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

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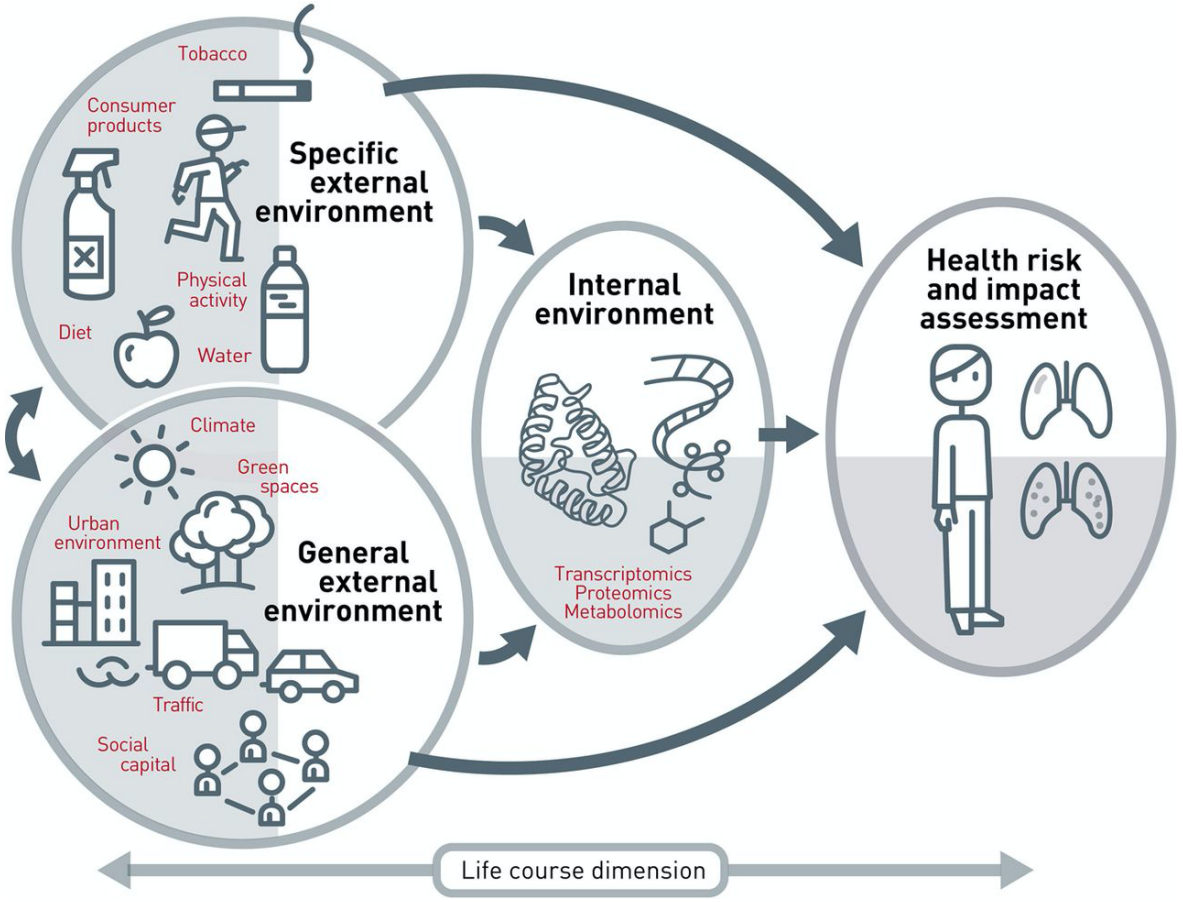
How can environmental health sciences be more effective in advancing health equity and environmental justice?

Zota AR and VanNoy BN. Integrating Intersectionality into the Exposome Paradigm: A Novel Approach to Racial Inequities in Uterine Fibroids. *American Journal of Public Health* 2021; 111: 104-109

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.

