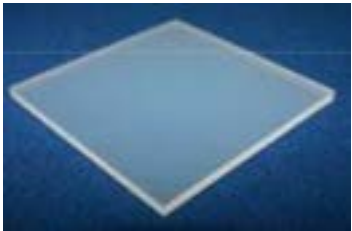
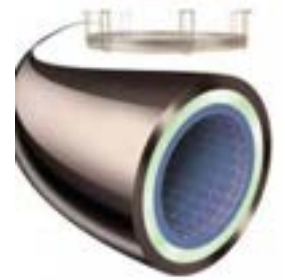


# Assessing Airborne Exposure using Novel Sampling and Measurement Techniques



Presentation at  
Clean Air Hamilton



Joseph Okeme, PhD

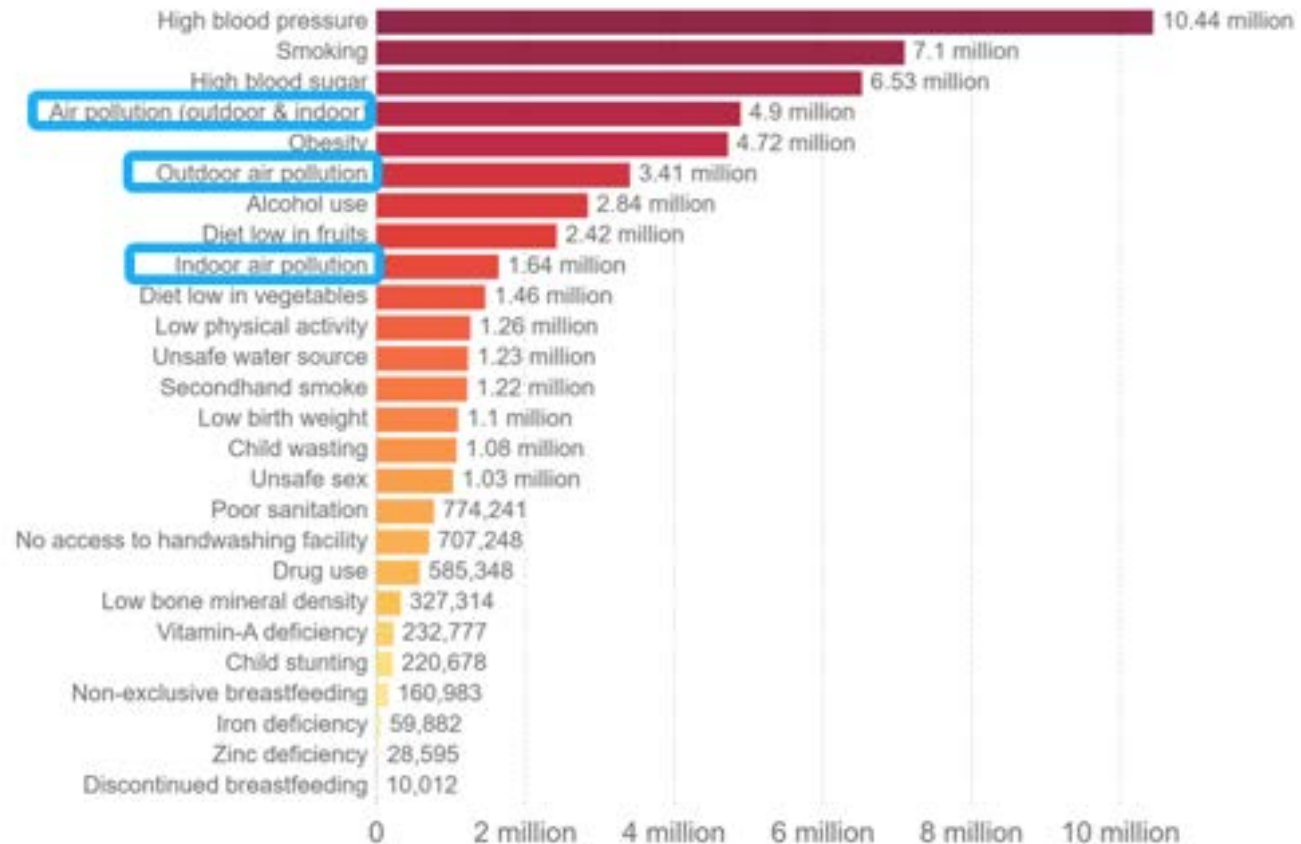
Chemistry and Chemical Biology, McMaster University

