SCIENCE YOU CAN WEAR: THE SILICONE WRISTBAND JOURNEY FROM BENCH TO BIOMONITORING

FOR BIOMONITORING CALIFORNIA SCIENTIFIC GUIDANCE PANEL ANNUAL MTG

AUGUST 27, 2025

WEBINAR

Kim A. Anderson, PhD
Professor, Environmental & Molecular Toxicology
Director, Food Safety & Environmental Stewardship Program
Oregon State University

Stationary Monitors May Be a **Poor** Estimate of Personal Chemical Exposures

Worn Science: Inventing the Silicone Wristband for Measuring Real-World Chemical Exposures


Assessing the Exposome with External Measures: Commentary on the State of the Science and Research Recommendations

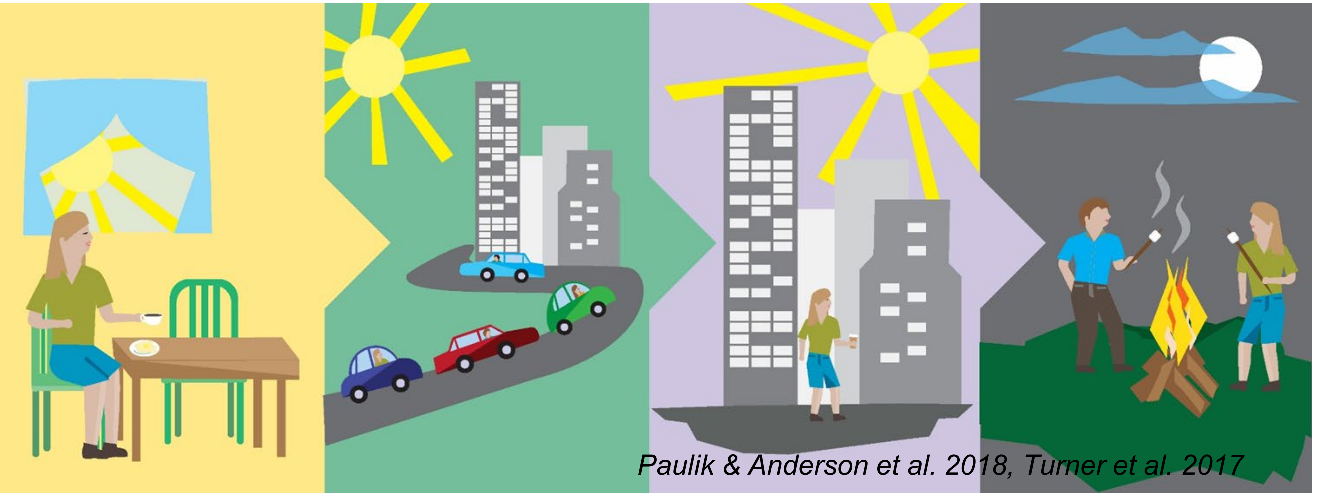
Michelle C. Turner,[1,2,3,4] Mark Nieuwenhuijsen,[1,2,3] Kim Anderson,[5] David Balshaw,[6] Yuxia Cui,[6] Genevieve Dunton,[7] Jane A. Hoppin,[8] Petros Koutrakis,[9] and Michael Jerrett[10,11]

Annu. Rev. Public Health 2017. 38:215–39

The Lancet, Vol. 391, No. 10119

Although the risks of developing diseases are attributed to both genetic and environmental factors, 70% to 90% of disease risks are probably due to differences in environments.

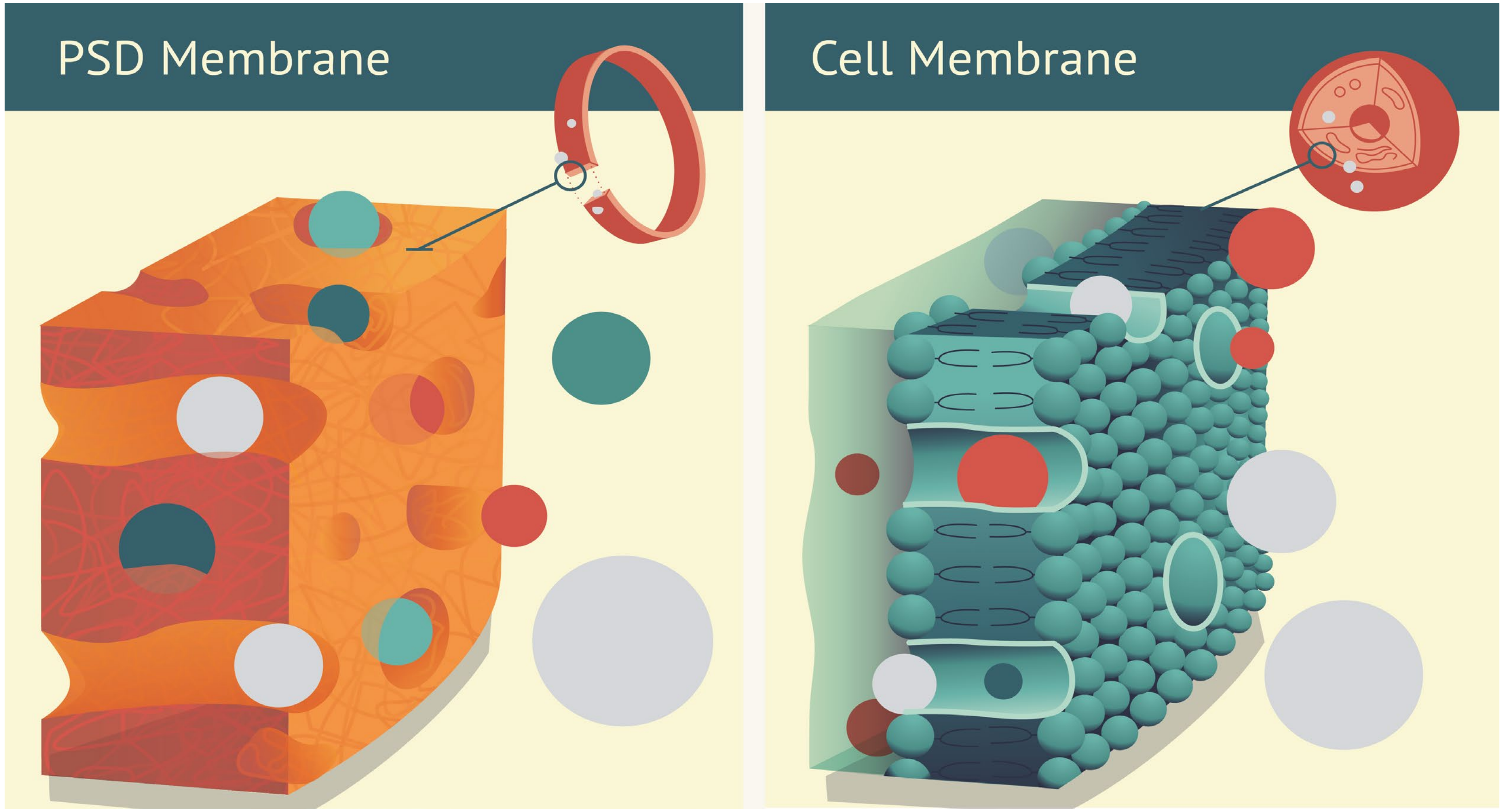
- Rappaport and Smith, Science, 2010
- Willett, Science, 2002
- Lichtenstein et al, N. Engl J. Med. 2000



Paulik & Anderson et al. 2018, Turner et al. 2017

Purpose-Built: Quantifying bioavailability

- Mimic passive uptake and accumulation



dx.doi.org/10.1021/es405022f | Environ. Sci. Technol. 2014, 48, 3327−3335

Environmental Science & Technology

Article

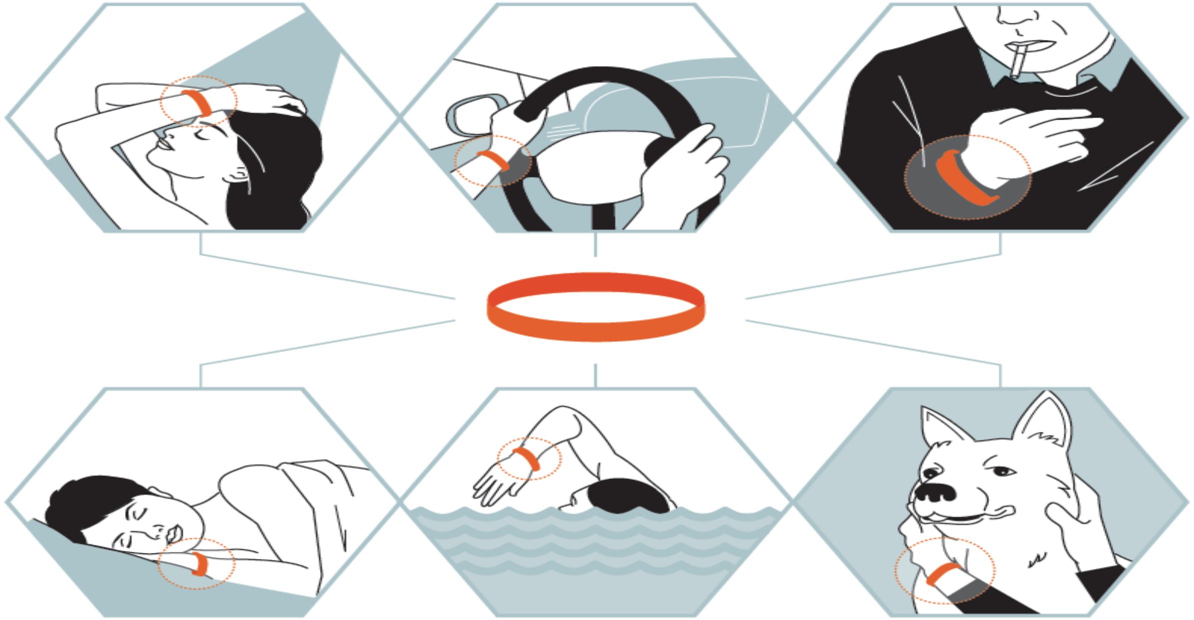
pubs.acs.org/est

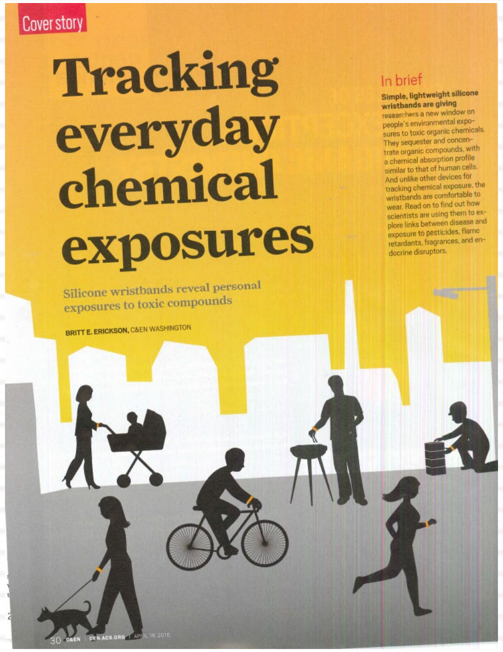
Silicone Wristbands as Personal Passive Samplers