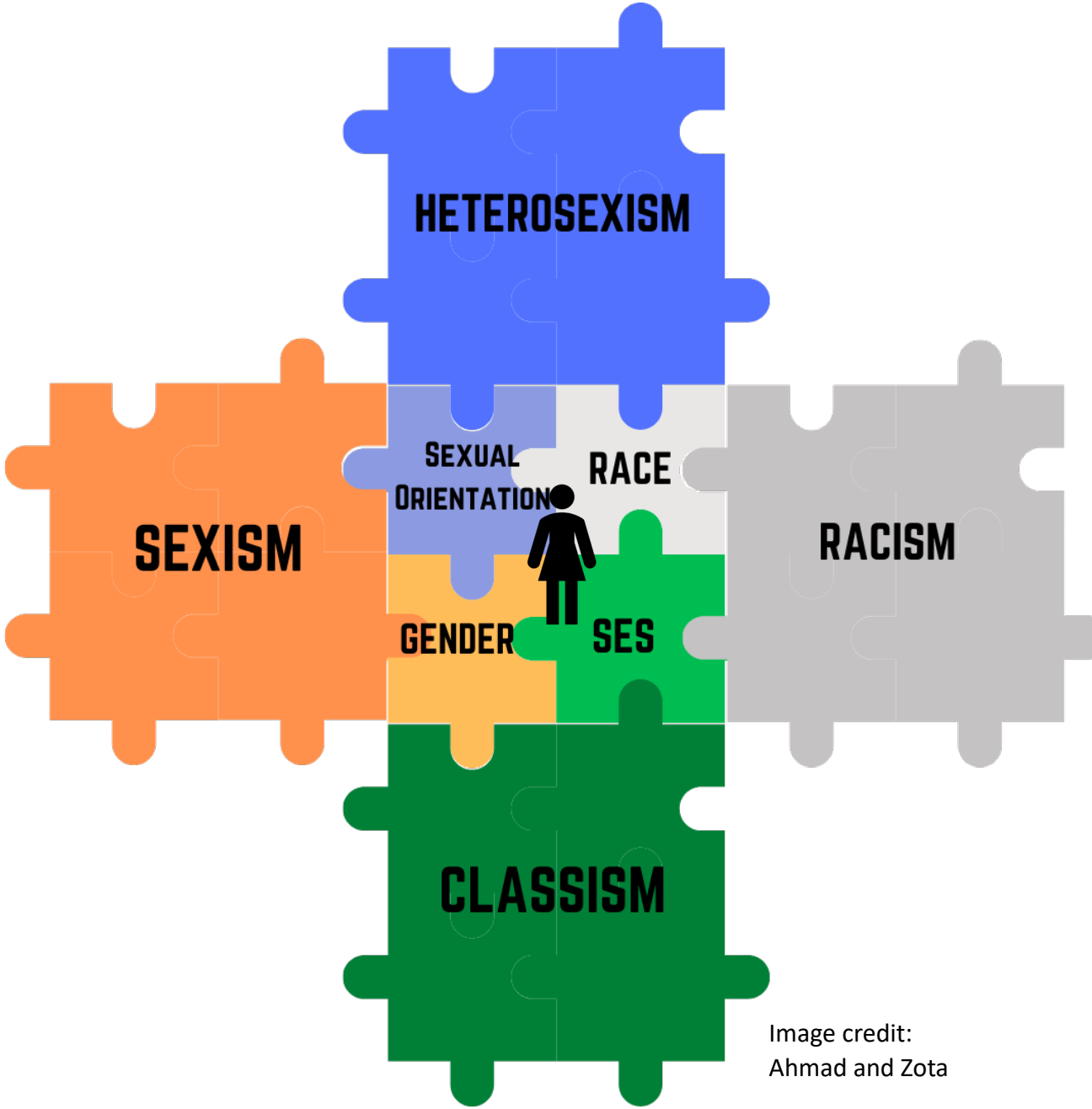


Image credit:
Ahmad and Zota

Crenshaw 1991; Bowleg 2012; Zota and VanNoy 2021

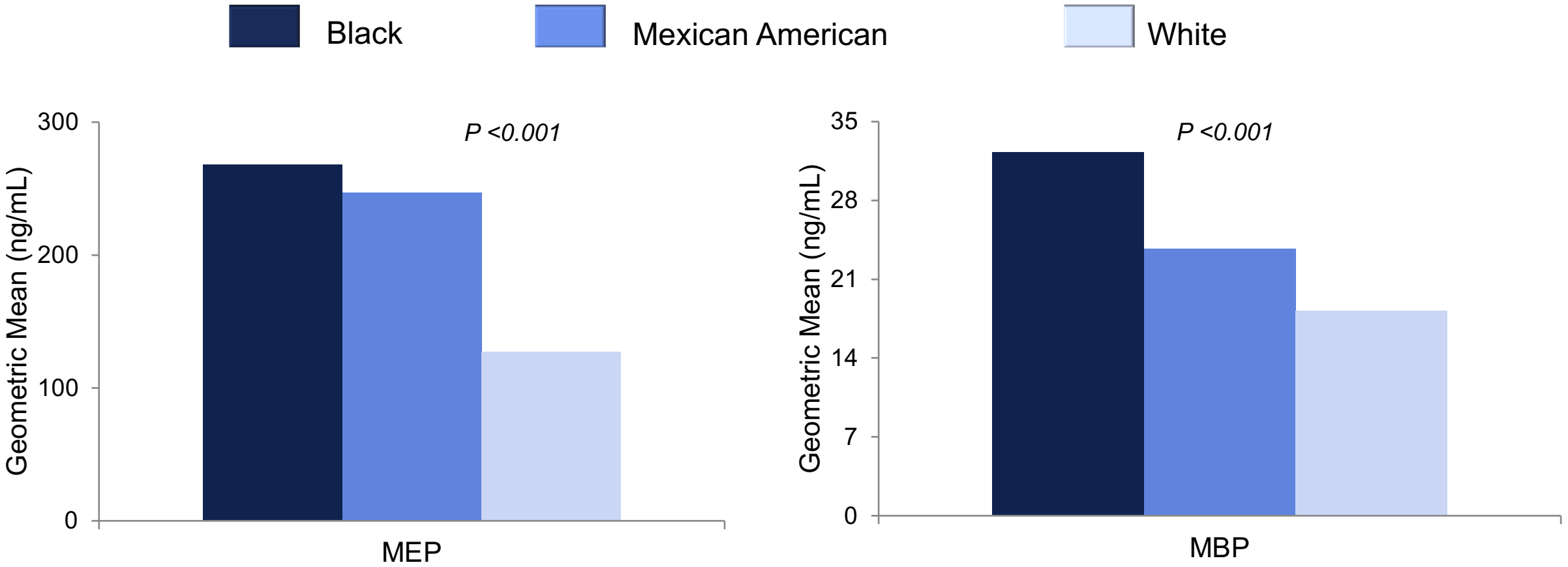