17 April 2023

# Motivation

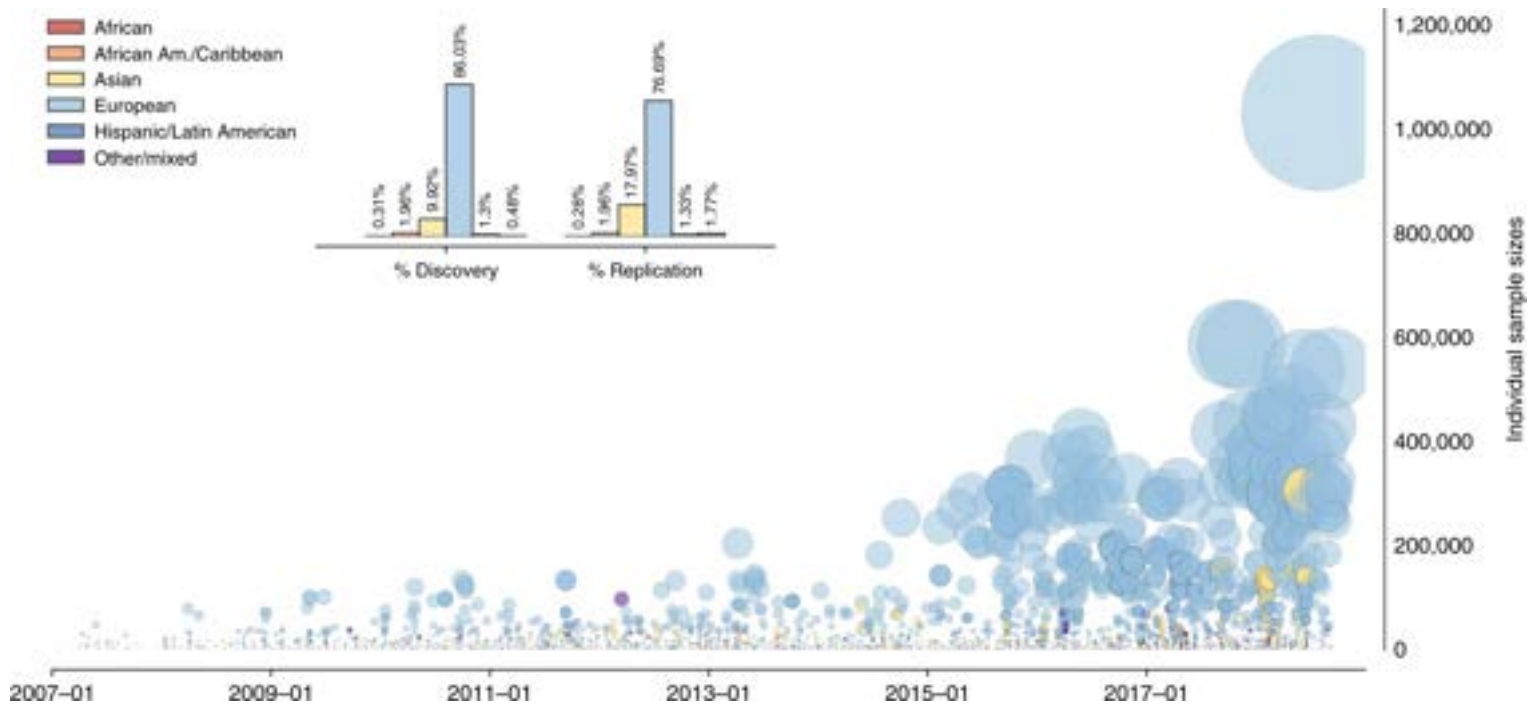
## Number of deaths by risk factor, World, 2017

Total annual number of deaths by risk factor, measured across all age groups and both sexes.



Source: IHME, Global Burden of Disease (GBD)

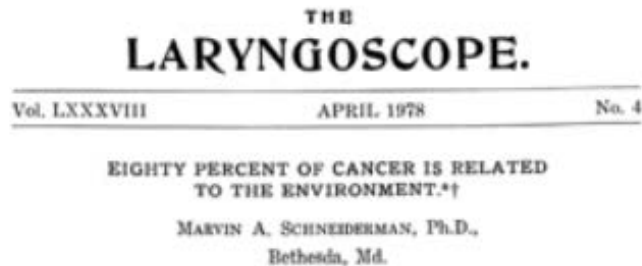
# Genome-wide association



1. Humans are 99.9% similar
2. Genes account for <10% disease risks

Mills & Rahal.. *Commun Biol* **2**, 9 (2019);  
Lee, J.J. *et al. Nat Genet* **50**, 1112–1121 (2018).

