



# Experiences of the Flint Water Crisis Among Reproductive-Age Michigan Women in Communities Outside of Flint: Differences by Race and Ethnicity

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Received: 12 October 2021 / Revised: 17 February 2022 / Accepted: 19 February 2022  
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## Abstract

We sought to understand how women in Michigan communities outside of Flint experienced the Flint water crisis, an avoidable public health disaster widely attributed to structural racism. Using survey data from 950 Michigan women aged 18–45 from communities outside of Flint, we examined racial and ethnic differences in personal connections to Flint, perceived knowledge about the water crisis, and beliefs about the role of anti-Black racism in the water crisis factors that could contribute to poor health via increased psychological stress. We found that White (OR = 0.32; 95% CI: 0.22, 0.46) and Hispanic (OR = 0.21; 95% CI: 0.09, 0.49) women had lower odds than Black women of having family or friends who lived in Flint during the water crisis. Compared to Black women, White women were less likely to be moderately or very knowledgeable about the water crisis (OR = 0.58; 95% CI: 0.41, 0.80). White women (OR = 0.26; 95% CI: 0.18, 0.37), Hispanic women (OR = 0.38; 95% CI: 0.21, 0.68), and women of other races (OR = 0.28; 95% CI: 0.15, 0.54) were less likely than Black women to agree that the water crisis happened because government officials wanted to hurt Flint residents. Among those who agreed, White women (OR = 0.47; 95% CI: 0.30, 0.74) and women of other races (OR = 0.33; 95% CI: 0.12, 0.90) were less likely than Black women to agree that government officials wanted to hurt people in Flint because most residents are Black. We conclude that the Flint water crisis was a racialized stressor, with potential implications for the health of reproductive-age Black women.

**Keywords** Flint water crisis · Structural racism · Vicarious racism · Racialized stressor

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The Flint water crisis is an ongoing human-made disaster that has profoundly impacted the city's nearly 100,000 residents, a majority of whom are Black [1]. While research has begun to document the direct effects of the water crisis on the physical and mental health of Flint residents [2–10], the public health consequences of the water crisis may extend well beyond the city limits of Flint. Building on previous quasi-experimental studies documenting the effects of indirect exposure to macro-level racialized stressors on the health of racial and ethnic minorities [11–14], the objective of the current study was to determine whether experiences of the Flint water crisis among Michigan women who live in communities outside of Flint differ by race and ethnicity. We hypothesized that Black women would be more likely than women in other racial and ethnic groups to have personal connections to Flint, to report greater knowledge of the water crisis, and to attribute the water crisis to anti-Black racism on the part of government officials — factors that may contribute to the burden of poor health and health disparities among Black women via increased psychological stress.

## The Flint Water Crisis

The Flint water crisis began in April 2014 when the state-appointed emergency manager switched the city's source of drinking water from the Detroit water system to the Flint River. The change was projected to save the economically distressed city \$5 million over a 2-year period [15]. Within 1 month of the switch, residents began to complain about the smell, taste, and appearance of the water, as well as health-related problems like rashes and hair loss [16]. The first of several boil water advisories was issued in August 2014 due to detection of fecal coliform bacteria [17], and just 6 months after the switch, General Motors stopped using water from the Flint River in its factories, noting that the water was causing engine parts to rust [18]. The failure to properly treat water from the Flint River also resulted in corrosion of pipes and solder in the city's water distribution system, causing lead and other metals to leach into the water supply [17, 19]. High lead levels were found in the tap water of Flint residents as early as February 2015, but authorities continued to insist that the water was safe to drink and only agreed to reconnect to the Detroit water system after the September 2015 release of a report documenting high blood lead levels in Flint children [2]. On January 5, 2016, nearly 2 years after the water crisis began, Michigan governor Rick Snyder issued a state of emergency in Flint. Less than 2 weeks later, President Barack Obama declared a federal state of emergency [16].

After the governor's emergency declaration, coverage of the Flint water crisis became prominent in regional and

national media outlets [17]. Many of these reports suggested that racism played a role in the series of events that led to the crisis, as well as in the responses of the state and federal government to the crisis [20, 21]. A report issued in February 2017 by the Michigan Civil Rights Commission substantiated this claim, concluding that racist policies and practices in the areas of employment, housing, and education, as well as racially disparate effects of the state's emergency manager law, contributed to the water crisis [22]. Furthermore, a growing body of academic research has characterized the Flint water crisis as an example of structural racism [23–27], and Flint residents themselves have described the water crisis as an act of genocide targeting Black people [28], who accounted for 57% of the city's population when the water crisis began [29].

## Health Impacts of the Flint Water Crisis

In addition to elevated blood lead levels in children [2, 3], which are expected to cost the city of Flint \$400 million in long-term social and educational costs [4], Flint residents have experienced a number of other health-related problems as a result of the water crisis. Low chlorine levels in the municipal water system resulted in an outbreak of Legionnaires' disease that killed 12 people and sickened dozens of others [5]. Residents reported rashes, hair loss, and nausea [6], as well as increased mental health symptoms, such as stress and anxiety, problems sleeping, depressed mood, and trouble concentrating [7–9]. Pregnant women were more likely to smoke after the water switch, and mothers of infants were less likely to breast-feed [30]. Studies examining changes in fertility rates produced mixed results [10, 31, 32], but a number of studies found evidence of an increase in adverse birth outcomes, including lower birthweight and increased incidence of low birthweight [10, 32, 33]. In contrast to the growing body of evidence documenting effects of *direct* exposure to the water crisis on the mental and physical health of Flint residents, little is known about the potential health impacts of *indirect* exposure for people who live outside of Flint. Several recent quasi-experimental studies have shown that exposure to vicarious structural racism, defined as witnessing the effects of racist structural conditions or practices on members of one's own racial or ethnic group [34, 35], is a risk factor for adverse health-related outcomes. For example, Alsan and Wanamaker [13] found that disclosure of the Tuskegee Study in 1972 was associated with increased medical mistrust and mortality and decreased health care utilization among Black men but not among other groups, while Bor et al. [12] found that exposure to one or more police killings of unarmed Black people in a respondent's state of residence during the 3 months