Applications of our framework

- 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?

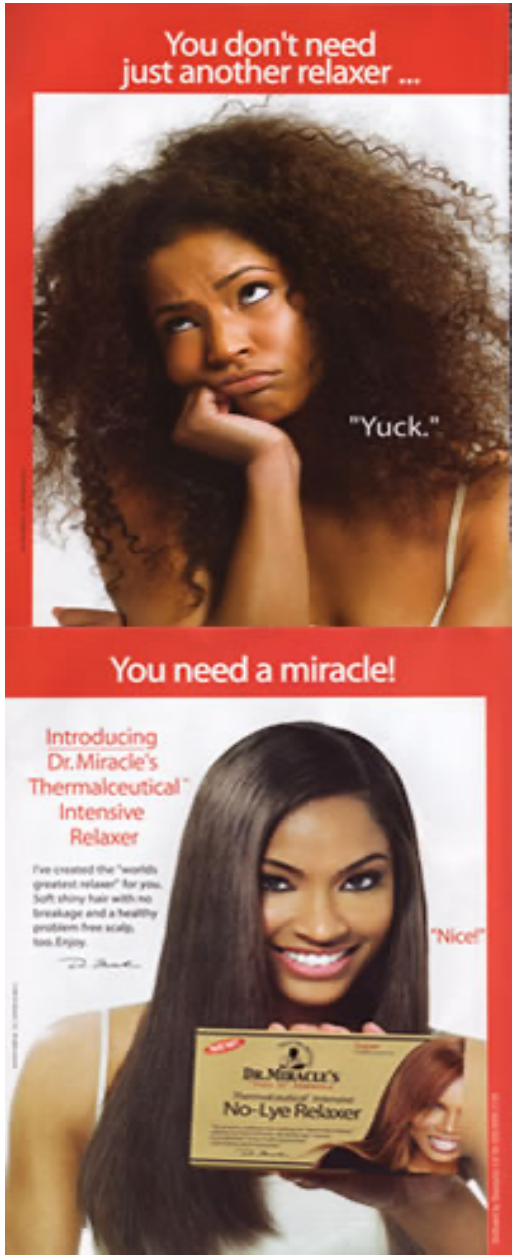
Else-Quest and Hyde 2016; Zota and VanNoy 2021