# Gene or environment?



**PREVENTING DISEASE THROUGH HEALTHY ENVIRONMENTS**

A global assessment of the burden of disease from environmental risks

A Publication of the World Health Organization

© World Health Organization 2016

1979

2000

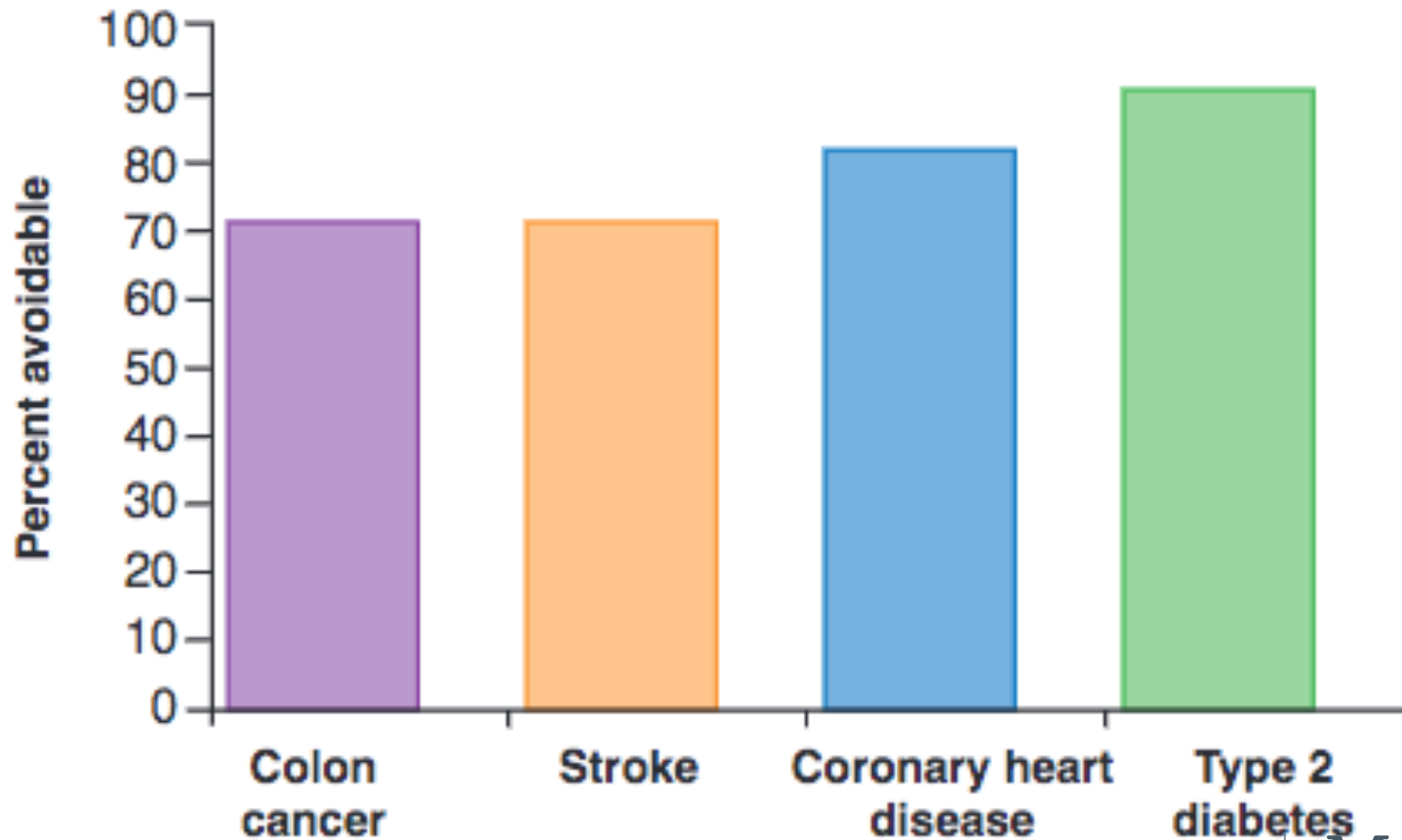
2002

2016

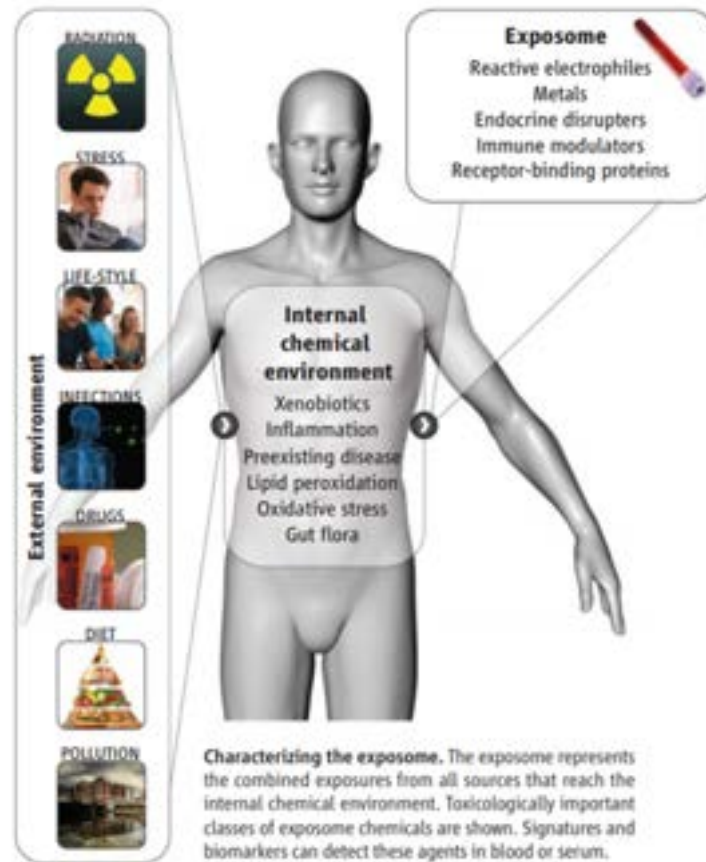


# Good news

**Science**  
**Balancing Life-Style and Genomics  
Research for Disease Prevention**  
Walter C. Willett  
SCIENCE VOL 296 26 APRIL 2002



# What are the exposure sources?



EPIDEMIOLOGY

22 OCTOBER 2010 VOL 330 SCIENCE

## Environment and Disease Risks

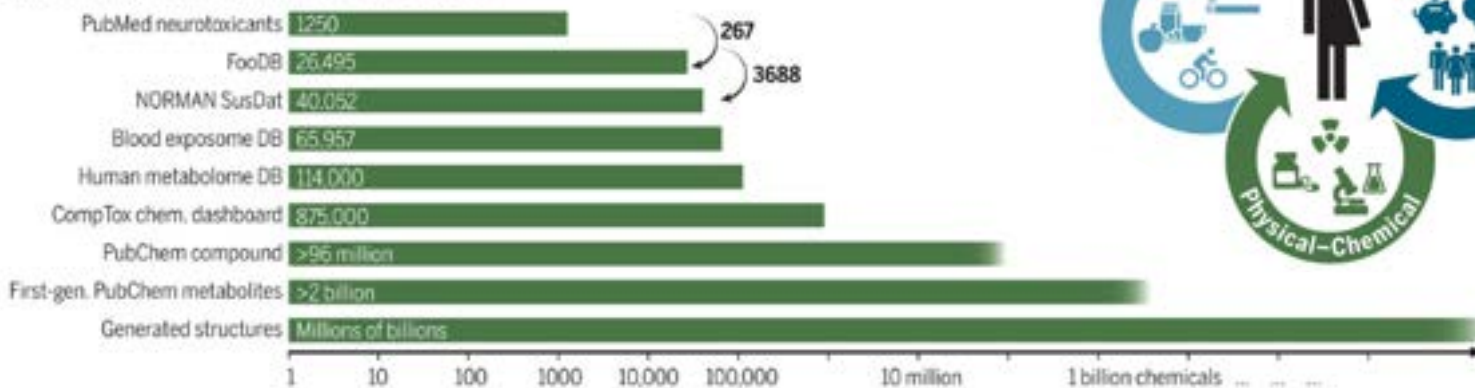
Stephen M. Rappaport and Martyn T. Smith