prior to completing the Behavioral Risk Factor Surveillance System (BRFSS) interview was associated with an increase in the number of poor mental health days reported by Black respondents only. Similarly, Novak et al. [11] found that babies born to Hispanic mothers in the state of Iowa in the 37 weeks following a major immigration raid in a rural Iowa town had increased risk of low birth weight compared to the same 37-week period in the prior year, while no such changes were observed among babies born to non-Hispanic mothers. Finally, Vu [14] found that the likelihood of very low birth weight increased by 23% for infants of foreign-born Hispanic mothers only, following implementation of a strict immigration enforcement program. These prior studies suggest that vicarious exposure to the Flint water crisis had the potential to negatively impact the mental and physical health of Black people who live outside of Flint.

### **Vicarious Structural Racism and Health: Mechanisms**

Though not directly examined in previous research, there are a number of plausible mechanisms underlying observed associations between exposure to vicarious structural racism and health-related outcomes. First, people of the same race or ethnicity may be more likely to have personal connections to those who were directly affected by the event. Research using functional magnetic resonance imaging (fMRI) has shown that the emotional brain circuits that are activated when an individual experiences a painful stimulus firsthand are the same as those that are activated when witnessing a loved one being subjected to a painful stimulus [36]. Similarly, witnessing the painful direct effects of structural racism on close friends or family members likely has negative psychological consequences for those who are aware of their loved ones' exposure, even in the absence of being directly exposed themselves. Second, news of the event may be more salient to people of the same race or ethnicity as those directly affected, leading to higher levels of information-seeking behavior [37], either from personal connections or from the media. Given evidence that exposure to disaster media coverage is associated with negative psychological outcomes [38], having greater knowledge of an event may contribute to observed associations between exposure to vicarious structural racism and adverse health outcomes. Finally, people of the same race or ethnicity as those directly affected by an event may be more likely to consciously perceive that racism contributed to the event, resulting in greater distress due to a sense of personal vulnerability [39] and inability to trust in government or other important institutions [40].

### **Hypotheses**

Using data from a survey of Michigan women who live in communities outside of Flint, we examined racial and ethnic differences in personal connections to Flint, knowledge of the water crisis, and opinions and beliefs about the water crisis. First, we hypothesized that Black women would be more likely than women from other racial and ethnic groups to have previously lived in Flint and to have family or friends who lived in Flint during the water crisis. Next, we hypothesized that Black women would be more likely than women from other racial and ethnic groups to have heard about the FWC from personal connections and to report greater knowledge of the water crisis. Finally, we hypothesized that Black women would be more likely than women from other racial and ethnic groups to attribute the water crisis to anti-Black racism.

### **Methods**

#### **Study Population and Data Collection**

Data are from the What's in Your Glass? study, which was designed to explore the impact of the Flint water crisis on reproductive-age women in Michigan communities outside of Flint. Topics examined in the What's in Your Glass? study include perceived water safety and quality, water use, beverage consumption, child feeding practices, perceived knowledge of the water crisis, sources of information about the water crisis, opinions and beliefs about the water crisis, emotional reactions to the water crisis, personal connections to Flint, trust in government, self-rated health, and discrimination. Recruitment materials stated that the purpose of the What's in Your Glass? study was to learn more about their beverage choices. Thus, the decision to participate in the study was not influenced by knowledge, opinions, or beliefs about the Flint water crisis or race-related matters.

Individuals were recruited to participate in the What's in Your Glass? study via non-probability sampling techniques in partnership with the University of Michigan's Data Office for Clinical and Translational Research, which supports engagement of Michigan Medicine health system patients in clinical research. Data were collected via an online survey administered between August and December of 2020. Development of the survey instrument was informed by a focus group conducted in October 2019 with leaders of Michigan-based organizations that serve women and children. With the goal of obtaining a sociodemographically diverse sample, study invitations containing

a link to the study's website and eligibility screener were first emailed to 1500 women aged 18–45 and parents/caregivers of children aged 0–4 who received healthcare at the Ypsilanti Health Center in Ypsilanti, Michigan, between March 1, 2019, and March 1, 2020. Patients from the Ypsilanti Health Center were recruited because the health center provides preventative healthcare to a racially, ethnically, and socioeconomically diverse patient population. Individuals who enrolled in the study via this effort were also invited to share the study website with female friends and family.

In the first week of data collection, 593 individuals provided valid and complete data on the eligibility screener. Of these, 447 were eligible and completed the study. Enrollment was paused during the second week of data collection due to concerns about potentially fraudulent survey responses. All survey responses submitted after the suspected fraudulent activity began were discarded to be conservative regarding the inclusion of valid data. After implementing a number of additional data security systems and examining the demographic composition of the existing participants, a second recruitment wave was initiated to increase representation of low-income women in the study sample. Study invitations containing a personal, one-time-use link to the eligibility screener were emailed to 3881 women who were publicly-insured (Medicaid) and had given birth at the University of Michigan Hospital between September 1, 2016, and November 18, 2020. From this recruitment effort, 606 individuals completed the eligibility screener. Of these, 503 were eligible and completed the study. The final, combined sample includes 950 respondents.

Eligibility screening and data collection were conducted using surveys developed in Qualtrics (Provo, UT). Self-identified females between the ages of 18 and 45 who were able to complete the survey in English and who lived in any Michigan county except Genesee County (i.e., the county where Flint is located) were eligible to participate in the study. Individuals who did not meet these eligibility criteria or who had missing data for any of the screening questions were ineligible and were not invited to complete the survey. Eligible individuals were immediately redirected to the survey after completing the eligibility screener. Individuals who completed at least 78% of survey questions were sent a \$20 gift card. The study was determined to be exempt from oversight by the University of Michigan's Institutional Review Board.