Steven G. O'Connell, Laurel D. Kincl, and Kim A. Anderson*

Department of Environmental and Molecular Toxicology and [‡]College of Public Health and Human Sciences, Oregon State University, Corvallis, Oregon 97331, United States

Fit for Purpose: Building, Testing, and Applying the Silicone Wristband for Chemical Exposure Science



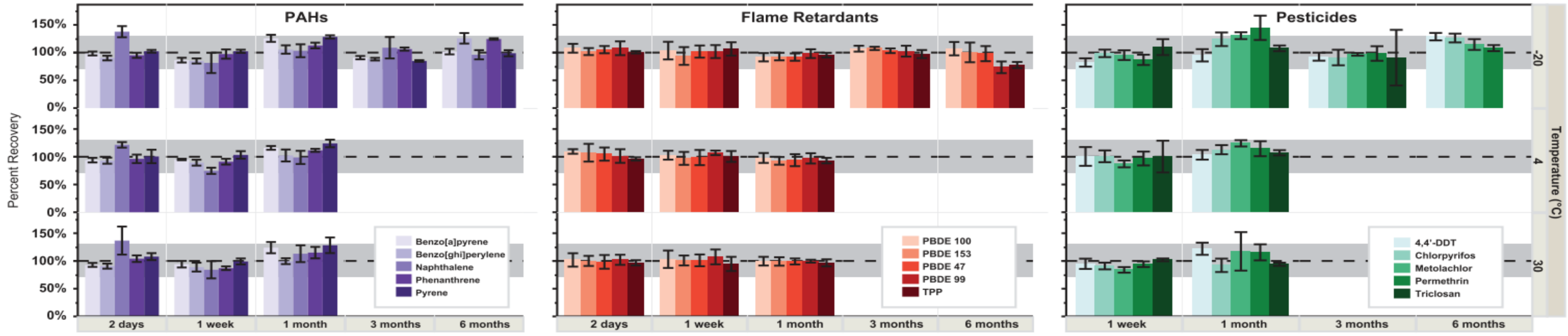


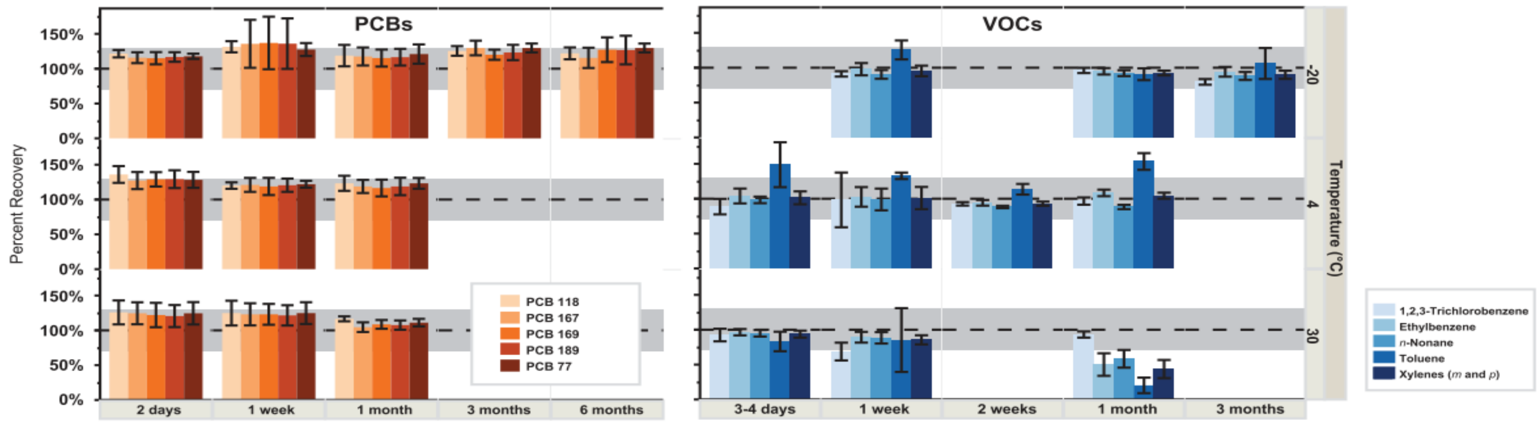
Wristband FAQs at: http://fses.oregonstate.edu/

Built for Purpose: Transport and long-term storage stability

n=4 for each experiment, 148 chemicals all 102%, SVOCs 104%, VOCs 99%

Transport at ambient temp, in airtight bags





OPEN

Journal of Exposure Science and Environmental Epidemiology (2017) 27, 551–559

www.nature.com/jes

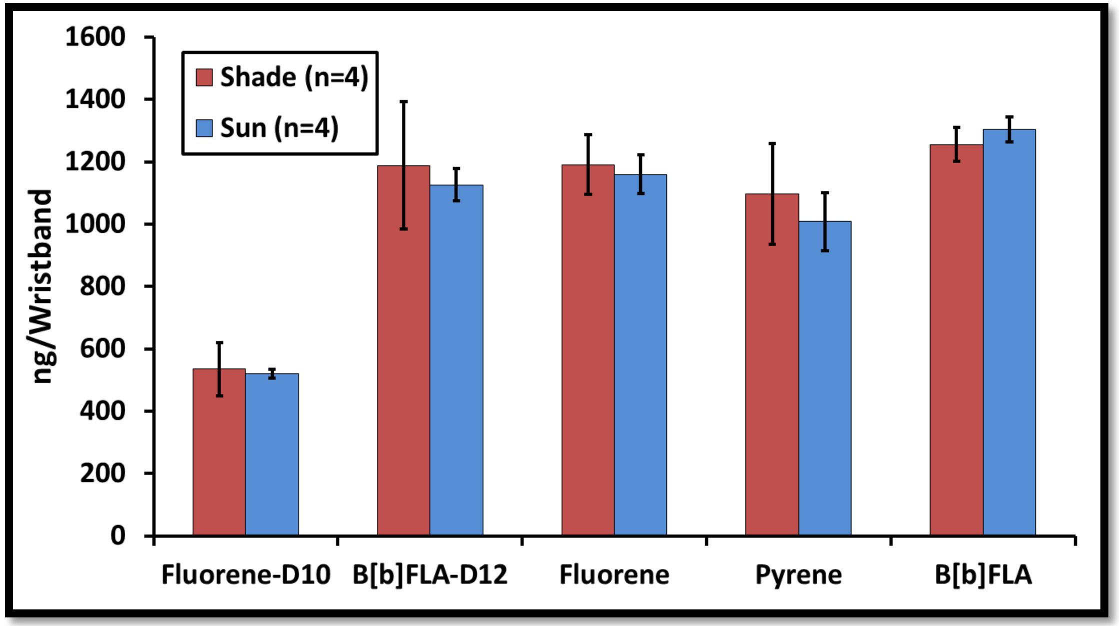
ORIGINAL ARTICLE

Preparation and performance features of wristband samplers and considerations for chemical exposure assessment

Kim A. Anderson[1], Gary L. Points III[1], Carey E. Donald[1], Holly M. Dixon[1], Richard P. Scott[1], Glenn Wilson[1], Lane G. Tidwell[1], Peter D. Hoffman[1], Julie B. Herbstman[2] and Steven G. O'Connell[1]

Measuring what matters: Your exposures

wristbands left in **sun**



Measuring What Matters: Captures Many Chemicals

0°C	5000°C	15,000,000°C
Water freezes	sun surface	**sun center**
log 0	log 3.7	log 7

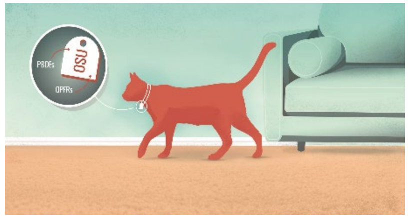
Wide applicability of types of chemicals that can be sequestered

octanol water partitioning coefficient, log K_{ow} -0.7 to 9.5

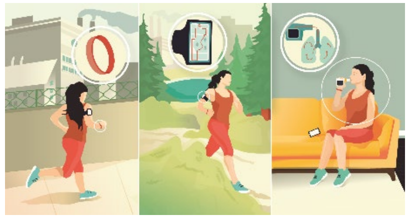
octanol air partitioning coefficient, log K_{oa} 5.5 to 13

Inventing the Silicone Wristband for Personal Chemical Exposure Assessment

Testing in the field – a peak at a few past exposure studies



Measuring Flame Retardant Exposure in Cats


Measuring PAH Exposure and Lung Function

Measuring Firefighter Chemical Exposure

Global Assessment of Human Chemical Exposure

Technology Highlights

- Over 6,000 wristbands analyzed
- Wristbands deployed in 6 continents
- Over 500 different chemicals detected
- 123 papers published with wristband technology