# Can we measure our exposure history and why?

## Typical HRMS sample



## Selected exposomics, chemical data sources



## REVIEW

## The exposome and health: Where chemistry meets biology

Roel Vermeulen<sup>1,2\*</sup>, Emma L. Schymanski<sup>3</sup>, Albert-Laszlo Barabási<sup>4,5,6</sup>, Gary W. Miller<sup>7\*</sup>

# Research goals

## Research Gap

Need for well characterised, simple and easy to use tools and data for exposure assessment

## Research goal

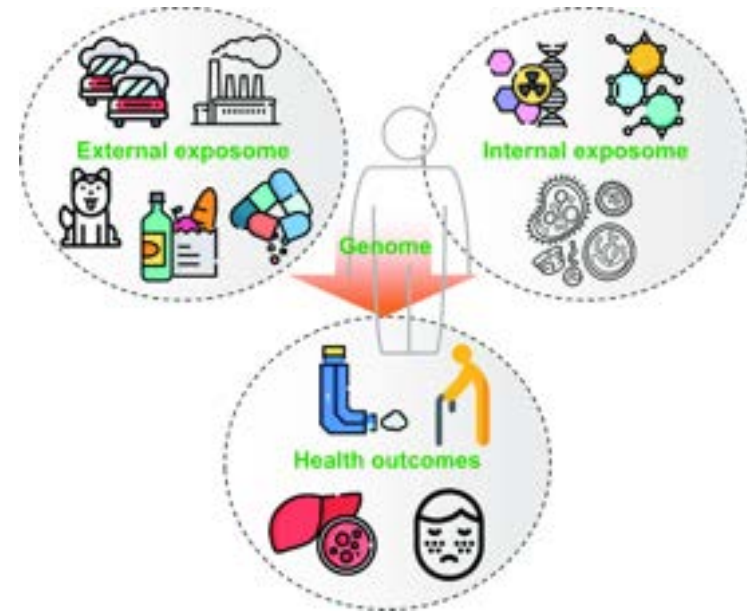
Improve how we measure and understand the contribution of the exposure to overall population health





# This seminar's objectives

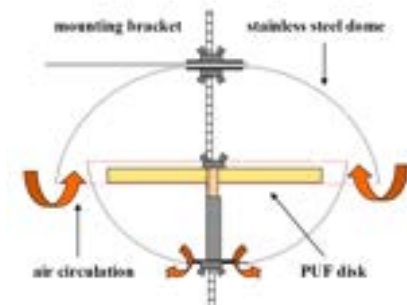
- External exposome
- Internal Exposome
- Current focus & future work



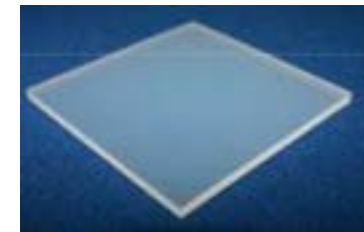
# #1. Airborne external exposome



PM<sub>2.5um</sub> Harvard Impactor set-up in room



Polyurethane foam (PUF) disk (Shoeib and Harner, 2002)



Polydimethylsiloxane (PDMS) or Silicone rubber

# #1. Stationary air sampling



2 visits over ~ 3 weeks, 52 homes

Collaborators: Drs. Diamond (PI), Congiao Yang (UofT), Shelley Harris (CCO), Liisa Jantunen (ECCC)

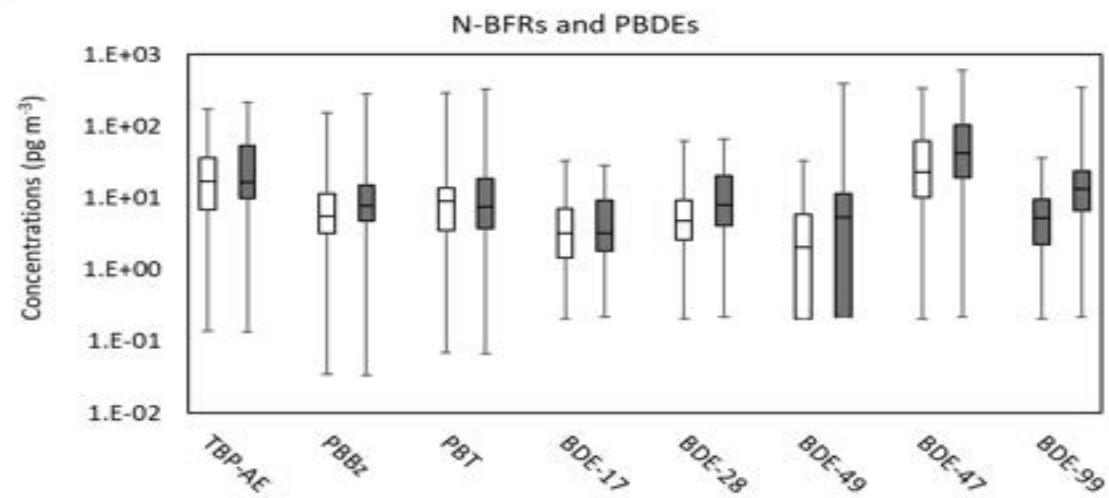
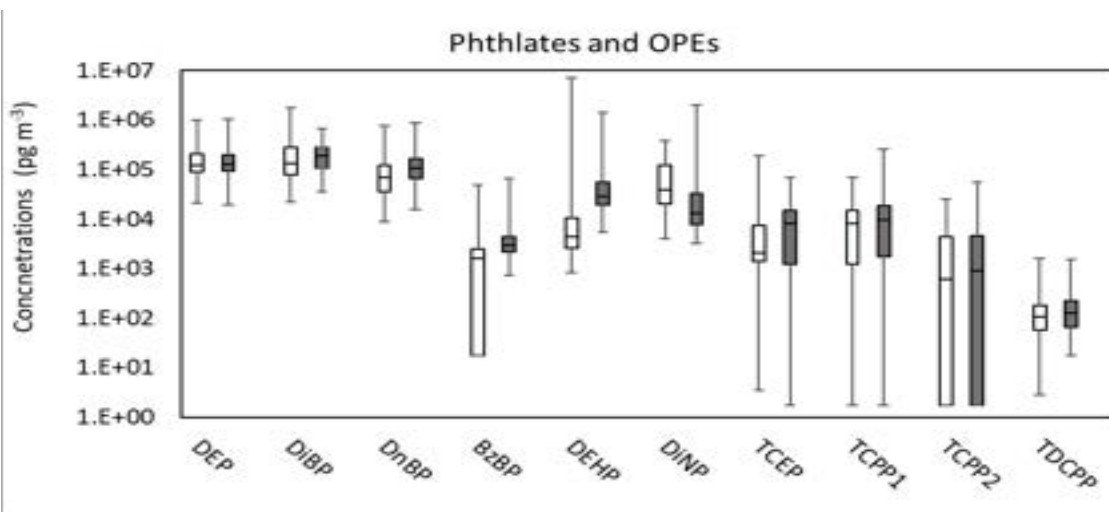
# #1. SVOCs in Canadian homes



