Integrating Intersectionality into the Exposome:
Applications for Theory, Data, and Practice

Ami R. Zota, ScD, MS
@amizota

Associate Professor
Department of Environmental and Occupational Health
George Washington University Milken Institute School of Public Health

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How can environmental health sciences be more effective in advancing health equity and environmental justice?

Exposome

• Contextual model of disease that considers the totality of an individual’s environmental exposures across the life course.

• **External** measures of exposure: chemical and physical hazards in food, consumer products, water, air, soil, and built environment

• **Internal** measures of exposure – often measured on “-omics” technologies, include epigenome, proteome, metabolome

Wild 2012; Stingone et al. 2017; Zota and VanNoy 2020
Intersectionality

- Theoretical framework for understanding how multiple social identities (e.g., race, gender, and SES) intersect at the microlevel of individual experience to reflect interlocking systems of privilege and oppression (e.g., racism, sexism, classism) at the macro social-structural level.

- Social identities are not independent and unidimensional but multiple and intersecting.

- People from multiple historically oppressed and marginalized groups are the focal or starting point.

Crenshaw 1991; Bowleg 2012; Zota and VanNoy 2021

Image credit: Ahmad and Zota
Applications of our framework

What are upstream drivers of environmental exposures?

How can we move away from framing race as a biological construct?

How does intersectional discrimination become biologically embedded?

How can we center experiences of people who are marginalized?

Who do our studies neglect?

How can we move towards intersectionality-informed public policy?

Else-Quest and Hyde 2016; Zota and VanNoy 2021
Black women are more highly exposed to beauty-product related chemicals.

Reproductive-aged women (n=739), NHANES 2001-2004

Branch et al. Environ Health 2015

Black

Mexican American

White

P <0.001

Geometric Mean (ng/mL)

MEP

MBP

P <0.001
Typical Environmental Health Framework: Focus on individual behaviors

- Beauty Product Use
- Chemical Exposure Burden
- Adverse Health Outcomes
Environmental Injustice of Beauty

- Intersectional Discrimination
- Racialized Beauty Practices
- Beauty Product Use
- Chemical Exposure Burden
- Health Inequities
Internalized Racism

Policies/Dress Codes
Targeted Advertising
Cultural Norms
Peer Pressure

Beauty Rituals

Structural racism, Patriarchy, Colonialism

Zota and Shamasunder, AJOG 2018
## Environmental Injustice of Beauty Examples

<table>
<thead>
<tr>
<th>Racialized Beauty Norm</th>
<th>Vulnerable Populations</th>
<th>Product Use</th>
<th>Chemical Exposures</th>
<th>Potential Adverse Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorism</td>
<td>Dark skinned women</td>
<td></td>
<td>Mercury</td>
<td>Mercury poisoning, neurotoxicity</td>
</tr>
<tr>
<td>Hair texture preferences</td>
<td>African American women</td>
<td></td>
<td>Parabens, phthalates, siloxanes</td>
<td>Uterine fibroids, breast cancer</td>
</tr>
<tr>
<td>Cultural norms about odor</td>
<td>African American and Latinx women</td>
<td></td>
<td>Phthalates, talc powder</td>
<td>Gynecologic cancers, endocrine disruption</td>
</tr>
</tbody>
</table>

Zota and Shamasunder, AJOG 2018
Intersectional Discrimination

Racialized Beauty Practices

Beauty Product Use

Chemical Exposure Burden

Adverse Health Outcomes

California’s Toxic-Free Cosmetics Act

Re-imagining the Policy Landscape
What if we target upstream, structural drivers of beauty product use?

The CROWN Act is a law that prohibits race-based hair discrimination in schools and the workplace.
Race, Phthalates, and the Fibroid Epigenome
Fibroids are more severe and common in Black women compared to White women. Black women have:

- 3 times greater lifetime risk of experiencing fibroids
- 3.5 times the annual rate of hospitalization due to fibroids
- 6.8 times the annual rate of myomectomy
- 2.4 times the annual rate of hysterectomy

Fibroids are larger, more numerous, grow more rapidly, and occur at an earlier age in Black women compared to White women.

Eltoukhi et al. 2014; Wechter et al. 2011; Jacoby et al. 2010; Laughlin-Tommaso et al. 2017
Conceptualization of race in fibroid research

• Most fibroid scientists have conceptualized race as a biological factor and focus on identifying molecular and genetic mechanisms responsible for racial disparities.

• Although isolated studies have found some biological differences between Black and White women, genetic and molecular differences do not explain increased fibroid burden for Black women.

• **Race is not a biological construct:** racial categories are weak proxies for genetic diversity. Use of biological concepts of race in biomedical, public health, and genetics research is problematic because racial groups are heterogenous and lack clear-cut genetic boundaries.