## Measures

**Race and Ethnicity** Respondents were asked to report which of the following racial or ethnic group(s) they most identify with: Black or African American, Hispanic or Latina, American Indian or Alaska Native, Asian or Pacific Islander,

White, and other. For respondents who selected more than one race/ethnicity, we used the procedure developed by the National Longitudinal Study of Adolescent to Adult Health to assign them to a single category [41]. Those who selected Hispanic or Latina were coded as Hispanic. For respondents who did not select Hispanic or Latina, race/ethnicity was coded in the following order: Black or African American, Asian or Pacific Islander, American Indian or Alaska Native, other, and White. Due to small sample sizes, women who identified as American Indian or Alaska Native, Asian or Pacific Islander, or other were combined into a single other race category [41]. The reference racial/ethnic group is Black or African American.

**Personal Connections to Flint** To assess personal connections to Flint, respondents were asked whether they ever lived in Flint, MI (1 = yes; 0 = no or do not know/not sure),<sup>1</sup> and whether they had any family or friends who lived in Flint when the water crisis happened (1 = yes; 0 = no or do not know/not sure).

**Knowledge and Sources of Information About the Water Crisis** Respondents were asked to report their level of knowledge about the Flint water crisis. Response options included not knowledgeable at all, slightly knowledgeable, moderately knowledgeable, very knowledgeable, and do not know/not sure. Responses were combined to create a dichotomous variable (1 = moderately or very knowledgeable; 0 = slightly or not at all knowledgeable or do not know/not sure). Next, respondents were asked to report how they heard about the water crisis. Response options included friend or family member, television, newspaper, radio, social media, and "other," which included the option to write in a response (1 = yes; 0 = no). Respondents could select all responses that applied.

**Opinions and Beliefs About the Water Crisis** Respondents were asked to report who, in their opinion, was responsible for the Flint water crisis. Response options included no one/it was an accident, the Michigan government, the Flint government, the US government, people who live in Flint, business owners in Flint, and "other," which included the option to write in a response (1 = yes; 0 = no). Respondents could select all responses that applied. Next, respondents were asked to report their opinion regarding the following statements about factors that may have contributed to the water crisis: (1) government officials did not care about what happened to people in Flint, (2) government officials wanted to hurt people in Flint, (3) people in Flint did not fight hard

<sup>1</sup> Two respondents replied "do not know/not sure" when asked whether they ever lived in Flint, MI.

**Table 1** Descriptive statistics for the study sample by race/ethnicity,  $n = 932$ 

	Black	White	Hispanic	Other race	<i>p</i> -value
Age, in years (M, SD)	31.1 (6.2)	32.2 (6.0)	31.2 (6.8)	31.4 (5.7)	0.09
Educational attainment ( <i>n</i> , %)					< 0.0001
High school or less	69 (28.3)	62 (11.0)	17 (23.9)	5 (9.4)	
Some college/associate's degree	132 (54.1)	245 (43.4)	32 (45.1)	14 (26.4)	
Bachelor's degree or more	43 (17.6)	257 (45.6)	22 (31.0)	34 (64.2)	
Recruitment wave ( <i>n</i> , %)					< 0.0001
1	96 (39.3)	287 (50.9)	21 (29.6)	39 (73.6)	
2	148 (60.7)	277 (49.1)	50 (70.4)	14 (26.4)	

*P*-values for differences by race/ethnicity calculated by chi-square tests for categorical variables and by one-way ANOVA for continuous variables. Data were collected between August and December of 2020 via online survey from a sample of women aged 18–45 in Michigan communities outside of Flint

enough to make their voices heard, (4) government officials did not know how to make water from the Flint River safe to drink, (5) government officials were greedy, and (6) Flint's emergency manager did not listen to the people because he was not elected by them. Response options for each of the above possible contributing factors included a great deal, somewhat, and not at all and were combined to create a dichotomous variable for each statement (1 = somewhat or a great deal; 0 = not at all). Respondents who answered somewhat or a great deal to the first statement about contributing factors ( $n = 839$ ) were asked a follow-up question to assess why they agreed that government officials did not care about what happened to people in Flint. Response options included the following: (1) because most people in Flint are poor, (2) because government officials do not care about the people they serve, (3) because most people in Flint do not vote, (4) because most people in Flint are Black, (5) because the people in charge were not from Flint, and (6) "other," which included the option to write in a response (1 = yes; 0 = no). Respondents could select all responses that applied. Respondents who answered somewhat or a great deal to the second statement about contributing factors ( $n = 457$ ) were asked a follow-up question to assess why they agreed that government officials wanted to hurt people in Flint. Response options included the following: (1) because they wanted to make people spend more money on health care, (2) because most people in Flint are poor, (3) because they wanted to get more money from the federal government, (4) because most people in Flint are Black, (5) because they wanted to take power away from the people in Flint, and (6) "other," with the option to write in a response (1 = yes; 0 = no). Respondents could select all responses that applied.

**Covariates** Covariates include age (in years), educational attainment (high school or less, some college/associate's degree, bachelor's degree or more [reference category]), and recruitment wave (1 = wave 2; 0 = wave 1).

## Statistical Analysis

First, we calculated descriptive statistics for each study variable by race/ethnicity. "Other" responses for questions about sources of information about the water crisis and opinions and beliefs about the water crisis were excluded from the current analysis but are briefly summarized in the supplemental materials (Supplementary Tables S1–S4). *P*-values for racial/ethnic differences were calculated by chi-square tests for categorical variables and by one-way ANOVA for continuous variables. Next, to determine whether there were differences by race/ethnicity in personal connections to Flint, knowledge of the water crisis, and opinions and beliefs about the water crisis, we ran a series of logistic regression models in which we regressed each outcome on race, controlling for age, educational attainment, and recruitment wave. We excluded one participant who reported that they had not heard of the Flint water crisis, 17 participants who reported that they lived in Flint in 2014 or later, and one participant who did not report their race/ethnicity. The analytic sample ranged from 457 to 932 participants, depending on the outcome. In sensitivity analyses, we stratified the logistic regression models by recruitment wave to determine whether differences in recruitment procedures affected study results.