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

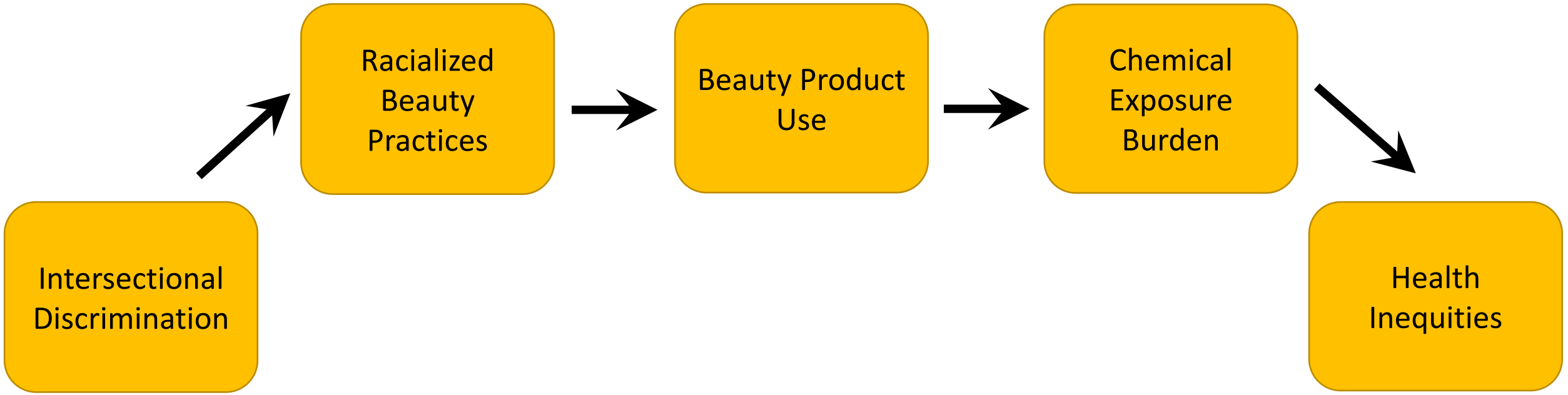


Typical Environmental Health Framework:

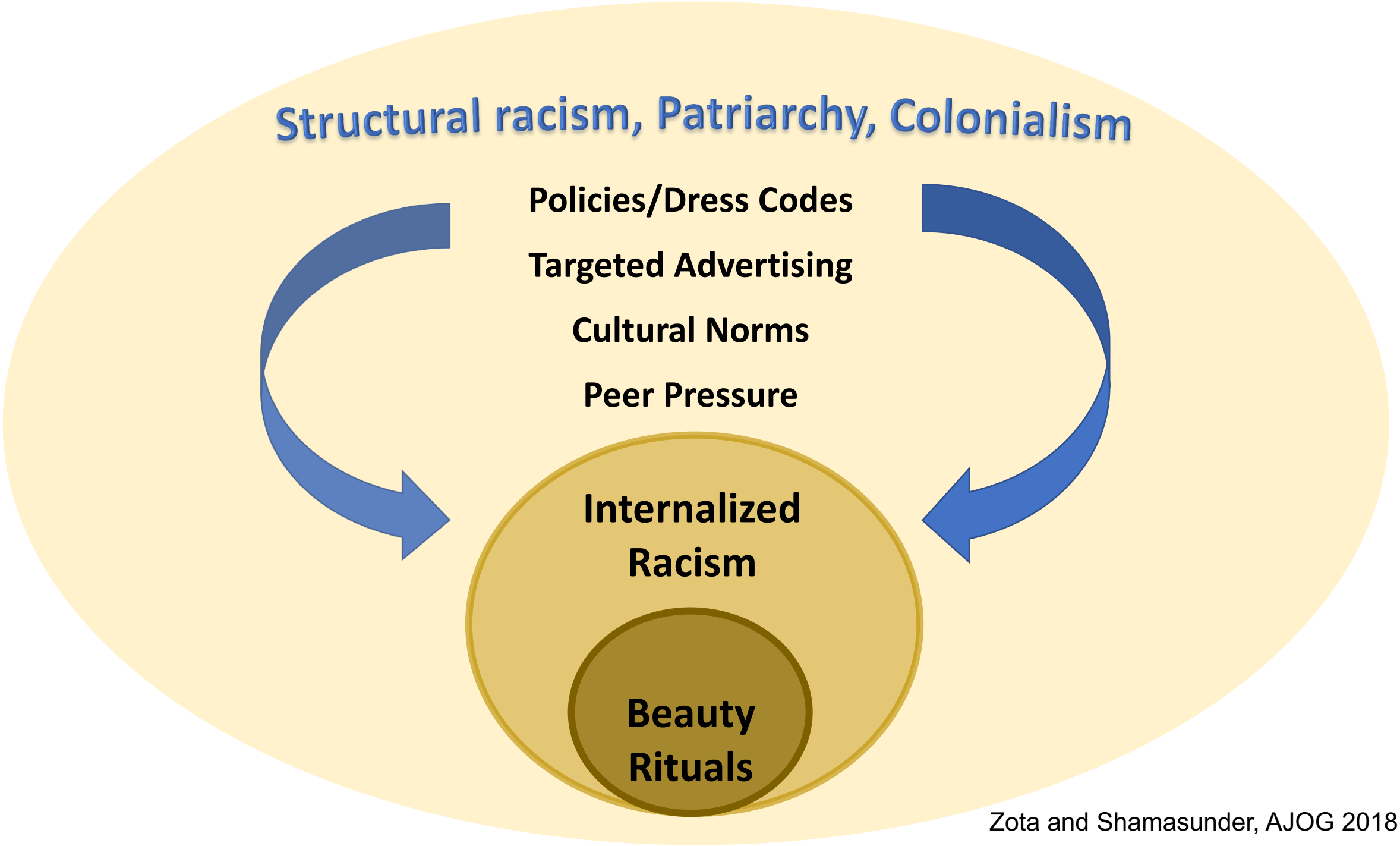
Focus on individual behaviors

Beauty Product Use → Chemical Exposure Burden → Adverse Health Outcomes

Environmental Injustice of Beauty



Zota and Shamasunder, AJOG 2018; Zota and VanNoy AJPH 2021

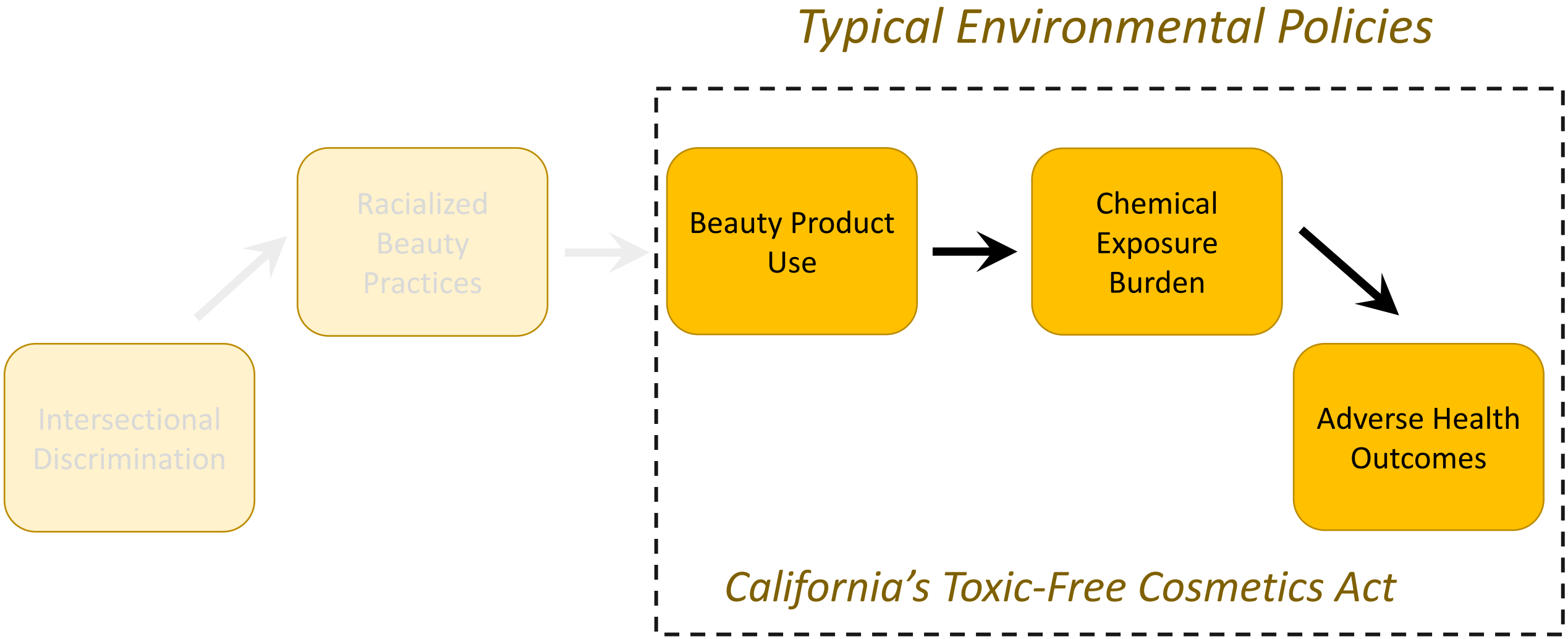


Zota and Shamasunder, AJOG 2018

Environmental Injustice of Beauty Examples

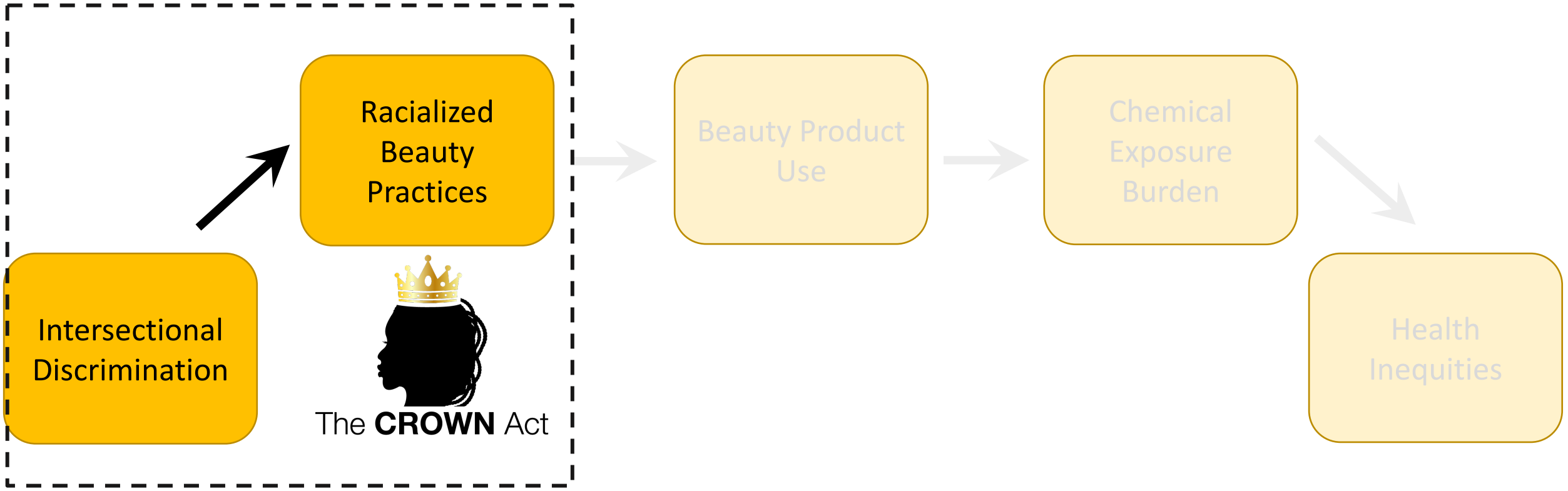
Racialized Beauty Norm	Vulnerable populations	Product use	Chemical exposures	Potential adverse outcomes
Colorism	Dark skinned women		Mercury	Mercury poisoning, neurotoxicity