Measuring PAH Exposure in Pregnant Women

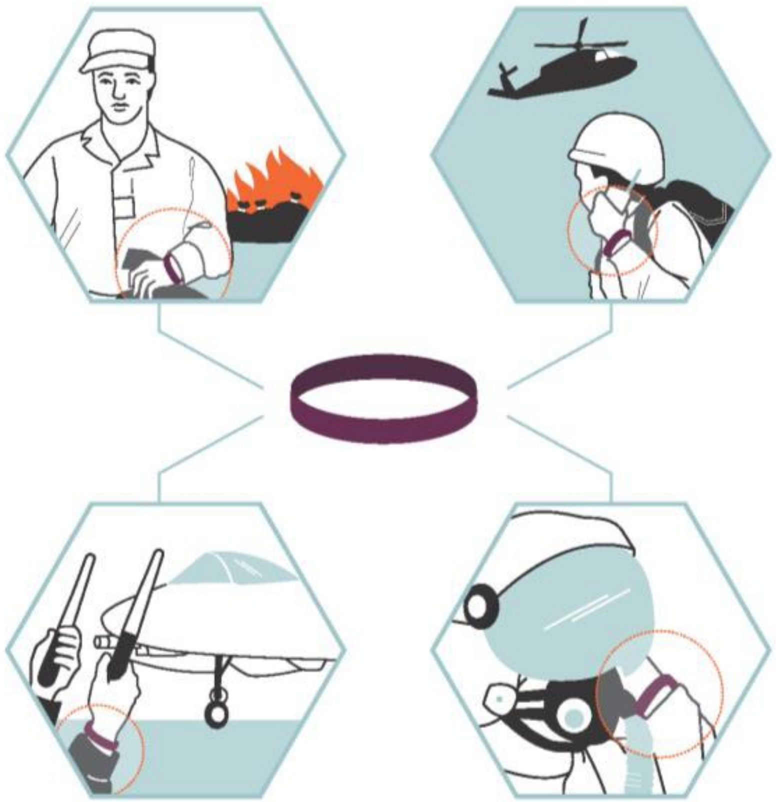

Multi-class Chemical Exposure in Peru

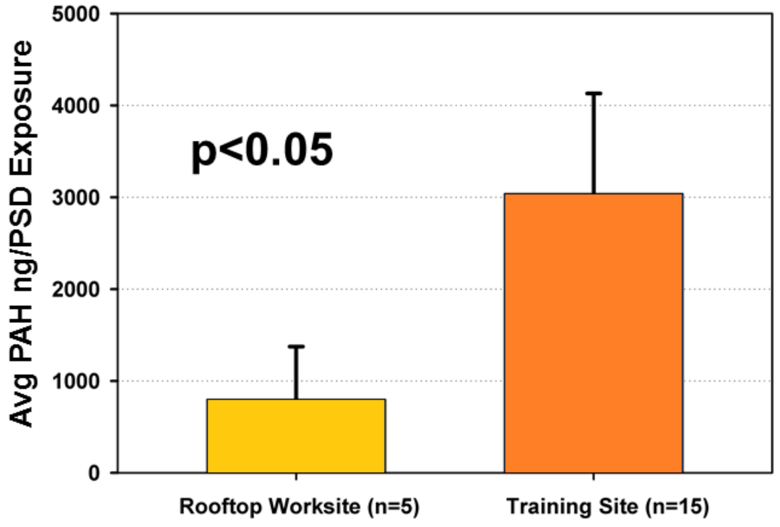
Measuring PAH Exposure Related to Fracking


Measuring Pesticide Exposure in Senegal

A New Lense on Exposures:

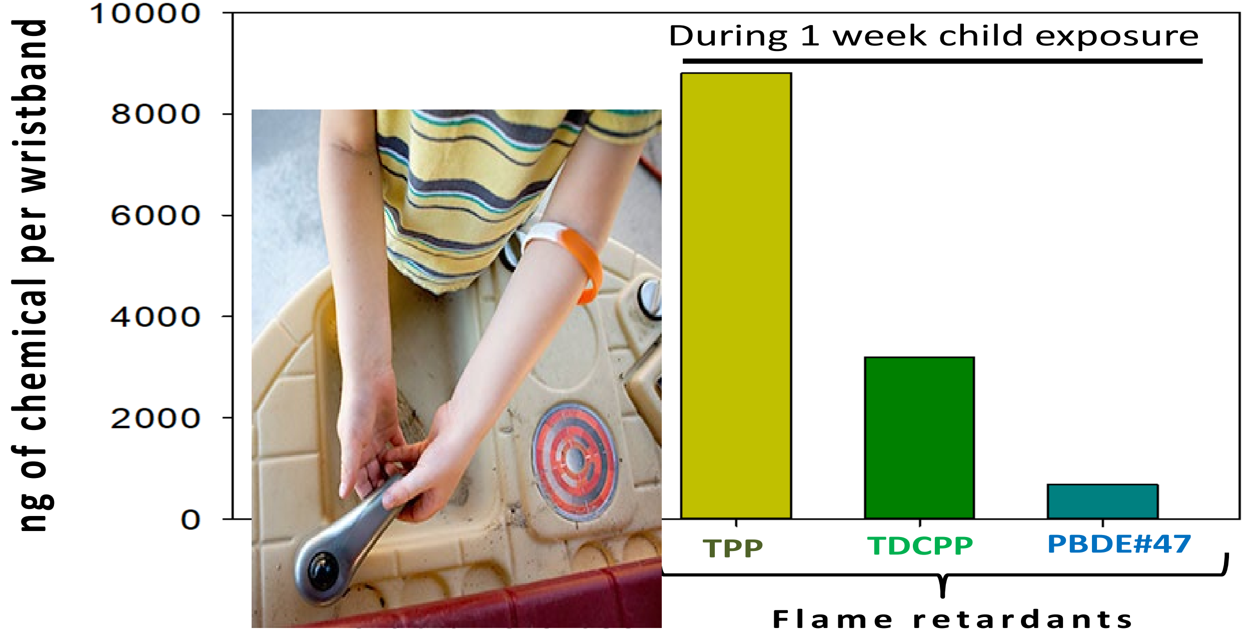
Transport at ambient temp, in airtight bags



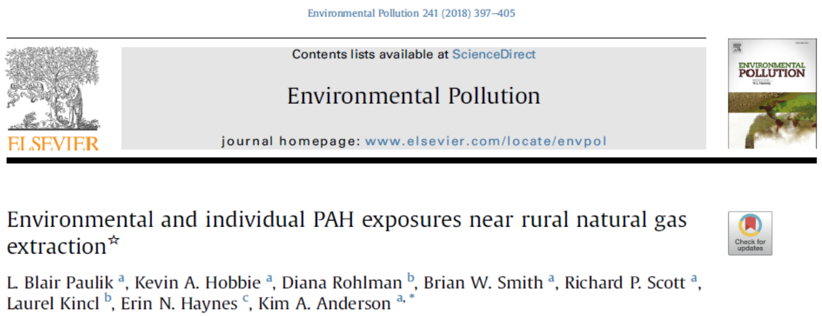


Empowering Exposure Science: Networking with communities

Children and flame retardants



Abbreviations used : ng = nanograms, hr = hours, PAHs = sum of 33 polycyclic aromatic hydrocarbons; TPP = triphenyl phosphate, TDCPP = tris(1,3-dichloro-2-propyl) phosphate, PBDE#47 = pentabromodiphenyl ether congener 47.


Environmental Pollution 241 (2018) 397–405
Contents lists available at ScienceDirect
Environmental Pollution
journal homepage: www.elsevier.com/locate/envpol

Environmental and individual PAH exposures near rural natural gas extraction☆

L. Blair Paulik [a], Kevin A. Hobbie [a], Diana Rohlman [b], Brian W. Smith [a], Richard P. Scott [a], Laurel Kincl [b], Erin N. Haynes [c], Kim A. Anderson [a, *]

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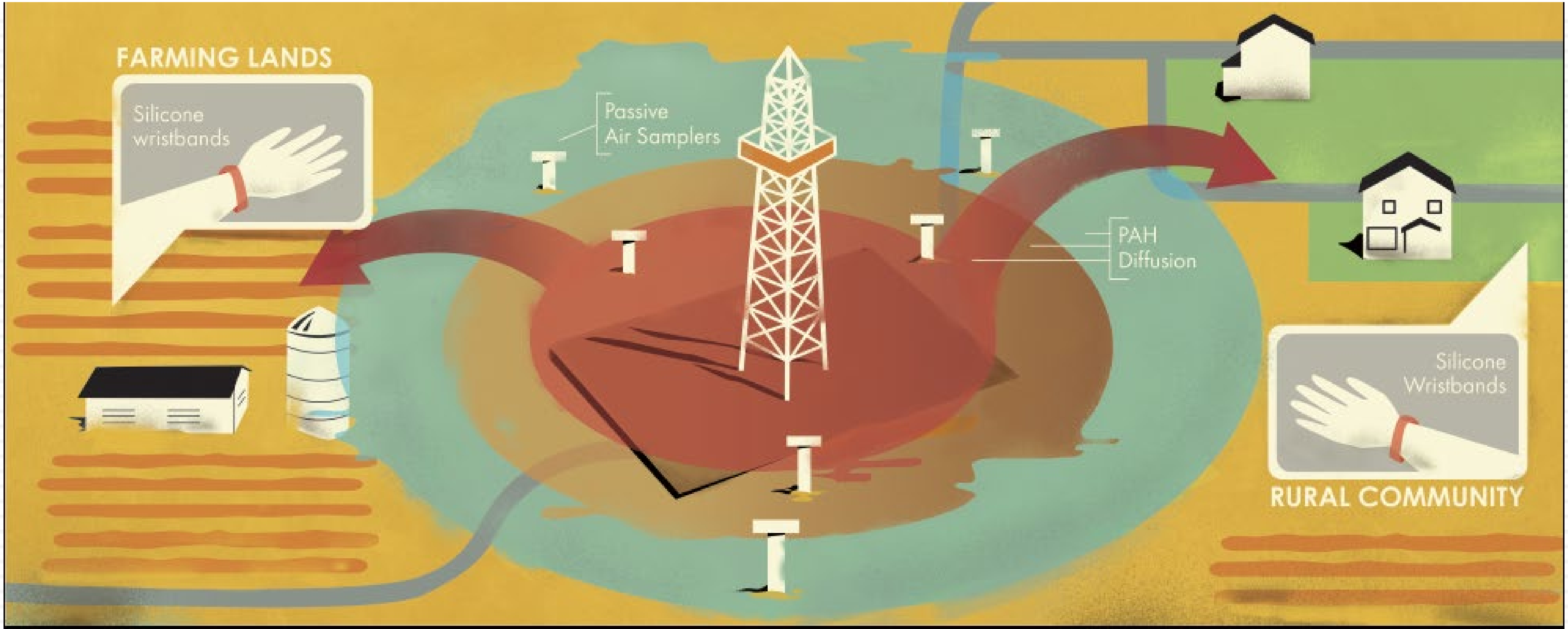
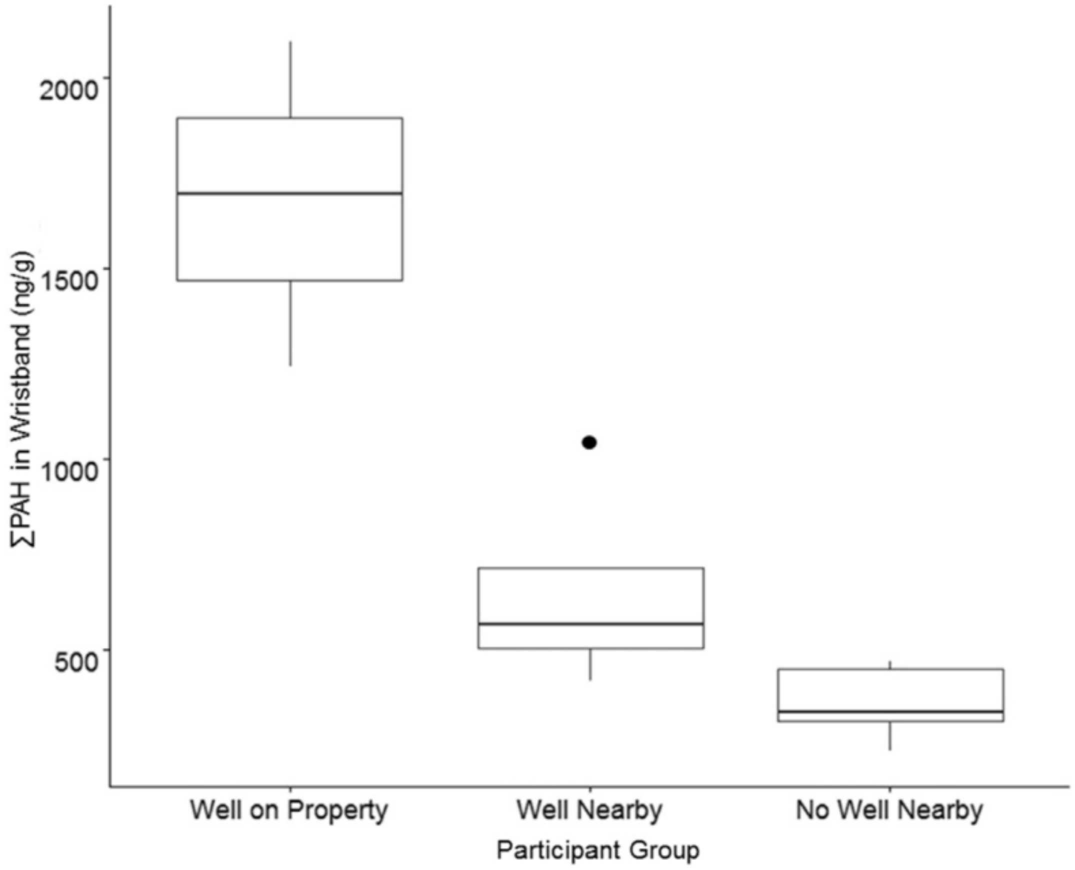
The Silicone Wristband as a Tool for Real-World Chemical Exposure

