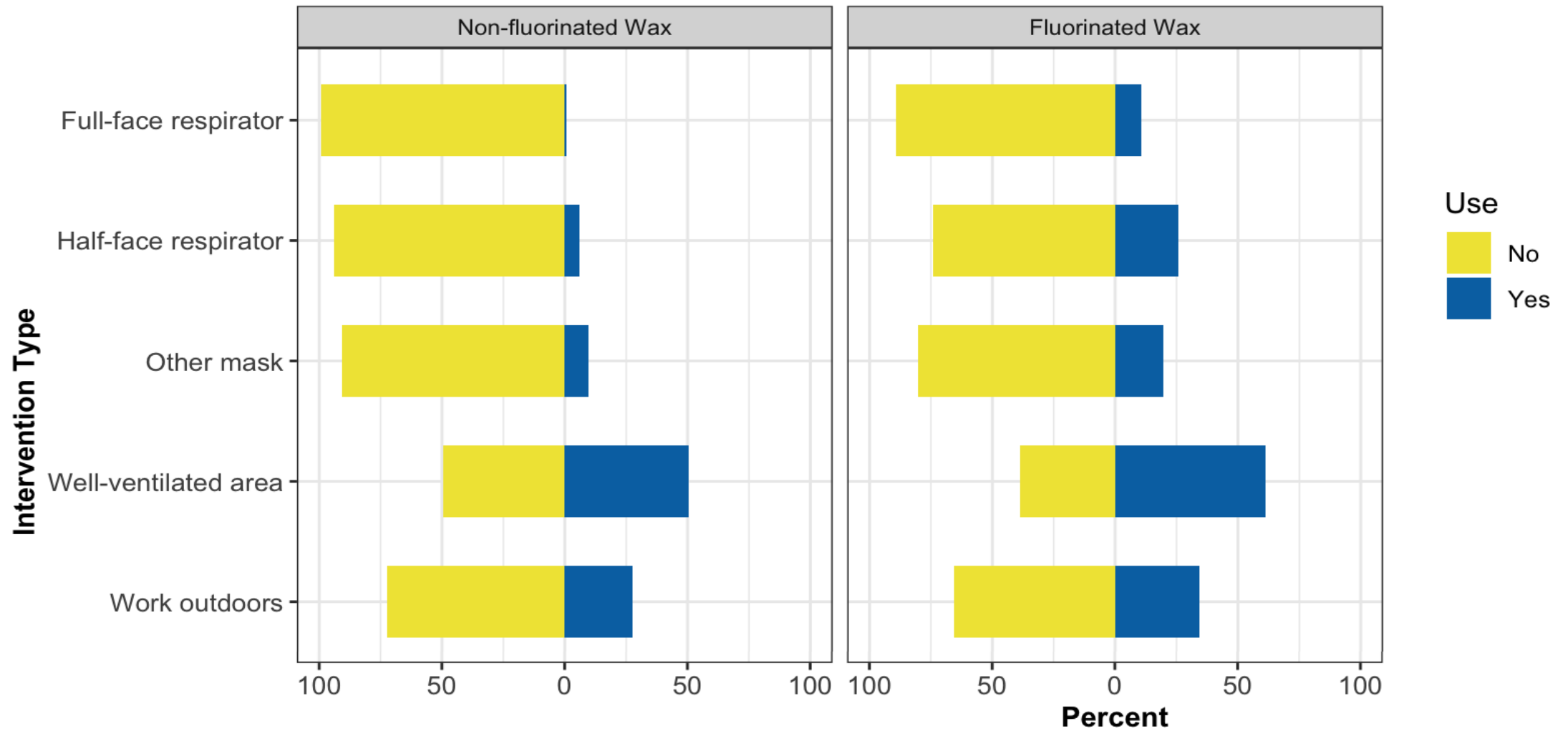
Role

- Competitive Athlete
- Industry Professional
- All Other Roles

Key Findings:

- Fluorinated wax use was most abundant among industry professionals
- Recreational participants also use fluorinated waxes

Minimal Use of Respiratory Exposure Interventions



Summary

- US skiers and snowboarders are exposed to PFAS via waxing activity.
- Exposures occur repeatedly over long durations of time.
- Exposure tends to be highest among professionals; but also occurs among recreational participants.
- Exposure interventions are not commonly used.

Research Objectives

1. Evaluate the: (a) intensity,, (b) duration, and (c) frequency of exposure to fluorinated waxes among recreational, amateur, and professional participants.
2. Determine use of exposure interventions to reduce wax-related exposures among study participants.
3. Quantify PFAS concentrations in dust collected from a US ski race venue.
 - *Dust wipes collected from waxing tables*

PFAS in Wax Room Dust



- Dust wipes collected before and after wax application
 - n=21 locations sampled; n=8 locations analyzed
- 18 (of 40) analytes present in ski wax
 - Preliminarily, concentrations \geq range observed in homes and fire stations
 - (Hall et al., 2020)
- Most abundant PFAS:
 - PFOA, PFDA, PFDoA, PFTeDA (long-chain carboxylic acids)
 - HFPO-DA (GenX)

Acknowledgements & Questions

- **Study Participants**
 - Electronic survey
 - Dust wipe sampling
- **Collaborators**
 - Birgit Claus Henn, Boston University School of Public Health
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 - Nicola Hartmann
 - Divya Gudur

What should skiers and snowboarders do with fluorinated waxes that they no longer want?



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