Hair texture preferences	African American women		Parabens, phthalates, siloxanes	Uterine fibroids, breast cancer
Cultural norms about odor	African American and Latinx women		Phthalates, talc powder	Gynecologic cancers, endocrine disruption

Zota and Shamasunder, AJOG 2018



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

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Dr. Shuang Wang, PhD

transdisciplinary research effort to address racial inequities in uterine fibroids

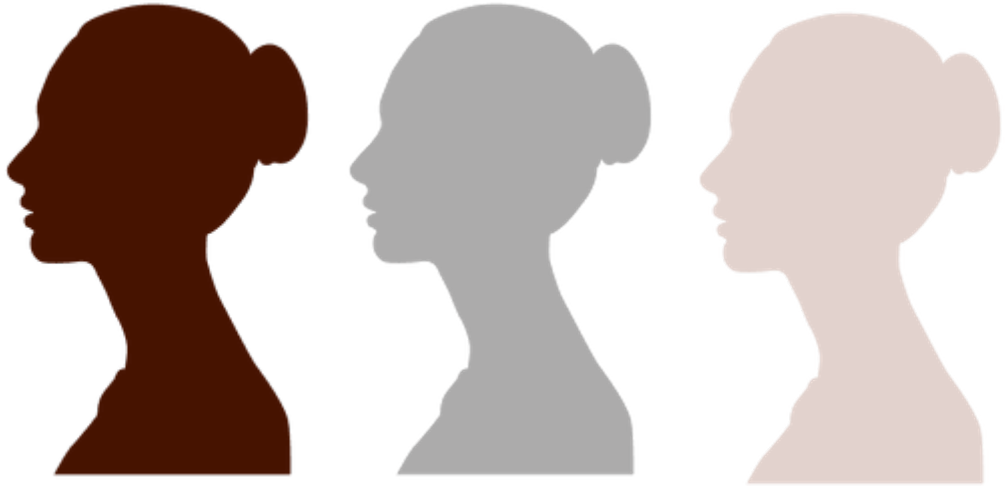
Types of Research Questions

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?