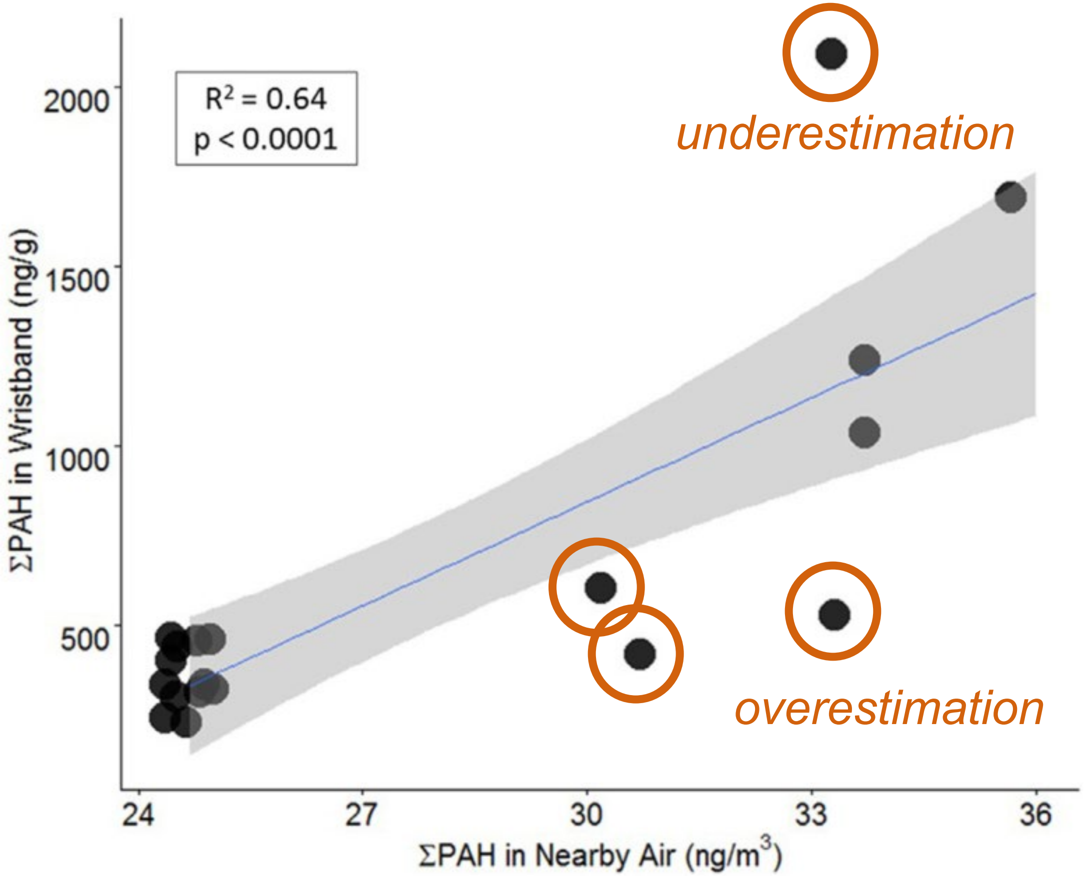
Connecting PAHs in air and the personal environment near rural natural gas extraction



ΣPAH significantly higher in wristbands worn by participants **closer** to active natural gas extraction



Significant positive correlation between **ΣPAH** in wristbands and **ΣPAH** in air near participants homes or workplaces



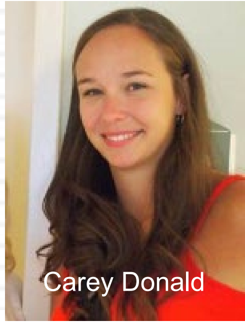
ROYAL SOCIETY OF CHEMISTRY

Silicone wristbands detect individuals' pesticide exposures in West Africa

Carey E. Donald, Richard P. Scott, Kathy L. Blaustein, Mary L. Halbleib, Makhfousse Sarr, Paul C. Jepson, Kim A. Anderson

Published 17 August 2016. DOI: 10.1098/rsos.160433

Published in collaboration with the Royal Society of Chemistry



The Role of Silicone Wristbands in Modern Biomonitoring

Africa *adaptable to many audiences, include many training formats*

Farming community

Thirty-five men, women, and children from farming families in Diender, Senegal were recruited in November 2015 (n=70)

Given two wristbands **to wear for two separate** periods of up to 5 days

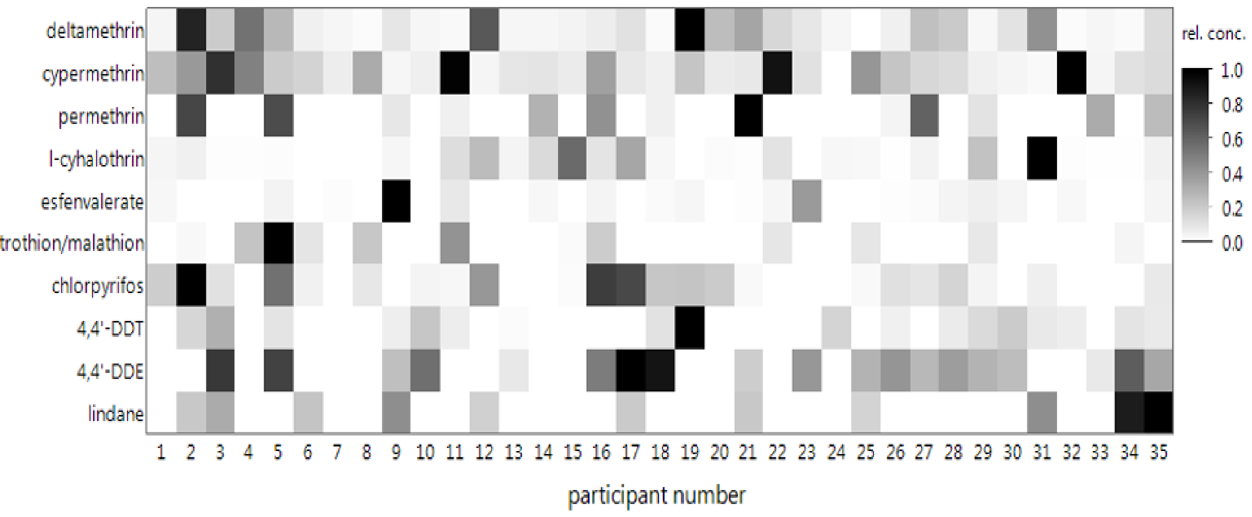
acknowledging limitations of small sample size in studies

Lessons from a Decade+ of Silicone Wristband Use

Intra-Inter individual differences

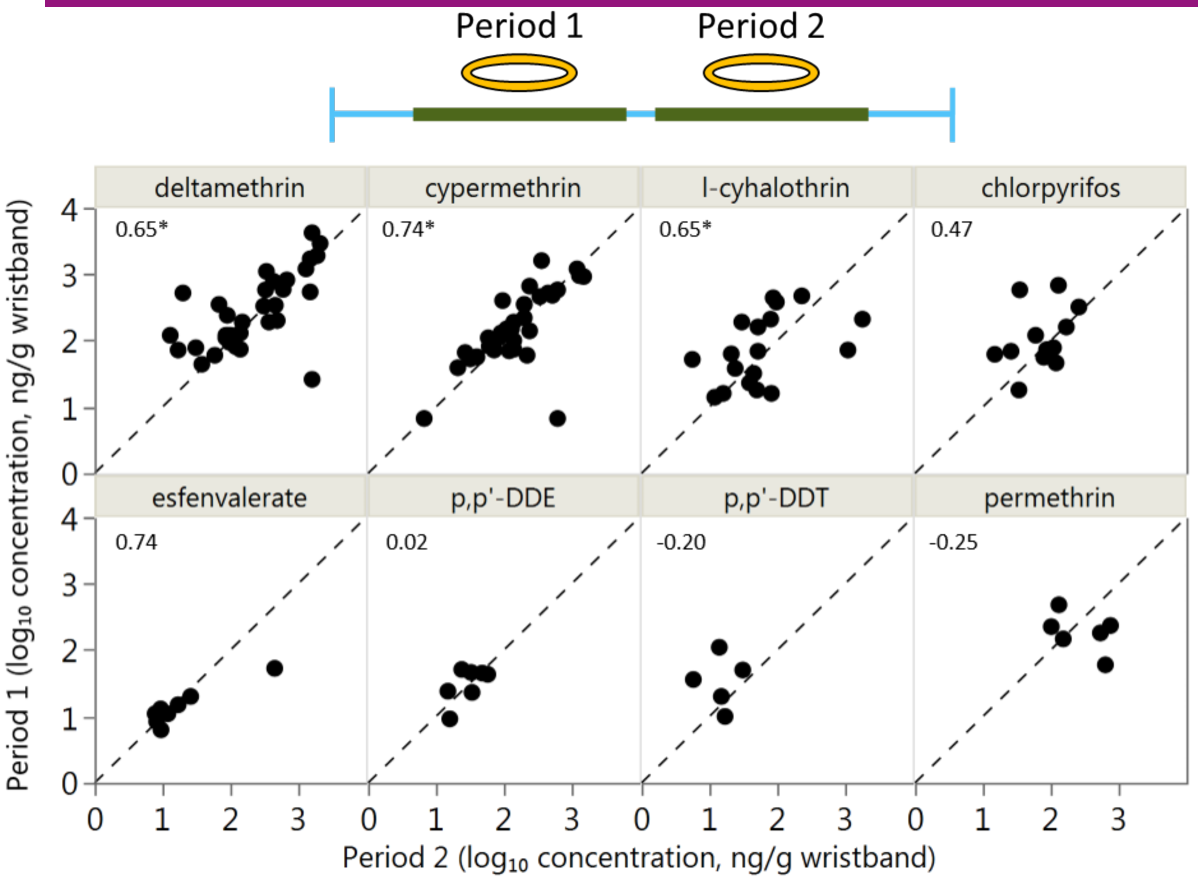
Intra-individual differences large

Frequency of detected pesticides by concentration



Inter-individual differences small

Neither the number of positive detected nor the concentrations of individual pesticides sequestered in a participant's wristband were different between the two periods