White

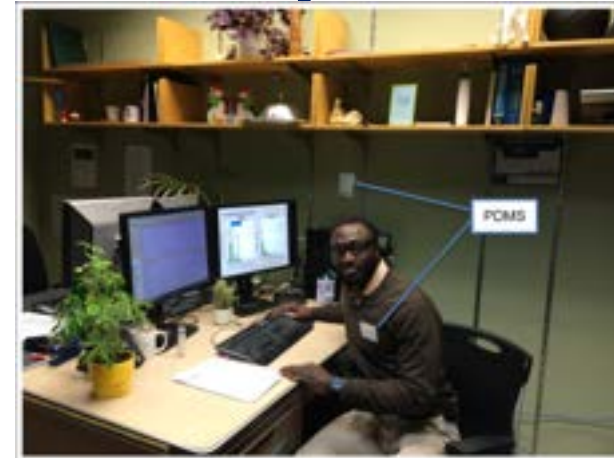


Grey

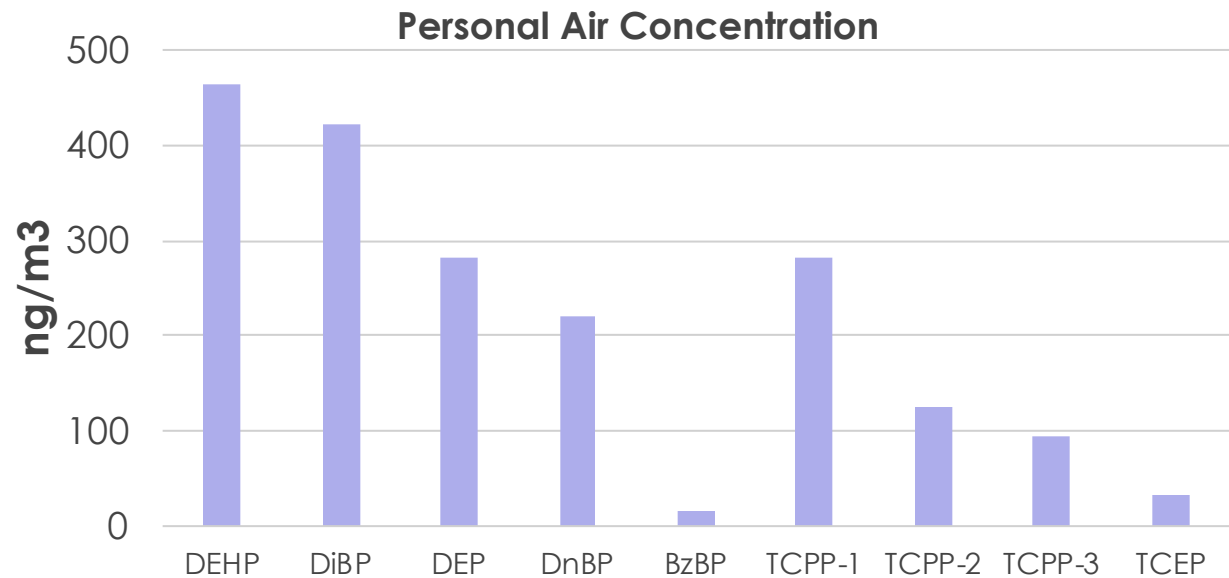
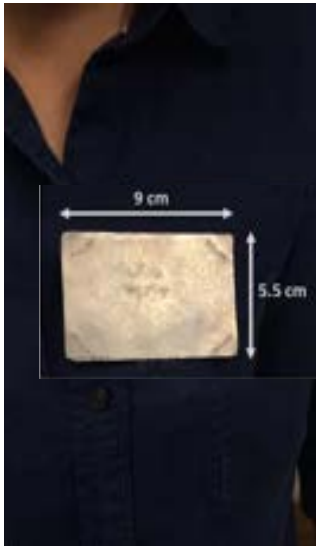