## Results

### Descriptive Statistics

The study sample included 244 Black women (26.2%), 564 White women (60.5%), 71 Hispanic women (7.6%), and 53 women of other races (5.7%). As shown in Table 1, there were no significant differences in age by race/ethnicity ( $p = 0.09$ ). Mean age was 31–32 years in all racial/ethnic groups. Women of other races (64.2%) were most likely to report having a bachelor's degree or more, followed by

White women (45.6%), Hispanic women (31.0%), and Black women (17.6%) ( $p < 0.0001$ ). Finally, there were significant differences in recruitment wave by race/ethnicity ( $p < 0.0001$ ). A majority of Black (60.7%) and Hispanic (70.4%) participants were recruited in the second wave, while a majority of women of other races (73.6%) were recruited in the first wave. White women were evenly split between the first and second recruitment waves (50.9% in wave 1 and 49.1% in wave 2). Descriptive statistics for race/ethnicity, age, and educational attainment by recruitment wave are shown in Supplementary Table S5. Descriptive statistics for the outcome variables by race/ethnicity are available in Supplementary Tables S6–S11.

### Personal Connections to Flint

In the first set of logistic regression models, we examined race/ethnicity as a predictor of personal connections to Flint. As shown in Fig. 1 and Supplementary Table S12, the odds of having previously lived in Flint were not significantly different for White women compared to Black women.<sup>2</sup> However, White (OR = 0.32; 95% CI: 0.22, 0.46;  $p < 0.0001$ ) and Hispanic (OR = 0.21; 95% CI: 0.09, 0.49;  $p = 0.0003$ ) women had significantly lower odds than Black women of having family or friends who lived in Flint during the water crisis.

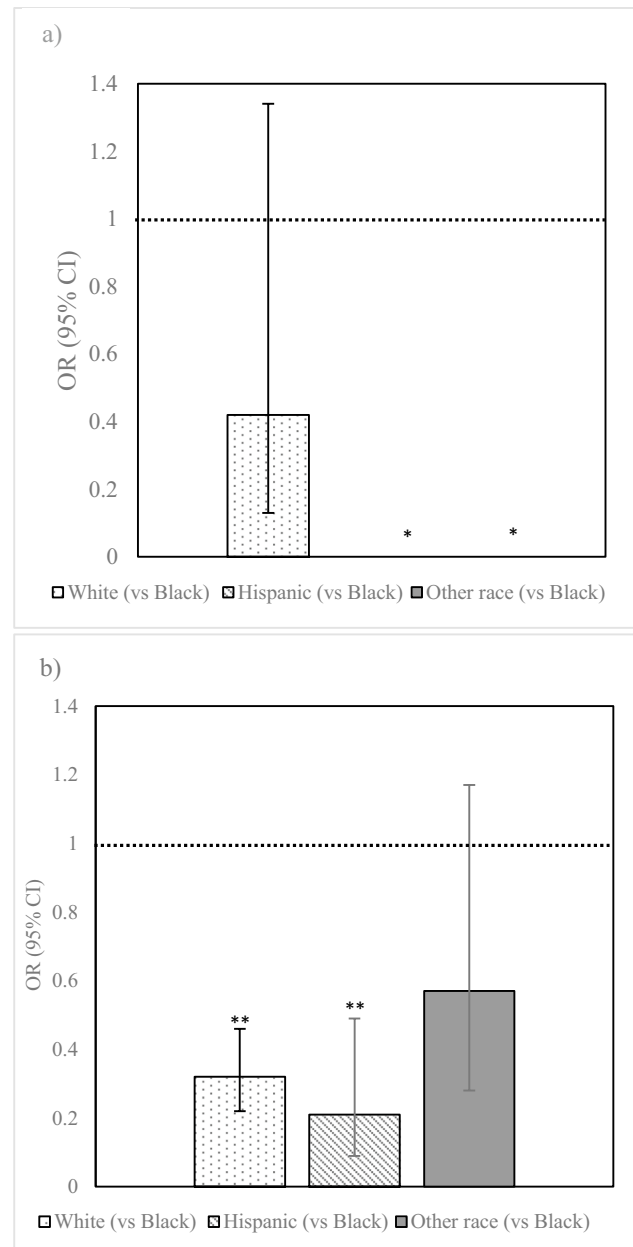
### Knowledge and Sources of Information About the Flint Water Crisis

In the next set of logistic regression models, we examined race/ethnicity as a predictor of knowledge and sources of information about the Flint water crisis. As shown in Fig. 2 and Supplementary Table S13, compared to Black women, White women had 42% lower odds (OR = 0.58; 95% CI: 0.41, 0.80;  $p = 0.0009$ ) of reporting that they were moderately or very knowledgeable about the water crisis versus slightly or not at all knowledgeable. There were no significant differences in self-reported knowledge for Hispanic women or women of other races compared to Black women. Furthermore, race/ethnicity was not significantly associated with the odds of having heard about the water crisis from friends or family, television, newspapers, radio, or social media.