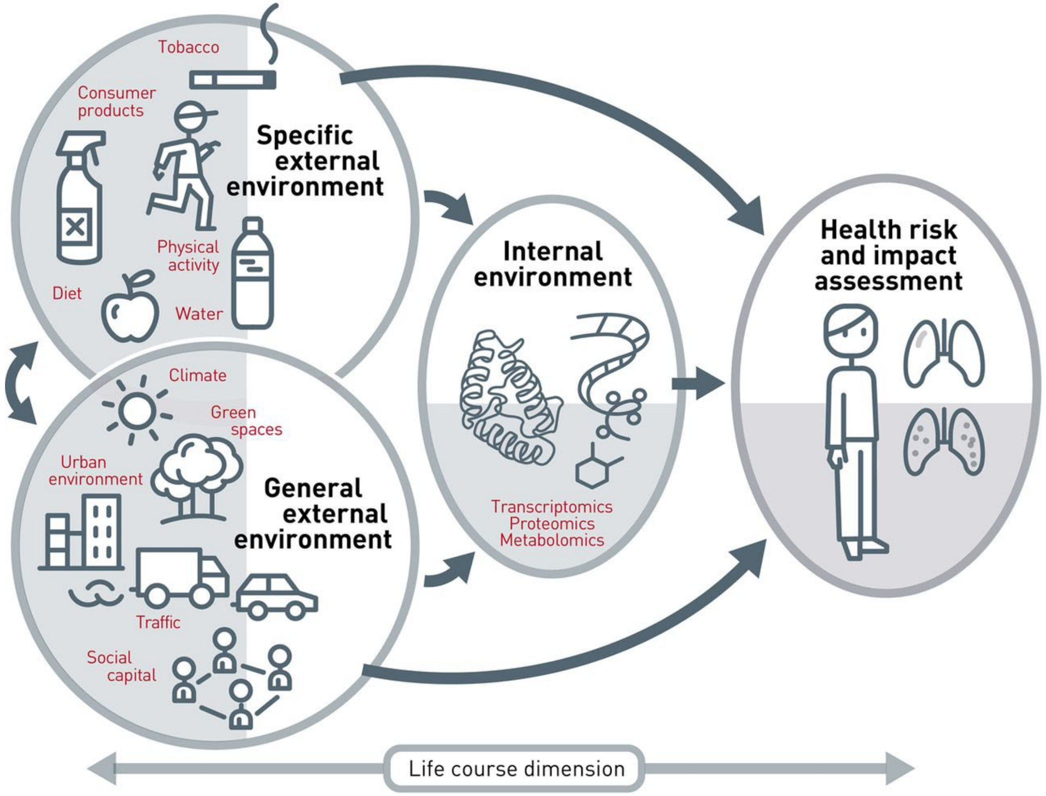


Africa

- 50% QC, 63 pesticides quantified
- 26 were detected in at least one wristband
  - Log K_{oa} ranged from 5.8 (chloroneb) to 12.5 (bifenthrin)
  - Log K_{ow} ranged from 0.8 (dimethoate) to 8.2 (bifenthrin)
- 2 and 10 pesticides in wristbands
- All pesticides reported by participants found
- 19 pesticides detected beyond those reported by participants

Carey E. Donald[a], Richard P. Scott[a], Kathy Blaustein[b], Mary L. Halbleib[b], Makhfousse Sarr[c], Paul C. Jepson[b], and Kim A. Anderson[a]*, Silicone wristbands detect individuals' pesticide exposures in West Africa, Royal Society Open Science, 3, 160433, **2016**.

Chemical exposures & adverse health effects



Vrijheid 2014

- **Interventions**
  - To change behaviors and built environments to reduce exposure to chemical stressors, the external personal chemical environment needs to be studied
  - All chemicals do not have a clear link to an internal biomarker
  - External measurement of chemicals in some cases can provide quicker link to an intervention (some chemicals bioaccumulate)
- **Regulations and Policy**
  - Policy on organic chemical exposures will be based on the external chemical exposure level
  - Due to variability in metabolism, lifestyle, and other personal variables, organic chemical regulations will not be based on biomarker concentrations

Chemical ?= DNA Damage / DNA Methylation ?= Mutation ?= Tumor ?= Cancer


Mutat Res Gen Tox En 822 (2017) 27–33

Contents lists available at ScienceDirect

Mutat Res Gen Tox En

journal homepage: www.elsevier.com/locate/gentox

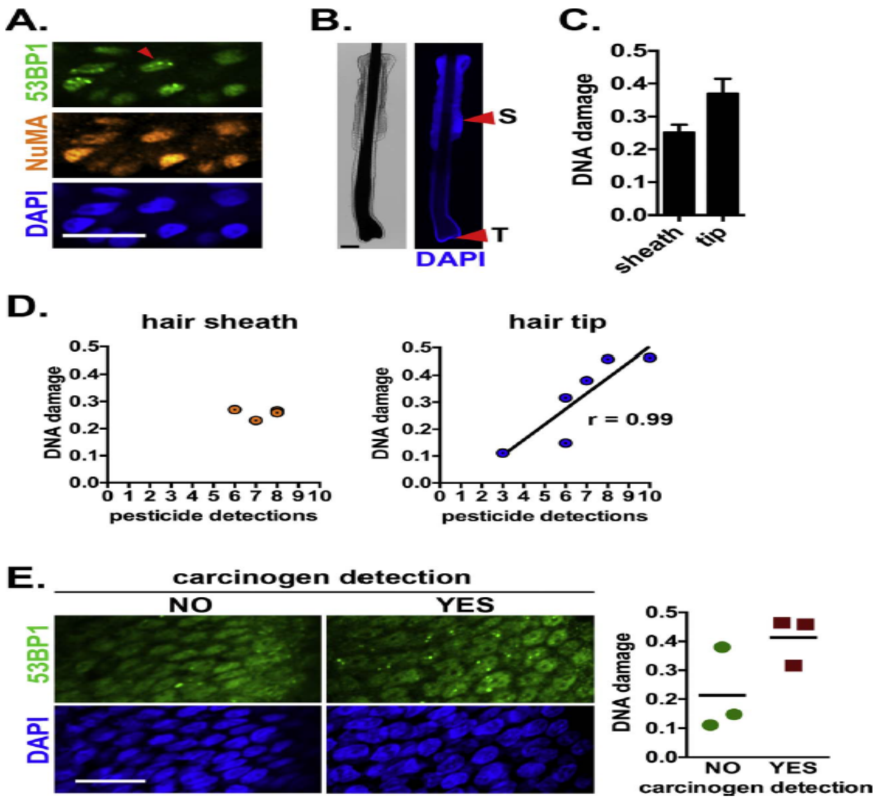
Personal samplers of bioavailable pesticides integrated with a hair follicle assay of DNA damage to assess environmental exposures and their associated risks in children

Pierre-Alexandre Vidi[a,b,*], Kim A. Anderson[c], Haiying Chen[d], Rebecca Anderson[a], Naike Salvador-Moreno[a], Dana C. Mora[e], Carolyn Poutasse[c], Paul J. Laurienti[f], Stephanie S. Daniel[e], Thomas A. Arcury[e,g]

Lessons from a Decade of Silicone Wristband Use

Significant association found between number of pesticides in wristbands and DNA damage in hair follicles

- 7-9 yr olds, n=10
- North Carolina
- Farmwork families
- Kruskal-Wallis testing,
- P<0.05 considered significant



(A) Staining of a child participant hair with antibodies against 53BP1 (DNA damage) and NuMA (staining control). The arrowhead points to a nucleus with DNA repair foci. Nuclei were counterstained with DAPI.
(B) Illustration of the sheath (S) and tip (T) regions of a scalp hair follicle plucked from a participant.
(C) DNA damage (average number of 53BP1 foci/nucleus cross section± SEM) in the sheath and tip regions
(D) DNA damage in hair sheaths or at hair tips, plotted against the number of pesticides detected with wristbands in each participant.
(E) Confocal images of 53BP1 staining (left) and DNA damage quantification (right) in participants with or without detection of pesticides described as carcinogenic by Cal/EPA. Individual values are plotted and means are indicated. Scale bars, 20 μm.

Analytical and Bioanalytical Chemistry (2018) 410:3059–3071
https://doi.org/10.1007/s00216-018-0992-z

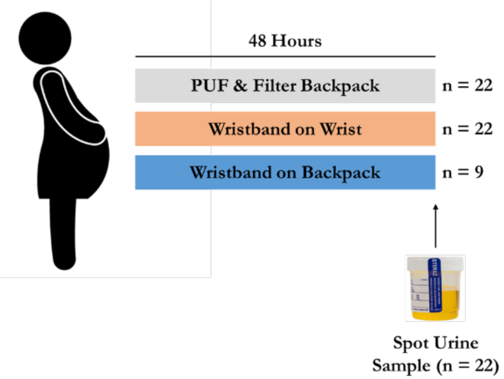
PAPER IN FOREFRONT

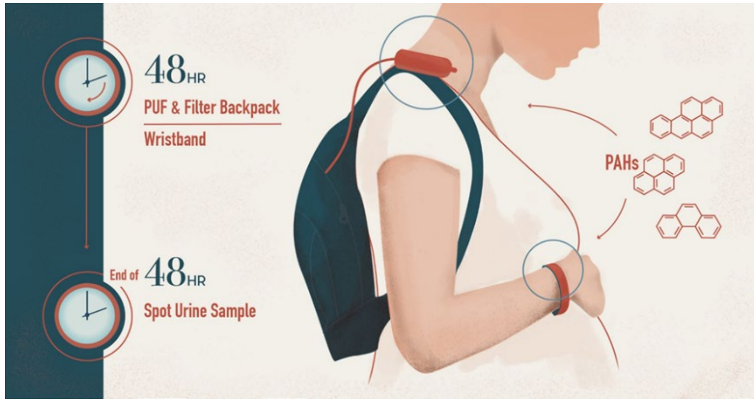
Silicone wristbands compared with traditional polycyclic aromatic hydrocarbon exposure assessment methods