# #1. Silicone rubber passive samplers

- Versatility:
  - water & air, stationary & personal
- Wide range of chemicals
- Easy to use
- Replicable
- Low blank levels
- Its cool



# #1. Silicone rubber Brooch



# #1. External exposome summary

- Concentrations varied widely from home-to-home
- PDMS- and PUF gave comparable air concentrations
- Brooch wearable sampler captures inhalation exposure



# #2. Internal exposome



- NHANES Study population  
Cross-sectional study from 1999 to 2014
  - Chemical biomarkers (541) and demographic variables



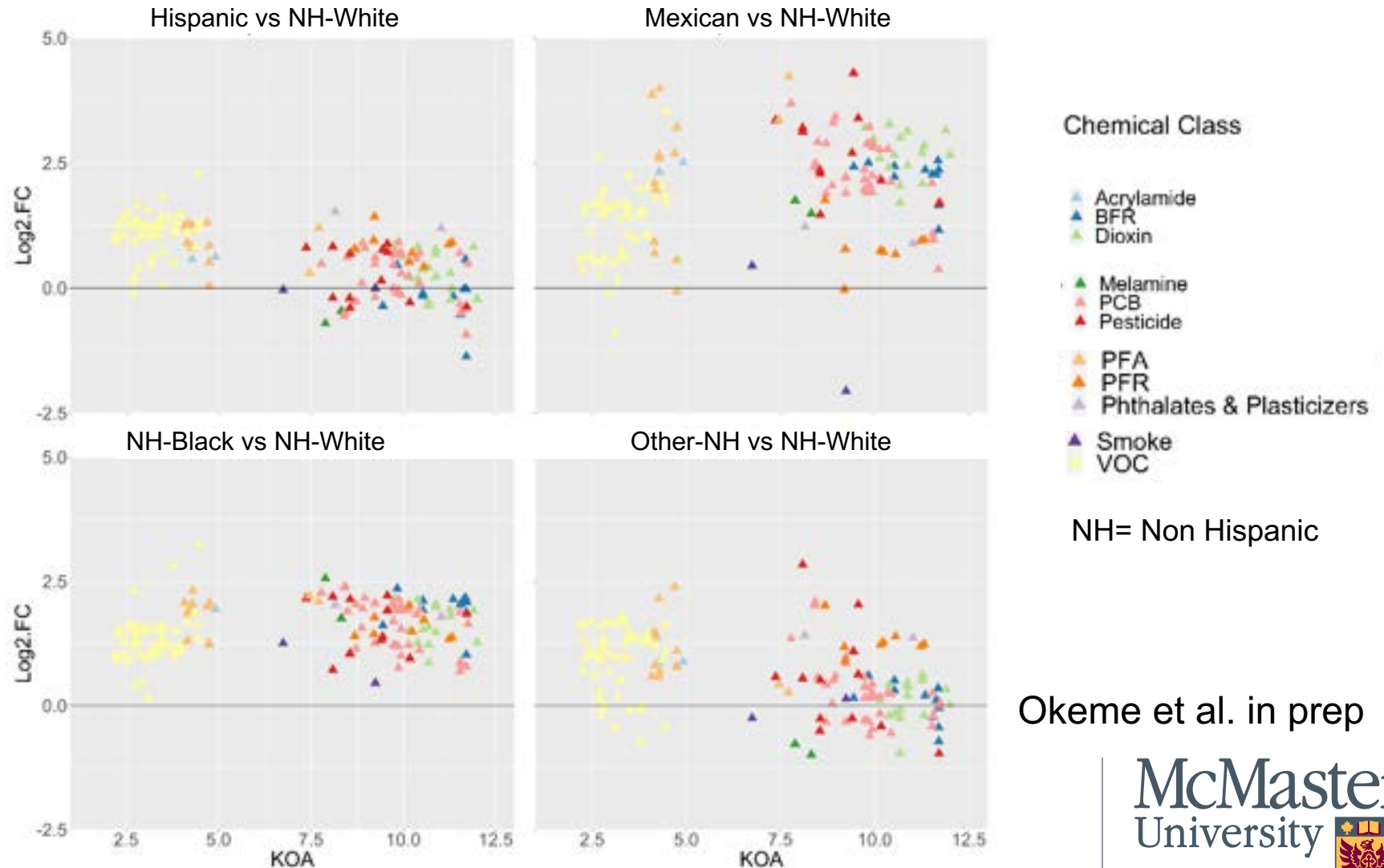
N= 82, 091



Collaborators: Dr.s Demers(OCRC), Arrandale (UofT), Li (Nevada)  
Nguyen(Harvard) & Rodgers (UBC), Yang (OCRC) & Zhang (UofT)