### Opinions and Beliefs About the Flint Water Crisis

Next, we examined race/ethnicity as a predictor of opinions and beliefs about the Flint water crisis. As shown in Fig. 3 and Supplementary Table S14, White respondents were nearly 3 times more likely than Black respondents (OR = 2.99; 95% CI: 1.19, 7.52;  $p = 0.02$ ) to report that no

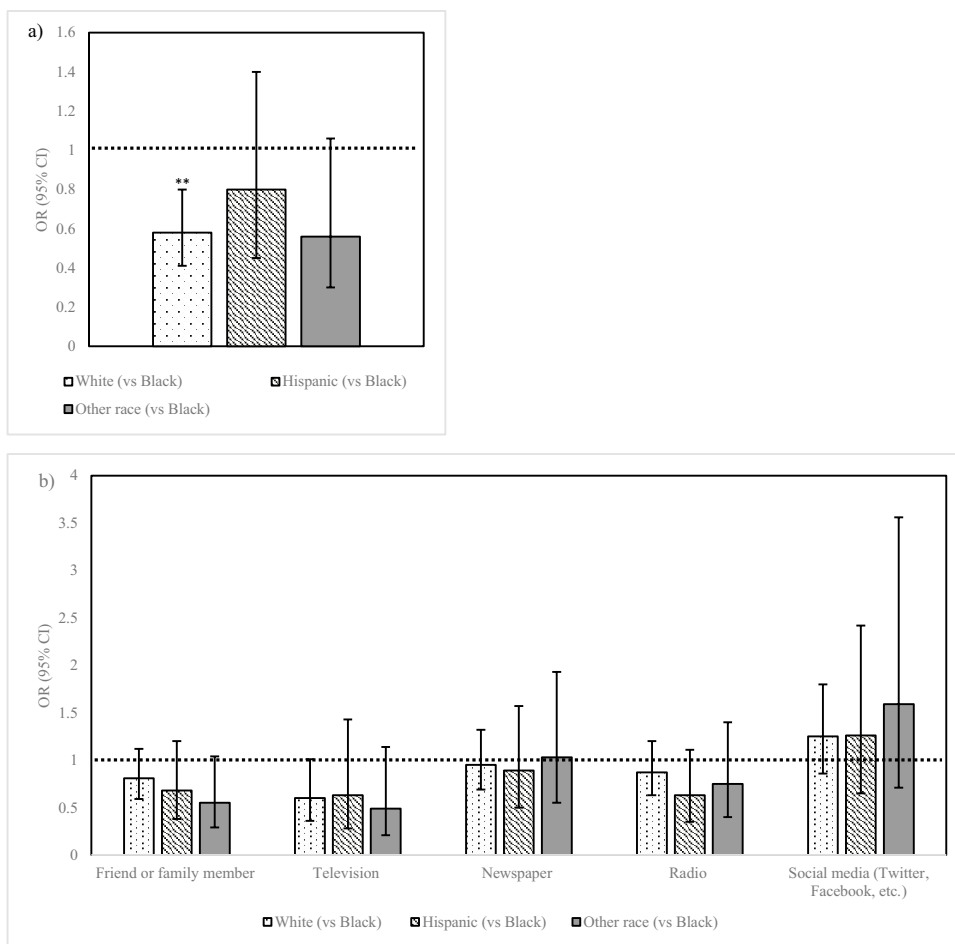
<sup>2</sup> Odds ratios for Hispanic women and women of other races could not be calculated because none of the study participants from these groups previously lived in Flint.



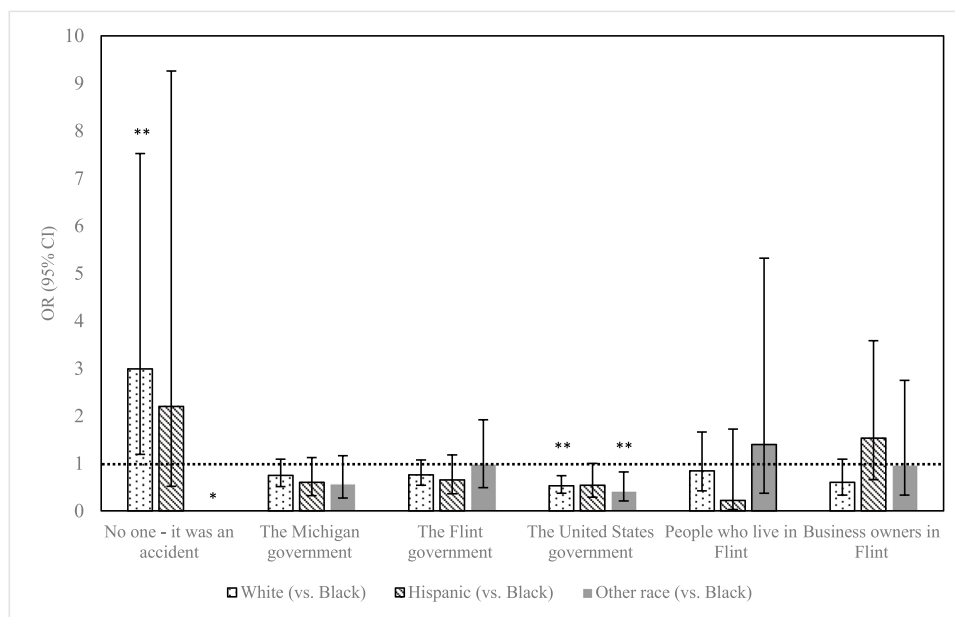
**Fig. 1** Logistic regression models examining race/ethnicity as a predictor of personal connections to Flint: **a** Odds of having previously lived in Flint, MI (vs. never having lived in Flint),  $n = 932$  and **b** odds of having family or friends who lived in Flint during the Flint water crisis (vs. having no loved ones directly affected),  $n = 893$ . Note: All models adjusted for age, educational attainment, and recruitment wave. Error bars refer to 95% confidence intervals. OR, odds ratio; CI, confidence interval. \*No Hispanic women or women of other races previously lived in Flint; therefore, there is no estimate. \*\* $p$ -value  $< 0.05$

one was responsible for the water crisis because it was an accident. Compared to Black respondents, White respondents (OR = 0.53; 95% CI: 0.37, 0.74;  $p = 0.0002$ ) and respondents of other races (OR = 0.41; 95% CI: 0.21, 0.82;

**Fig. 2** Logistic regression models examining race/ethnicity as a predictor of perceived knowledge of the Flint water crisis and sources of information about the Flint water crisis: **a** Odds of being moderately or very knowledgeable about the Flint water crisis (vs. slightly or not at all knowledgeable),  $n=898$  and **b** odds of having heard about the Flint water crisis from [information source] (vs. not having heard about the Flint water crisis from [information source]),  $n=899$ . Note: All models adjusted for age, educational attainment, and recruitment wave. Error bars refer to 95% confidence intervals. OR, odds ratio; CI, confidence interval. \*\* $p$ -value  $< 0.05$