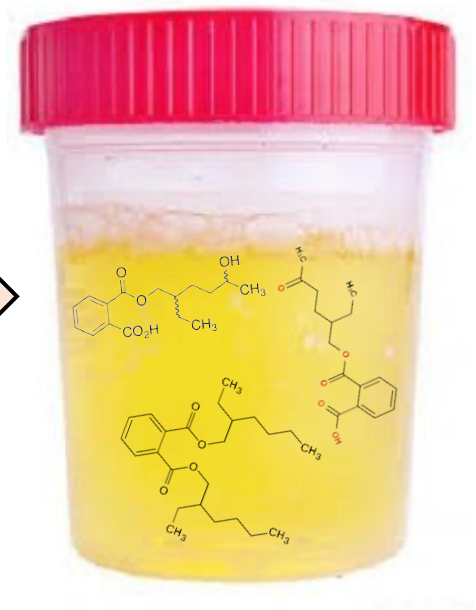
Exposure Disparities

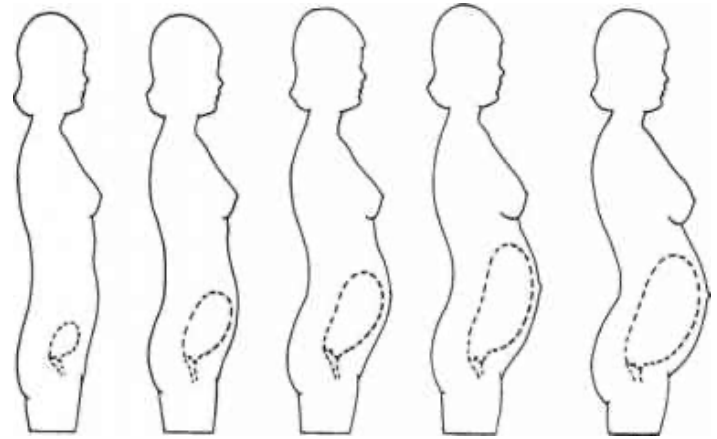


Beauty product-related phthalate exposure was **more than 30% higher in Black women**

Zota et al. *Fertility and Sterility* 2018

Higher urinary concentrations of DEHP and other high MW phthalates associated with an increase in uterine volume





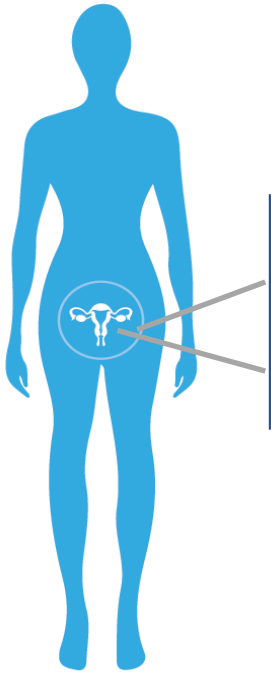
A doubling in ΣDEHP exposure was associated with 33.2% (95% CI: 6.6 – 66.5) increase in uterine volume

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



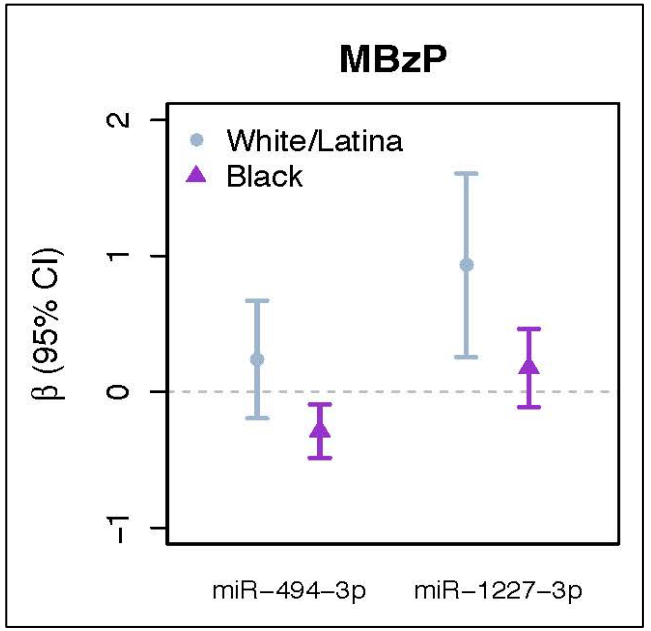
leiomyoma (N=45)

myometrium (N=19)

754 miRNAs measured with Taqman Open Array

<u>After multiple comparison adjustments:</u>

- 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

Patient-Provider Interactions
The fibroid diagnosis experience and interactions with clinicians impacted how participants navigated fibroids care and management

The Social and Historical Value of the Uterus
While some respondents expressed positive or neutral feelings about hysterectomy as a treatment option, others reacted negatively to the recommendation, conveying medical mistrust

Fertility Consequences and Fear of Malignancy
Younger women were concerned about the fertility consequences of fibroids, and a small group of participants were concerned that fibroids could be cancerous

The Role of Community
Social networks and community norms about reproductive health were instrumental in how Black participants conceptualized fibroids and evaluated their medical options.