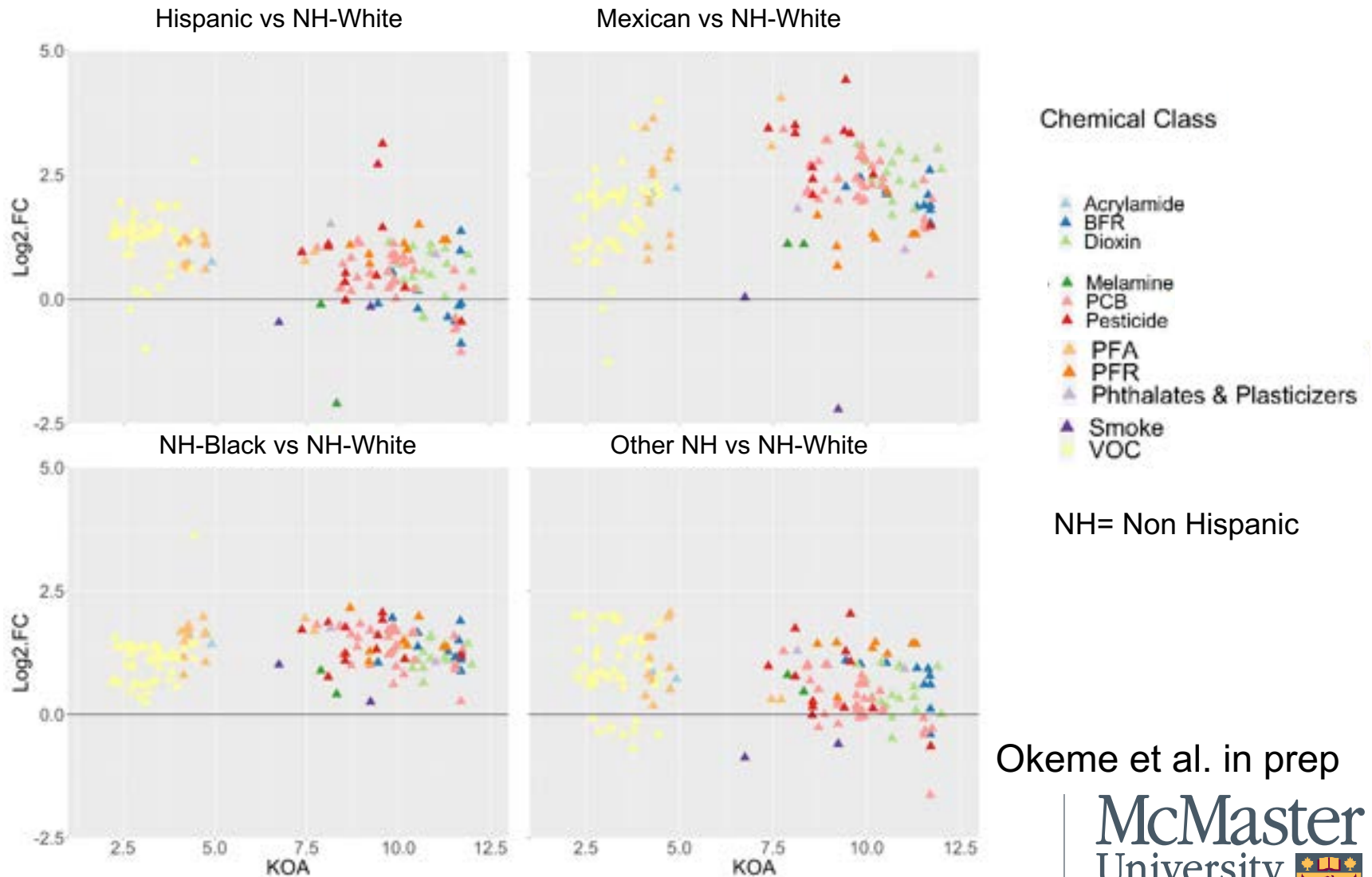


# #2. NHANES: biomarkers in male



Okeme et al. in prep

# #2. NHANES: Biomarkers in female



Okeme et al. in prep

## #2. Internal exposure summary

- Chemical biomarkers
  - Mexicans and non-Hispanic Blacks are the most exposed
- Production to Exposure (PROTEX) modeling
  - Ongoing

# #3. Ongoing collaborations



Figure 1 The majority of electronics assembly line workers are female.

World at work: The electronics industry D Koh, G Chan, E Yap

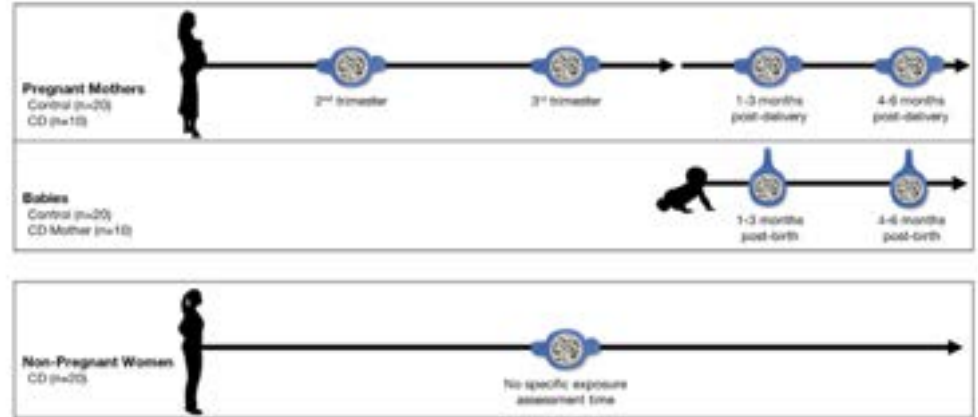


Figure 1. Overview of longitudinal personal exposure assessment of CD and healthy pregnant women, their offspring, enrolled in the MOMmy-CD cohort. FreshAir samplers will be worn for two consecutive days at each measurement time point. A total of 152 personal air samples will be collected from women and babies.