Holly M. Dixon[1] · Richard P. Scott[1] · Darrell Holmes[2] · Lehyla Calero[2] · Laurel D. Kind[3] · Katrina M. Waters[4] · David E. Camann[5] · Antonia M. Calafat[6] · Julie B. Herbstman[2] · Kim A. Anderson[1]

Lessons from a Decade of Silicone Wristband Use

Three times more positive, significant correlations between PAH and OH-PAH pairs in **wristbands and urine** samples than there were between PUFs-filters and urine samples





Continuation:

- 150 women
- Paired wristbands, backpacks, and urine
- Respiratory health of children compared to mother's chemical exposures

Table 4 Correlation table for creatinine-corrected OH-PAHs in urine and PAHs in backpacks (PUFs and filters) and wristbands

PAH	PAH metabolite	Urine PAH metabolite and PUF PAH		Urine PAH metabolite & PUF-filter PAH		Urine PAH metabolite & wristband PAH	
		r_s	*p*-value	r_s	*p*-value	r_s	*p*-value
Naphthalene	1-OH-naphthalene	**0.53**	**0.01***	**0.53**	**0.01***	**0.48**	**0.02***
	2-OH-naphthalene	0.27	0.23	0.27	0.23	**0.44**	**0.04***
	ΣOH-naphthalene[a]	0.35	0.11	0.35	0.11	**0.47**	**0.03***
Fluorene	2-OH-fluorene	**0.44**	**0.04***	**0.44**	**0.04***	0.33	0.13
	3-OH-fluorene	0.08	0.72	0.08	0.72	0.14	0.52
	ΣOH-fluorene[b]	0.33	0.13	0.33	0.13	0.27	0.22
Phenanthrene	1-OH-phenanthrene	0.18	0.41	0.18	0.41	**0.76**	**<0.0001***
	2- and 3-OH-phenanthrene	0.22	0.33	0.22	0.33	0.37	0.09
	4-OH-phenanthrene	0.23	0.30	0.23	0.30	0.18	0.42
	ΣOH-phenanthrene[c]	0.20	0.38	0.20	0.38	**0.64**	**0.002***
Pyrene	1-OH-pyrene	0.11	0.63	0.12	0.59	**0.66**	**0.0009***

[a] Sum of 1-OH-naphthalene and 2-OH-naphthalene concentrations

[b] Sum of 2-OH-fluorene and 3-OH-fluorene concentrations

[c] Sum of 1-OH-phenanthrene, 2- and 3-phenanthrene, and 4-OH-phenanthrene concentrations

* and **bold type** indicates $\alpha < 0.05$

Environmental Research 147 (2016) 365–372
Contents lists available at ScienceDirect
Environmental Research
journal homepage: www.elsevier.com/locate/envres

Using silicone wristbands to evaluate preschool children's exposure to flame retardants

Molly L. Kile[a], Richard P. Scott[c], Steven G. O'Connell[c], Shannon Lipscomb[a,b], Megan MacDonald[a], Megan McClelland[a], Kim A. Anderson[c,*]

Lipscomb et al. Environmental Health (2017) 16:23
DOI 10.1186/s12940-017-0224-6
Environmental Health
RESEARCH Open Access

Cross-sectional study of social behaviors in preschool children and exposure to flame retardants

Shannon T. Lipscomb[1], Megan M. McClelland[2], Megan MacDonald[2], Andres Cardenas[3], Kim A. Anderson[4] and Molly L. Kile[2*]

Environmental Science & Technology
Article
pubs.acs.org/est

Measuring Personal Exposure to Organophosphate Flame Retardants Using Silicone Wristbands and Hand Wipes

Stephanie C. Hammel,[†] Kate Hoffman,[†] Thomas F. Webster,[‡] Kim A. Anderson,[§] and Heather M. Stapleton*[,†]

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Built Environment: Flame retardants in wristbands associated with children's social skills

Children with higher flame retardant exposures exhibited poorer social skills in three domains that play an important role in a child's ability to succeed academically and socially

1. **Higher organophosphate** flame retardant exposure were rated by their preschool teachers to show less responsible behavior and more externalizing behavior problems
2. Children with higher exposure to **brominated** flame retardants were rated by their preschool teachers as less assertive

Table 3 Multiple regression analyzes that examined the relationship between two classes of flame retardants and social behavior subscales (*n* = 69) adjusted for gender, age, family context, and child's exposure to adverse experiences

	Assertion	Responsibility	Externalizing
	B (*SE*)®	*B* (*SE*)®	*B* (*SE*)®
Covariates			
Gender[a]	0.21 (0.10) 0.21*	0.44 (0.10) 0.43**	−0.29 (0.10) −0.30**
Age	0.32 (0.07) 0.44**	0.24 (0.07) 0.33**	−0.12 (0.10) −0.18
Family Context	0.13 (0.08) 0.18[†]	0.21 (0.08) 0.27**	−0.21 (0.11) −0.32[†]
Adverse Experiences	0.04 (0.07) 0.06	−0.04 (0.07) −0.05	0.31 (0.10) 0.42**
Flame Retardants			
Ln ΣPBDE	−0.13 (0.04) −0.31**	0.03 (0.04) 0.07	−0.05 (0.10) −0.04
Ln ΣOPFR	0.09 (0.06) 0.15	−0.16 (0.06) −0.25**	0.24 (0.10) 0.31*
R square	0.41	0.44	0.35
R square for model without Flame Retardant variables	0.28	0.29	0.19

[a]0 = male, 1 = female
B = Unstandardized Estimate. *SE* standard error. ® = Standardized Estimate
[†]*p* < .10. **p* < .05. ***p* < .01

FROM CONCEPT TO GLOBAL IMPACT:

DISCOVERY OF COMMON CHEMICAL EXPOSURES ACROSS THREE CONTINENTS USING SILICONE WRISTBANDS

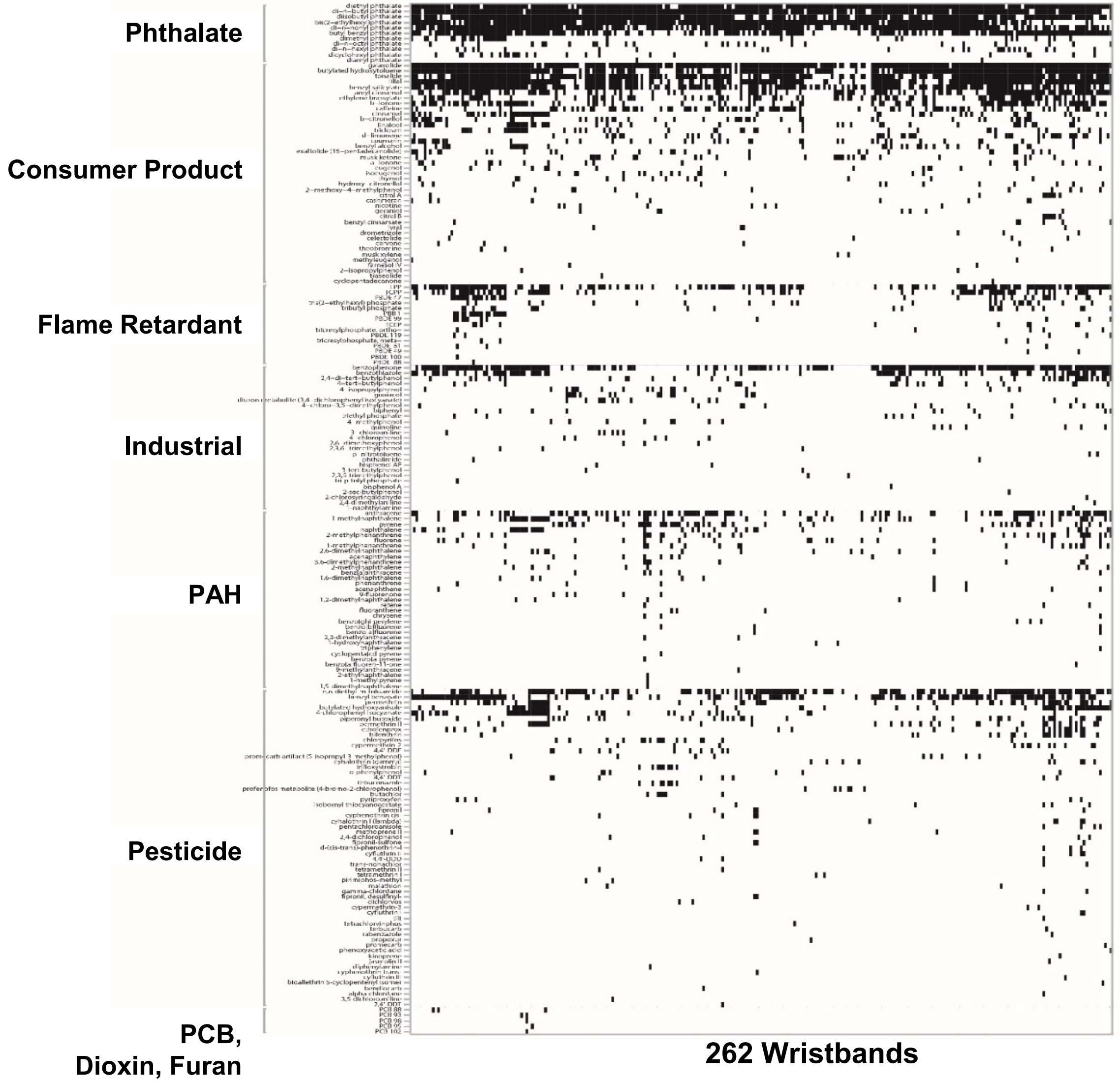
Two hundred and forty-seven volunteers from fifteen distinct communities in the U.S.A., Senegal, South Africa, and Peru

Discovery of common chemical exposures across three continents using silicone wristbands

Published:06 February 2019https://doi.org/10.1098/rsos.181836

Measuring What Matters:

No Two Wristbands Have Same Chemical Detection Profile



400,860 chemical data points

Patterns Emerge

14 chemicals in over 50% of the wristbands

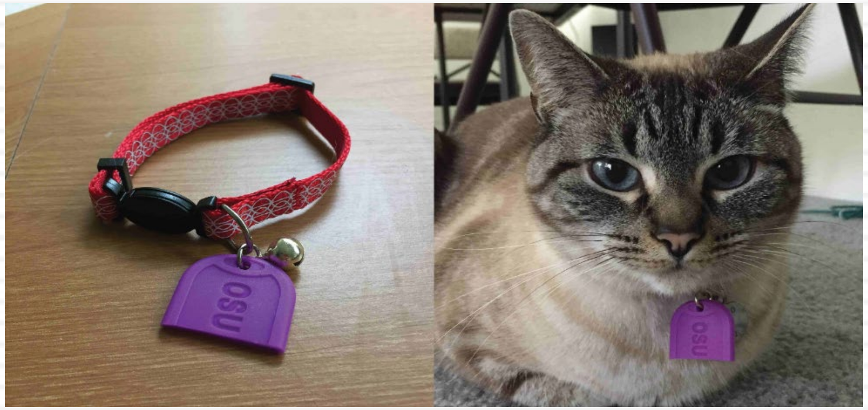
Chemical	Frequency of Detection out of 262 Wristbands (%)	Potential Endocrine Disruptor Chemical
diethyl phthalate	94	Yes
galaxolide	93	Yes
di-n-butyl phthalate	92	Yes
diisobutyl phthalate	85	Yes
bis(2-ethylhexyl)phthalate	84	Yes
di-n-nonyl phthalate	82	Yes
butylated hydroxytoluene	78	Yes
tonalide	76	Yes
lilial	75	Yes
benzyl salicylate	73	Yes
butyl benzyl phthalate	66	Yes
benzophenone	64	Yes
triphenyl phosphate	52	Yes
N,N-diethyl-m-toluamide	52	No

U.S. in 2008 banned these in conc. >0.1% in children toys and articles

DEET, insect repellent

The Role of Silicone Wristbands in Modern Biomonitoring

Hyperthyroid Case-Control Silicone Cat Tag Studies



- Tris(1,3-dichloro-2-isopropyl) phosphate (TDCIPP) concentrations were higher in hyperthyroid than non-hyperthyroid pet tags (adjusted odds ratio, $p<0.07$; Mantel-Cox, $p<0.02$).
- Higher TDCIPP concentrations were associated with higher fT_4 and TT_4 concentrations ($p<0.05$).

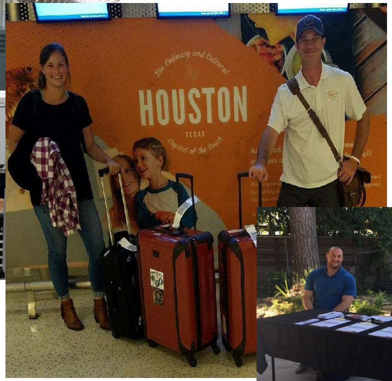
Poutasse C. et al, ES&T 2019: and Nelson et al 2025 in review

Exposures from Environmental Disasters

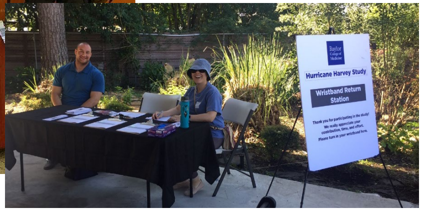
First Responders, Cleanup Crews, Citizens, after disasters

Preparing wristbands
Quality control before using wristbands

Preparation logistics



Communities



"Go" travel bags
Disaster IRB in place
Trained staff

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Bracelets Can Detect Chemical Exposures

The next wave of wrist wear might act as a fashionable archive of your exposure to everything from caffeine to pesticides

Mar 7, 2014 | By Brian Bienkowski and Environmental Health News

Wristbands are the accessory of choice for people promoting a cause. And the next wave of wrist wear might act as a fashionable archive of your chemical exposure.

Researchers at Oregon State University outfitted volunteers with slightly modified silicone bracelets and then tested them for 1,200 substances. They detected several dozen compounds – everything from caffeine and cigarette smoke to flame retardants and pesticides.

Silicone in wristbands absorbs chemicals. Researchers used modified ones to test people's exposure to 1,200 substances, such as flame retardants and cigarette smoke.
Credit: LexnGer/Flickr

"We were surprised at the breadth of chemicals," said Kim Anderson, a professor and chemist who was senior author of the study published in Environmental Science & Technology.

Response, Recovery, and Resilience to Oil Spills and Environmental Disasters: Exploration and Use of Novel Approaches to Enhance Community Resilience

Margaret A. Reams, PhD
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Wilma Subra, MS
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Lane Tidwell, PhD
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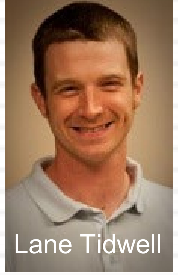
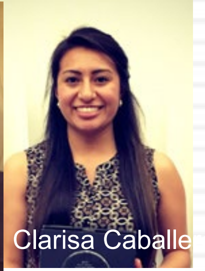
Department of Environmental and Molecular Toxicology
Oregon State University





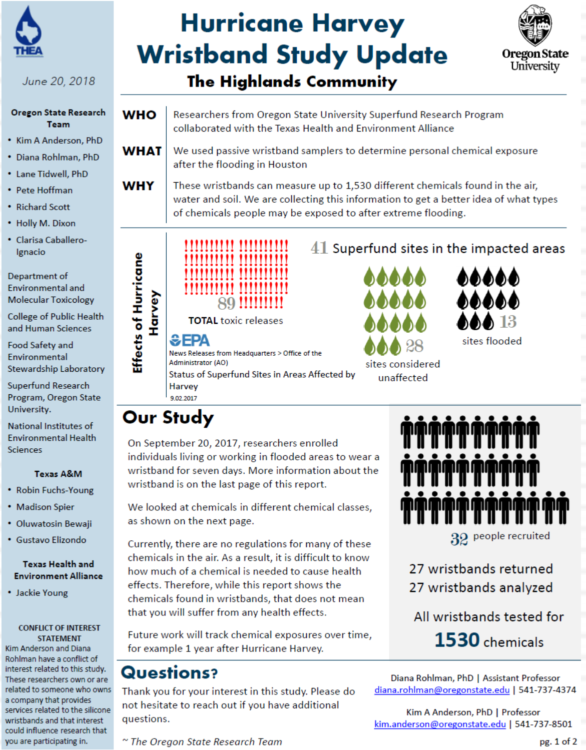
Data given to community and participants prior to general publications

The Role of Silicone Wristbands in Modern Biomonitoring

Rapid Response Hurricane Harvey: chemicals exposures can not be known *a priori*, lots of unknowns….

The Houston Health Dept stated that "millions of contaminants" were present in floodwaters.

Hiroko Tabuchi & Shelia Kaplan, A Sea of Health and Environmental Hazards in Houston's Floodwaters, *New York Times* (August 31, 2017)



THEA

June 20, 2018

Hurricane Harvey Wristband Study Update

The Highlands Community

Oregon State University

Oregon State Research Team

- Kim A Anderson, PhD
- Diana Rohlman, PhD
- Lane Tidwell, PhD
- Pete Hoffman
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- Oluwatosin Bewaji
- Gustavo Elizondo

Texas Health and Environment Alliance

- Jackie Young

CONFLICT OF INTEREST STATEMENT

Kim Anderson and Diana Rohlman have a conflict of interest related to this study. These researchers own or are related to someone who owns a company that provides services related to the silicone wristbands and that interest could influence research that you are participating in.

WHO Researchers from Oregon State University Superfund Research Program collaborated with the Texas Health and Environment Alliance

WHAT We used passive wristband samplers to determine personal chemical exposure after the flooding in Houston

WHY These wristbands can measure up to 1,530 different chemicals found in the air, water and soil. We are collecting this information to get a better idea of what types of chemicals people may be exposed to after extreme flooding.

Effects of Hurricane Harvey

89 **TOTAL** toxic releases

EPA
News Releases from Headquarters > Office of the Administrator (AO)
Status of Superfund Sites in Areas Affected by Harvey
9.02.2017

41 Superfund sites in the impacted areas

28 sites considered unaffected

13 sites flooded

Our Study

On September 20, 2017, researchers enrolled individuals living or working in flooded areas to wear a wristband for seven days. More information about the wristband is on the last page of this report.

We looked at chemicals in different chemical classes, as shown on the next page.

Currently, there are no regulations for many of these chemicals in the air. As a result, it is difficult to know how much of a chemical is needed to cause health effects. Therefore, while this report shows the chemicals found in wristbands, that does not mean that you will suffer from any health effects.

Future work will track chemical exposures over time, for example 1 year after Hurricane Harvey.

32 people recruited

27 wristbands returned
27 wristbands analyzed

All wristbands tested for
1530 chemicals

Questions?

Thank you for your interest in this study. Please do not hesitate to reach out if you have additional questions.

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~ The Oregon State Research Team

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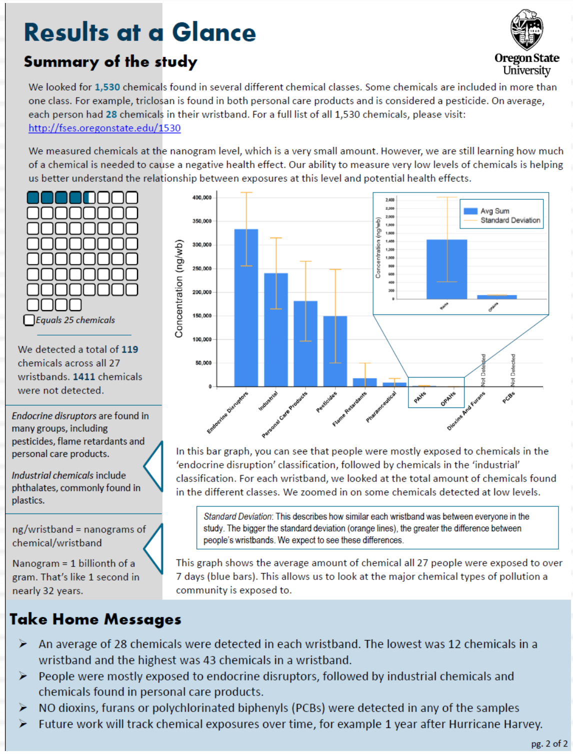

Results at a Glance

Summary of the study

Oregon State University

We looked for **1,530** chemicals found in several different chemical classes. Some chemicals are included in more than one class. For example, triclosan is found in both personal care products and is considered a pesticide. On average, each person had **28** chemicals in their wristband. For a full list of all 1,530 chemicals, please visit: http://fses.oregonstate.edu/1530

We measured chemicals at the nanogram level, which is a very small amount. However, we are still learning how much of a chemical is needed to cause a negative health effect. Our ability to measure very low levels of chemicals is helping us better understand the relationship between exposures at this level and potential health effects.

Equals 25 chemicals

We detected a total of **119** chemicals across all 27 wristbands. **1411** chemicals were not detected.

Endocrine disruptors are found in many groups, including pesticides, flame retardants and personal care products.

Industrial chemicals include phthalates, commonly found in plastics.

In this bar graph, you can see that people were mostly exposed to chemicals in the 'endocrine disruption' classification, followed by chemicals in the 'industrial' classification. For each wristband, we looked at the total amount of chemicals found in the different classes. We zoomed in on some chemicals detected at low levels.

Standard Deviation: This describes how similar each wristband was between everyone in the study. The bigger the standard deviation (orange lines), the greater the difference between people's wristbands. We expect to see these differences.

ng/wristband = nanograms of chemical/wristband

Nanogram = 1 billionth of a gram. That's like 1 second in nearly 32 years.