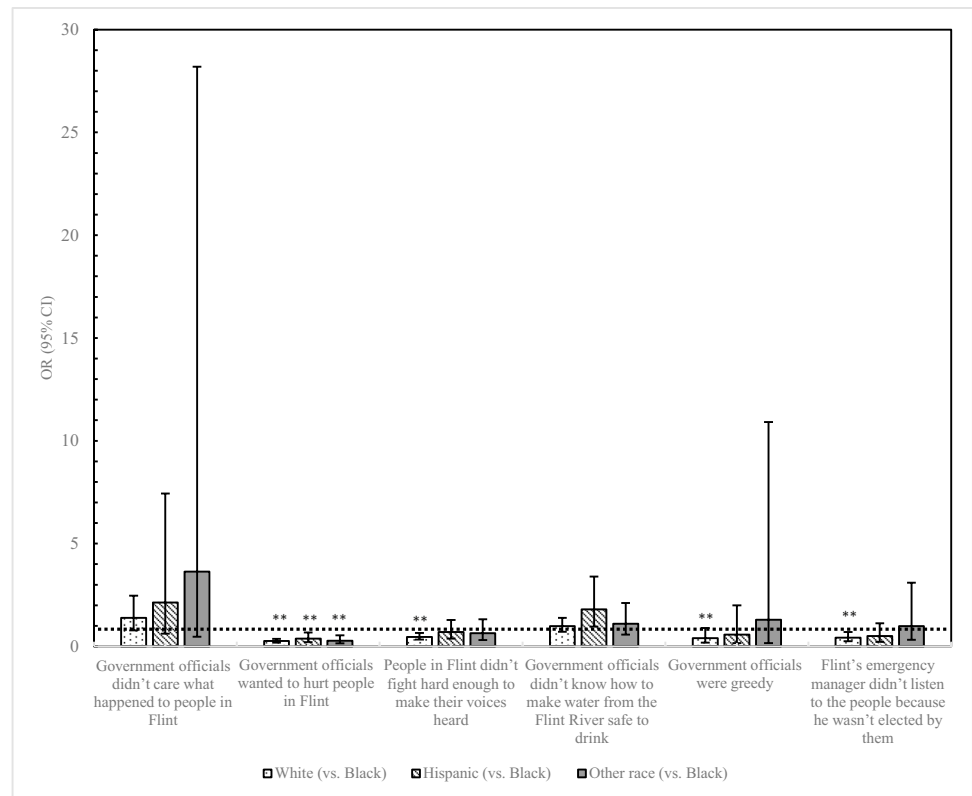
**Fig. 3** Logistic regression models examining race/ethnicity as a predictor of opinions about who was responsible for the Flint water crisis: odds of responding yes (vs. no) to each option,  $n=892$ . Note: All models adjusted for age, educational attainment, and recruitment wave. Error bars refer to 95% confidence intervals. OR, odds ratio; CI, confidence interval. \*No women of other races endorsed “No one — it was an accident”; therefore, there is no estimate. \*\* $p$ -value  $< 0.05$



$p=0.01$ ) had significantly lower odds of reporting that the US government was responsible for the water crisis. Race/ethnicity was not significantly associated with reporting that

the Michigan government, the Flint government, people who live in Flint, or business owners in Flint were responsible for the water crisis.

**Fig. 4** Logistic regression models examining race/ethnicity as a predictor of opinions about what contributed to the Flint water crisis: odds of responding somewhat or a great deal (vs. not at all) to each option,  $n = 883\text{--}899$  (see Supplementary Table S15 for sample sizes for each outcome). Note: All models adjusted for age, educational attainment, and recruitment wave. Error bars refer to 95% confidence intervals. OR, odds ratio; CI, confidence interval. \*\* $p$ -value  $< 0.05$



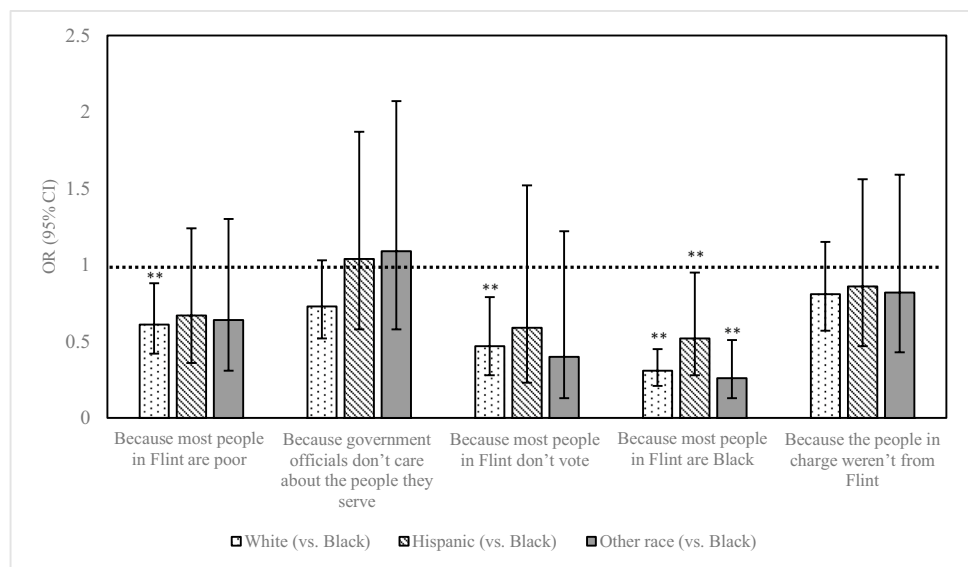
As shown in Fig. 4 and Supplementary Table S15, race/ethnicity was not significantly associated with the odds of agreement that the Flint water crisis happened because government officials did not care what happened to people in Flint. However, White respondents (OR = 0.26; 95% CI: 0.18, 0.37;  $p < 0.0001$ ), Hispanic respondents (OR = 0.38; 95% CI: 0.21, 0.68;  $p = 0.0012$ ), and respondents of other races (OR = 0.28; 95% CI: 0.15, 0.54;  $p = 0.0001$ ) were significantly less likely than Black respondents to agree that the water crisis happened because government officials wanted to hurt people in Flint. Compared to Black respondents, White respondents had 54% lower odds (OR = 0.46; 95% CI: 0.33, 0.65;  $p < 0.0001$ ) of agreement that people in Flint did not fight enough to make their voices heard. Race/ethnicity was not significantly associated with agreement that the water crisis happened because government officials did not know how to make the water from the Flint River safe to drink. Compared to Black respondents, White respondents had 60% lower odds (OR = 0.40; 95% CI: 0.18, 0.89;  $p = 0.02$ ) of agreement that the water crisis happened because government officials were greedy. Finally, White (OR = 0.42; 95% CI: 0.25, 0.70;  $p = 0.001$ ) respondents were significantly less likely than Black respondents to agree that the water crisis happened because Flint's emergency manager did not listen to the people because he was not elected by them.