"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)

VanNoy et al. 2021 (in press at Women's Health Issues)

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

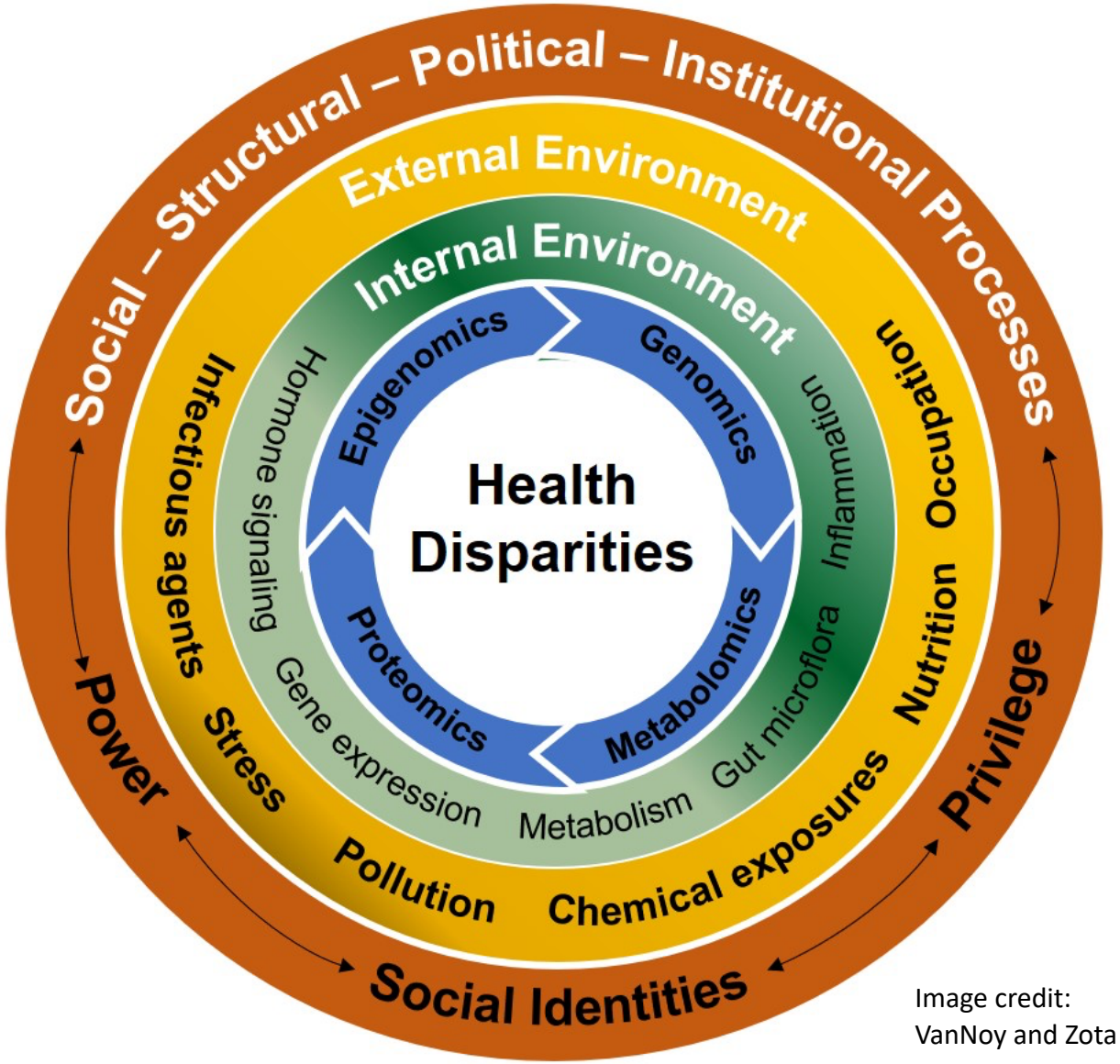


Image credit: VanNoy and Zota

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

Acknowledgements

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