This graph shows the average amount of chemical all 27 people were exposed to over 7 days (blue bars). This allows us to look at the major chemical types of pollution a community is exposed to.

Take Home Messages

- An average of 28 chemicals were detected in each wristband. The lowest was 12 chemicals in a wristband and the highest was 43 chemicals in a wristband.
- People were mostly exposed to endocrine disruptors, followed by industrial chemicals and chemicals found in personal care products.
- NO dioxins, furans or polychlorinated biphenyls (PCBs) were detected in any of the samples
- Future work will track chemical exposures over time, for example 1 year after Hurricane Harvey.

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Wristband Limitations & Considerations

- Time integrated
- Not real time
- Must be worn for a few hours
- External environmental exposures can include dermal
- Independent measure
- Our webpage:
  - **http://fses.oregonstate.edu/faq-page**

Quick Links: Analytical Methods || Wristbands - Frequently Asked Questions || Technical Attributes of Wristbands

Frequently Asked Questions

The following are questions frequently asked about the FSES Program's silicone wristbands. Our Technical Attributes page pro capabilities of our wristband technology.

Passive wristband samplers (9)

1. What kind of chemicals do the wristbands sample?
2. What are your wristbands made of?
3. How do I wear the wristband? Do I need to do anything special?
4. What happens if I drop it?
5. Can I wear the wristband at work?
6. I damaged my wristband, what should I do?
7. How long will I wear the wristband?
8. Because of my work I have to wear gloves/long sleeves or shirts. Can I wear my wristband in a place other than my wrist? (pocket, etc.)
9. Does the color matter, can I get a different color?

Chemical detection (9)

1. How are wristbands analyzed after they have been worn?
2. Can the samplers "fill up" with chemicals? Does it have a limit on how much it can sample?
3. Can you detect pollutants coming from natural gas activities and infrastructure (fracking)?
4. Can you detect urban pollutants like vehicle exhaust, smog, etc.?
5. Can you detect household concerns like mold, mildew, radon, lead, and carbon monoxide?
6. Can you detect agricultural pollutants like pesticides, fertilizers, and smoke from field burning?
7. What are your detection limits like? (How low can you go?)

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FEMA FP000754,

Oregon Taxpayers

In accordance with her management plan, Dr. Kim Anderson, **discloses** a financial interest in MyExposome, Inc.

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Swinomish Indian Tribal Community
Confederated Tribes of the Umatilla Indian Reservation

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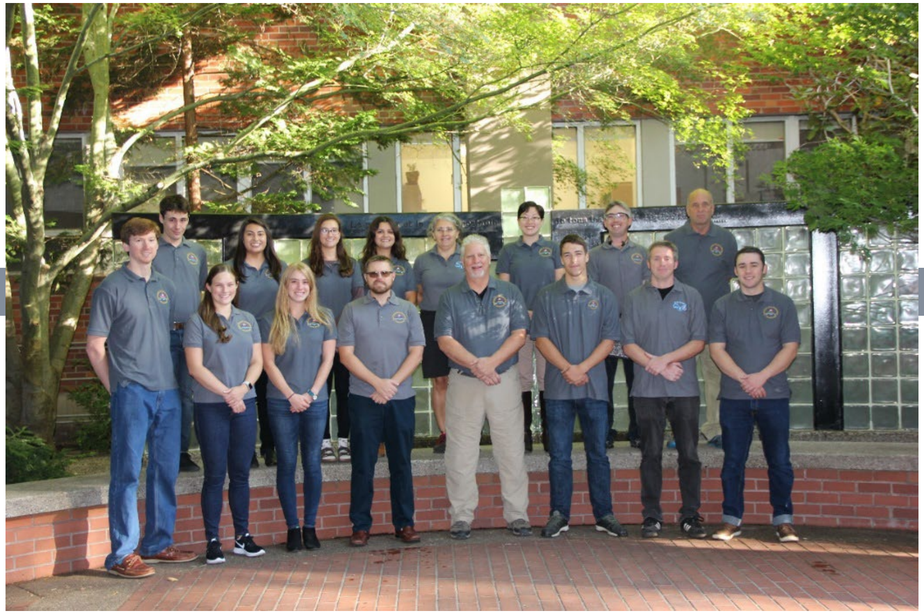
Mobile AL Ben Secour
National Refugre, J. Issacs
Pensacola FL Gulf Islands National Seashore, R. Hoggard



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Christine Ghetu, PhD
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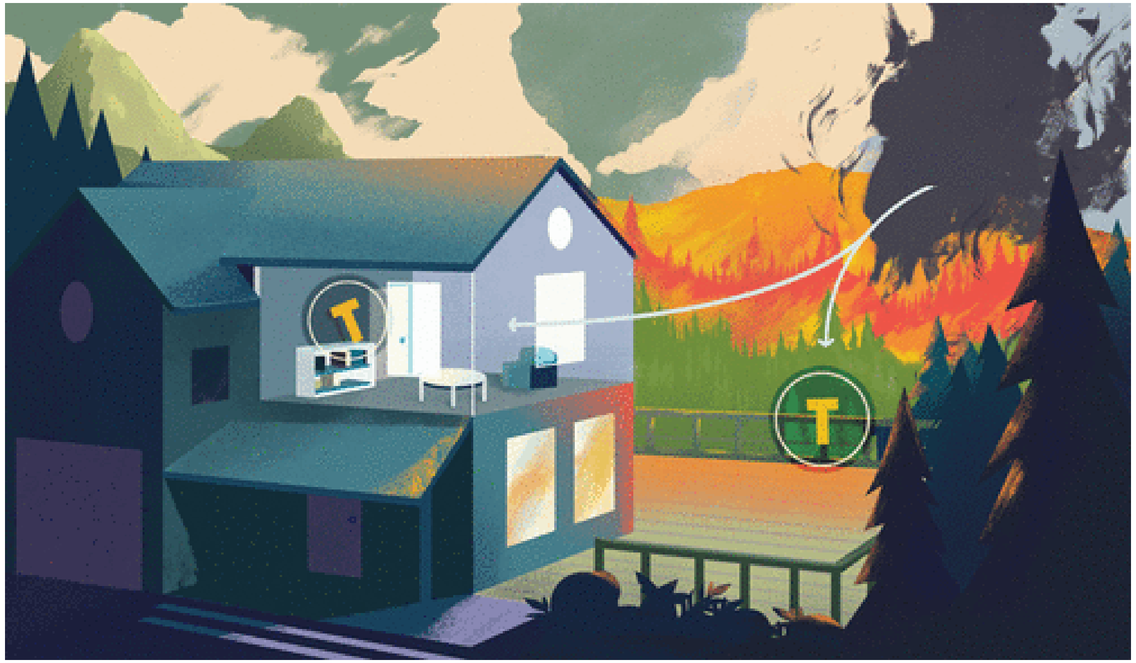
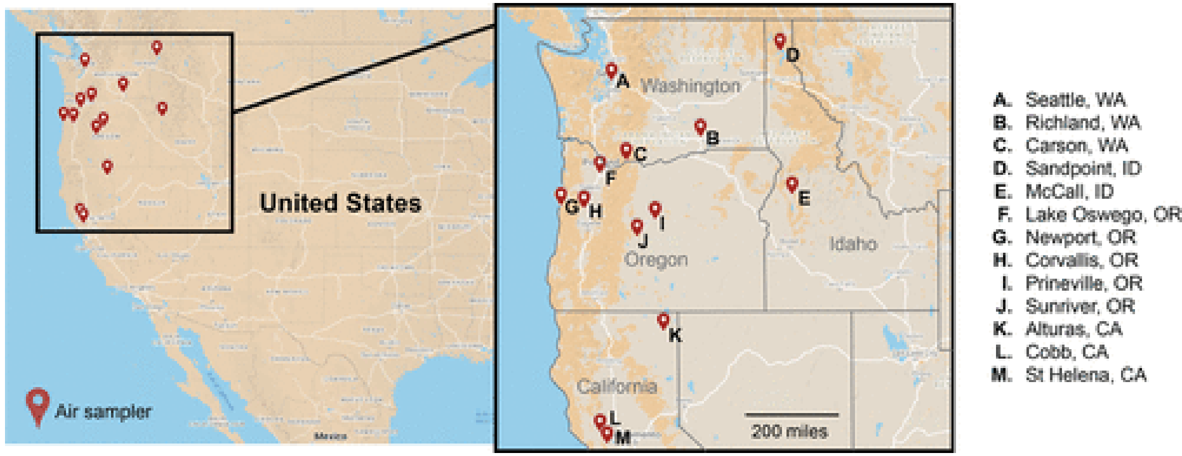
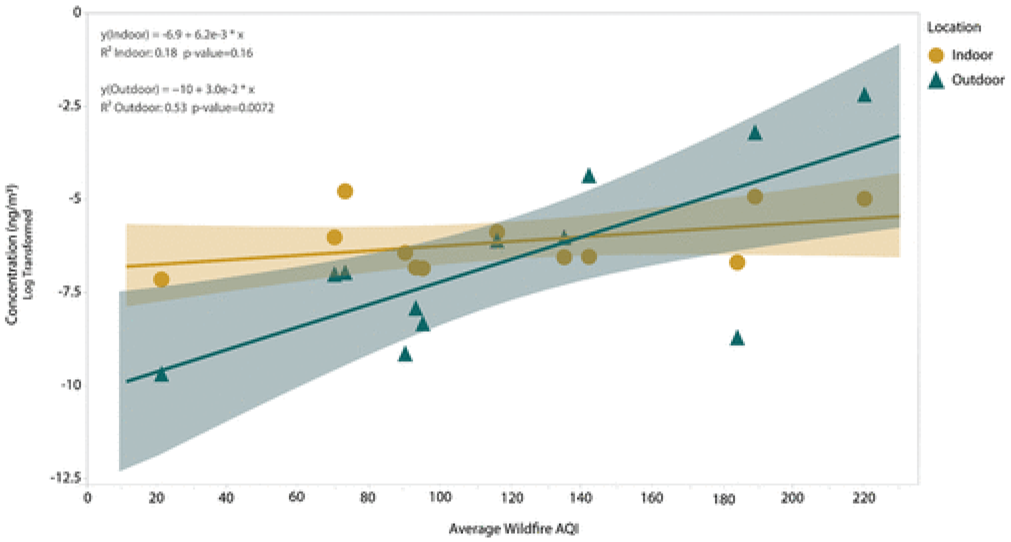
Bree Rivera, PhD
Clarisa Caballero
Ian Moran, PhD
Emily Bonner, PhD

A New Lens on Exposure

Wildfires: PAHs **higher indoors** during wildfires until AQI >150







Questions?

http://cen.acs.org/articles/94/i16/simple-way-track-everyday-exposure.html

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