• **Race:** social classification of people based on phenotype

• **Structural racism,** a confluence of institutions, culture, history, ideology, and codified practices that generate and perpetuate inequity among racial and ethnic groups, has been underexamined.

Hardeman et al. NEJM 2016; Yudell et al. Science 2016; Yaeger et al. 2008; Zota and VanNoy 2021; Hayden et al. 2018
Fibroids, Observational Research on Genes and the Environment (FORGE)

Research Team

**Public Health**
Dr. Ami Zota, ScD, MS

**Gynecologic Surgery**
Dr. Gaby Moawad, MD

**Human Epigenetics**
Dr. Andrea Baccarelli, MD, PhD

**Environmental Chemistry**
Dr. Antonia Calafat, PhD

**Social Psychology**
Dr. Lisa Bowleg, PhD, MA

**Radiology**
Dr. Nadia Khati, MD

**Bioinformatics**
Dr. Shuang Wang, PhD

**Transdisciplinary research effort to address racial inequities in uterine fibroids**

Types of Research Questions

- What are environmental determinants of uterine fibroid outcomes?
- What biological processes in fibroid pathogenesis may be impacted by environmental exposures?
- For Black women, how does the social experience of race impact their disease trajectory?
Exposure Disparities

Beauty product-related phthalate exposure was more than 30% higher in Black women.

Zota et al. *Fertility and Sterility* 2018
Higher urinary concentrations of DEHP and other high MW phthalates associated with an increase in uterine volume

A doubling in ΣDEHP exposure was associated with 33.2% (95% CI: 6.6 – 66.5) increase in uterine volume

Regression models adjusted for age, race, and BMI

Zota et al. Fertility and Sterility 2018
Phthalates associated with miRNA expression with evidence of effect modification by race/ethnicity

N=45

leiomyoma (N=45)  
myometrium (N=19)

754 miRNAs measured with Taqman Open Array

After multiple comparison adjustments:
• fibroid vs. myometrium: 74 miRNAs differed
• No significant differences by race/ethnicity
• 2 significant phthalate-miRNA associations
• 8 phthalate-miRNA associations varied by race/ethnicity

Phthalate metabolite MBzP is only associated with miR-494-3p in Black women and only associated with miR-1227-3p in White/Latina women

Zota et al. Epigenetics Insights. 2020
Using qualitative data to understand Black women’s psychosocial experiences seeking surgical care with fibroids

**Major themes**

<table>
<thead>
<tr>
<th>Patient-Provider Interactions</th>
<th>The Social and Historical Value of the Uterus</th>
<th>Fertility Consequences and Fear of Malignancy</th>
<th>The Role of Community</th>
</tr>
</thead>
<tbody>
<tr>
<td>The fibroid diagnosis experience and interactions with clinicians impacted how participants navigated fibroids care and management</td>
<td>While some respondents expressed positive or neutral feelings about hysterectomy as a treatment option, others reacted negatively to the recommendation, conveying medical mistrust</td>
<td>Younger women were concerned about the fertility consequences of fibroids, and a small group of participants were concerned that fibroids could be cancerous</td>
<td>Social networks and community norms about reproductive health were instrumental in how Black participants conceptualized fibroids and evaluated their medical options.</td>
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</table>

"The only [women] who told me… to find other doctors, were the [women] who were told [by clinicians] to have a hysterectomy…and [they] were like, “No, I don’t want that. I want to keep my uterus.” It was interesting in the sense that all of them were Black women. And so, we all did not know whether there was a concept of our uterus isn’t valued because we’re Black women, is it because we’re not valuable as Black women?” (Lauren, age 42, M)
Moving the Work Forward using an Intersectionality Framework

• Integration of sexual and gender minorities
  • Transmen without fibroids having hysterectomies as part of gender transition

• Identification of novel epigenetic signaling pathways in fibroids
  • Characterizing microRNA profiles in extracellular vesicles extracted from blood to help identify a non-invasive biomarker for fibroids

• Characterizing impacts of gendered racism using mixed-method approach
  • Conduct qualitative focus groups and integrate the Gendered Racial Microaggression Scale, which captures experiences of racism and sexism simultaneously
Benefits of integrating intersectionality into the exposome

- Greater ability to examine the interplay between social and historical processes, and systems of power and oppression that shape environmental health risks
- Greater attention to causal processes producing environmental health inequities
- Lead to development of more effective interventions and public policy that address systemic change

Zota and VanNoy 2021
Agents of Change in Environmental Health

A science communication program that amplifies voices of next generation environmental health and justice leaders who come from historically under-represented backgrounds in science and academia

https://www.agentsofchangeineh.com/
@agentschangeEh
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Co-Investigators/Collaborators

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