Among the 839 respondents who agreed somewhat or a great deal with the statement that the Flint water crisis happened because government officials did not care about what happened to people in Flint, there were a number of significant differences by race/ethnicity in opinions about reasons for government officials' indifference. As shown in Fig. 5 and Supplementary Table S16, White respondents were significantly less likely than Black respondents to agree that government officials did not care what happened to people in Flint because most people in Flint are poor (OR = 0.61; 95% CI: 0.42, 0.88;  $p = 0.008$ ) and because most people in Flint do not vote (OR = 0.47; 95% CI: 0.28, 0.79;  $p = 0.005$ ). Compared to Black respondents, White respondents (OR = 0.31; 95% CI: 0.21, 0.45;  $p < 0.0001$ ), Hispanic respondents (OR = 0.52; 95% CI: 0.28, 0.95;  $p = 0.03$ ), and respondents of other races (OR = 0.26; 95% CI: 0.13, 0.51;  $p < 0.0001$ ) had significantly lower odds of agreement that government officials did not care what happened to people in Flint because most people in Flint are Black. Race/ethnicity was not significantly associated with agreement that government officials did not care about what happened to people in Flint because government officials do not care about the people they serve or because officials were not from Flint.

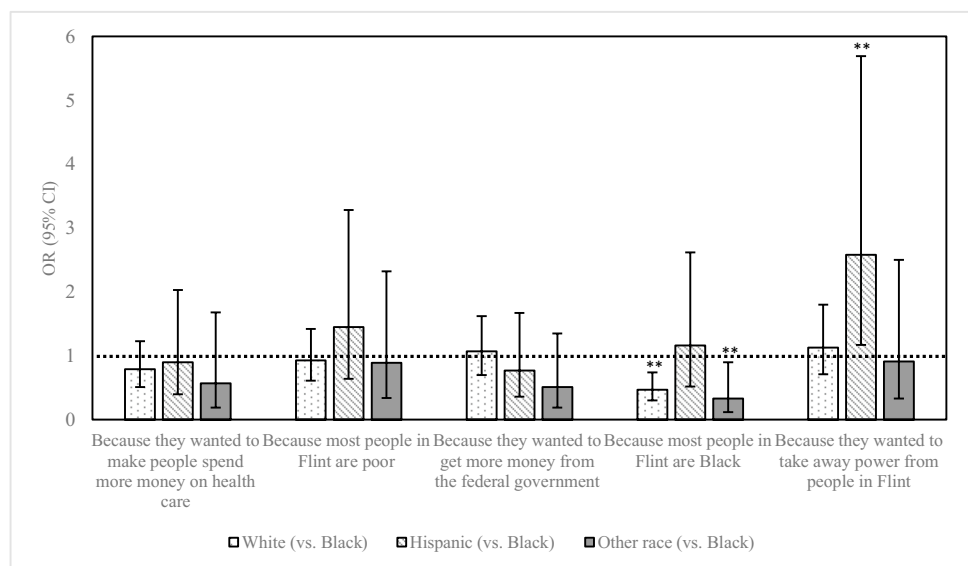
Finally, among the 457 respondents who agreed somewhat or a great deal with the statement that the Flint water crisis happened because government officials wanted to hurt people in Flint, there were some significant differences by



**Fig. 5** Logistic regression models examining race/ethnicity as a predictor of opinions about why government officials did not care what happened to people in Flint: odds of responding yes (vs. no) to each option,  $n=839$ . Note: This question was only asked of respondents who agreed somewhat or a great deal with the following statement: Government officials did not care what happened to people in Flint. All models adjusted for age, educational attainment, and recruitment wave. Error bars refer to 95% confidence intervals. OR, odds ratio; CI, confidence interval. \*\* $p$ -value  $< 0.05$



**Fig. 6** Logistic regression models examining race/ethnicity as a predictor of opinions about why government officials wanted to hurt people in Flint: odds of responding yes (vs. no) to each option,  $n=457$ . Note: This question was only asked of respondents who agreed somewhat or a great deal with the following statement: Government officials wanted to hurt people in Flint. All models adjusted for age, educational attainment, and recruitment wave. Error bars refer to 95% confidence intervals. OR, odds ratio; CI, confidence interval. \*\* $p$ -value  $< 0.05$



race/ethnicity in opinions about reasons for government officials' malice. As shown in Fig. 6 and Supplementary Table S17, White respondents (OR = 0.47; 95% CI: 0.30, 0.74;  $p=0.001$ ) and respondents of other races (OR = 0.33; 95% CI: 0.12, 0.90;  $p=0.03$ ) were significantly less likely than Black respondents to agree that government officials wanted to hurt people in Flint because most people in Flint are Black. Compared to Black respondents, Hispanic respondents were 2.6 times more likely (OR = 2.58; 95% CI: 1.17, 5.69;  $p=0.02$ ) to agree that government officials wanted to hurt people in Flint because they wanted to take away their power. Race/ethnicity was not significantly associated with agreement that government officials wanted to hurt people in Flint because they wanted to make people spend more money on health care, because most people in

Flint are poor, or because they wanted to get more money from the federal government.