20 e-waste workers

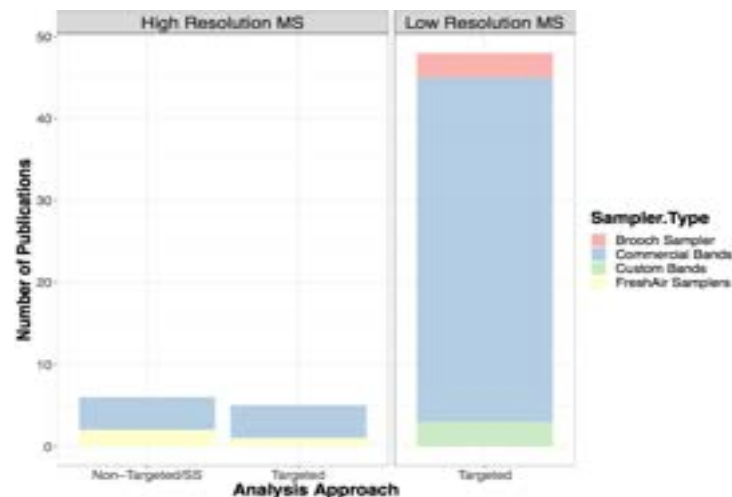
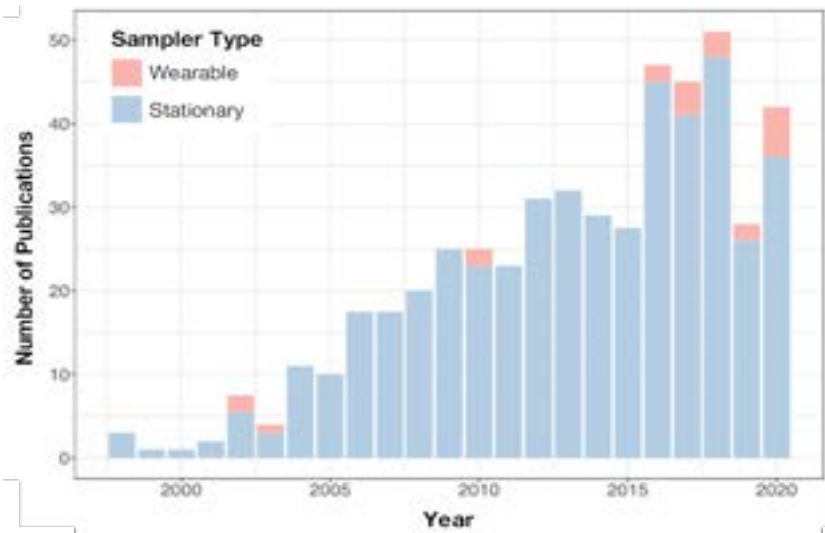


20 firefighters

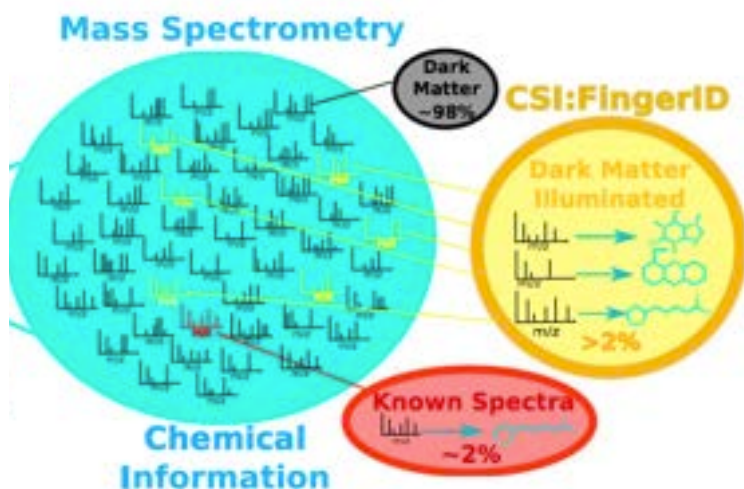


20 cleaners for comparison

# #4. Current focus & Future work



Okeme et al. 2022. Current Environ Health Report

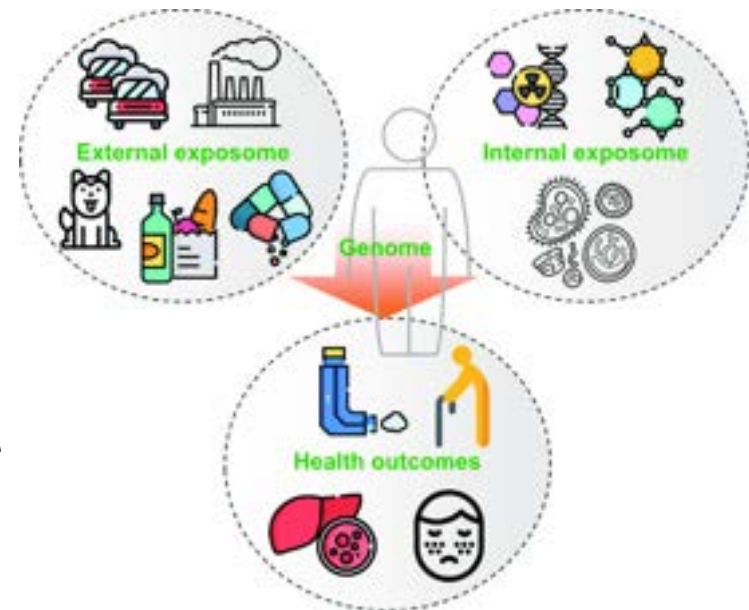


McMaster  
University



# Concluding summary

- External exposome
- Internal Exposome
- Exposome and disease



The exposome accounts for >80% disease risk-  
novel analytical tools and methods are key in  
exposome research

# Thank you!



Dr. Paul Demers

Yale

Dr. Krystal Pollitt



Dr. Frank Bidleman



Dr. Miriam Diamond  
Dr. Victoria Arrandale  
Dr. Jeff Brook



Dr. Gary Miller



Dr. Jana Klanova  
Dr. Lisa Melymuk



Dr. Tom Harner  
Dr. Liisa Jantunen  
Dr. Aman Saini



Dr. Scott Snapper



Dr. Roel Vermeulen



Dr. Vy Nguyen



Dr Peter Tromp  
Dr. Anjeeka Pronk



Dr. David Wishart



Dr. Li Li



Dr. Douglas Walker



Canadian  
Cancer  
Society