### Sensitivity Analyses

Sensitivity analyses stratified by recruitment wave produced results that are similar to the main study findings, with a few notable exceptions (results available upon request). First, in the full sample, race/ethnicity was not significantly associated with the odds of having previously lived in Flint. In stratified models, among wave 1 participants only, White respondents were significantly less likely than Black respondents to have previously lived in Flint. Next, in the full sample, White respondents were significantly less likely than Black respondents to report that they were moderately

or very knowledgeable about the water crisis versus slightly or not at all knowledgeable. In stratified models, this association was only observed for wave 2 respondents. In the full sample, race/ethnicity was not significantly associated with the odds of having heard about the water crisis from friends or family, television, newspapers, radio, or social media. In stratified models, among wave 1 respondents only, White and Hispanic women were significantly less likely than Black women to have heard about the water crisis from a friend or family member. Finally, in the full sample, White respondents were significantly less likely than Black respondents to agree that government officials wanted to hurt people in Flint because most people who live there are Black. In stratified models, this association was only significant for wave 2 respondents.

## Discussion

A growing body of research suggests that second-hand, or vicarious, exposure to racism is associated with adverse health outcomes [34]. While most prior research in this area has focused on interpersonal racism, recent studies have shown that exposure to macro-level racialized stressors, including the Tuskegee Study [13], police killings of unarmed Black people [12], and immigration enforcement [14, 42], also negatively impacts the health of racial and ethnic minorities. In this study, we sought to understand how women in Michigan communities outside of Flint experienced the Flint water crisis, an avoidable public health disaster that Flint residents [28], the media [17], the Michigan Civil Rights Commission [22], and scholars [23–27] alike have attributed to structural racism. We hypothesized that Black women would be more likely than women in other racial/ethnic groups to have personal connections to Flint, to report greater knowledge of the water crisis, and to attribute the water crisis to anti-Black racism on the part of government officials—factors that could contribute to poor health via increased stress. Overall, we found strong support for these hypotheses.

First, we found that Black women in Michigan communities outside of Flint were more likely to have friends or family who lived in Flint during the water crisis, although they were no more likely to have previously lived in Flint themselves. Given previous research demonstrating that the emotional brain circuits that are activated when an individual experiences a painful stimulus firsthand are the same as those that are activated when they witness a painful stimulus administered to a loved one [36], women with greater personal connections to Flint may be at increased risk for negative psychological outcomes. Next, despite a lack of significant racial/ethnic differences in sources of information (e.g., friends or family, television, social media) about the

crisis, we found that Black women reported greater knowledge of the water crisis. While we did not ask about the quantity of exposure to media coverage of the water crisis, it is possible that Black women perceive themselves to be more knowledgeable because they sought out more information about the crisis. Previous research has shown that exposure to disaster media coverage is associated with negative psychological outcomes [38]. Thus, it is possible that greater perceived knowledge among Black women could result in adverse health consequences.

With respect to opinions and beliefs about the water crisis, we found a number of notable differences by race/ethnicity. First, White women were nearly three times more likely than Black women to report that no one was responsible for the water crisis because it was an accident (although only 5.1% of White women reported this opinion), while Black women were more likely than White women and women of other races to blame the US government. Despite widespread agreement across racial/ethnic groups that the water crisis happened because government officials did not care about people in Flint, Black women were more likely to attribute officials' indifference to the fact that Flint is a majority Black city. Black women were more likely than all other groups to agree that the water crisis happened because government officials wanted to hurt people in Flint and to attribute officials' malice to the fact that most people who live in Flint are Black. Taken together, these results suggest that Black women are more likely to blame government officials for the water crisis and to attribute the water crisis to anti-Black racism. Thus, along with greater personal connections to Flint and greater perceived knowledge of the water crisis, Black women are more likely to report potentially distressing opinions and beliefs about what caused the water crisis.

## Limitations, Strengths, and Directions for Future Research

An important limitation of this study is the use of non-probability sampling techniques. Respondents were not randomly selected and, therefore, may not be representative of the target population of reproductive-age women in Michigan communities outside of Flint. Given our sampling strategy, some groups of women were more likely to receive an invitation to participate, including women from Southeast Michigan, publicly insured women, and women with young children. In addition, those who agreed to participate may be different than those who declined the invitation. Future studies using probability sampling techniques are needed to confirm or refute the results presented here. Another potential limitation is the initiation of a second recruitment wave following the detection of fraudulent activity. While it is possible that data from the first recruitment wave may include some fraudulent responses, it is more likely that we excluded valid

responses after applying our stringent quality control measures. A potentially more serious concern is related to differences in recruitment procedures between waves, which, by design, resulted in a higher proportion of Black respondents in wave 2 versus wave 1. Sensitivity analyses stratified by recruitment wave produced results similar to the main study findings, suggesting that differences in recruitment procedures did not affect study conclusions.

Other study limitations are related to the timing of data collection. First, the Flint water crisis emergency declaration occurred more than five years before we began data collection. Given the potentially greater salience of the water crisis to Black respondents, recall may differ by race/ethnicity. This is not necessarily problematic, though, since most study questions related to the water crisis (with the exception of questions about information sources) were not designed to assess objective data or past perceptions. Rather, most questions were designed to elicit current perceptions, opinions, and beliefs about the water crisis. A potentially more significant limitation of the timing of the study is that data collection occurred during the COVID-19 pandemic and shortly after the murder of George Floyd by Minneapolis police officer Derek Chauvin. Both the pandemic and George Floyd's murder drew heightened attention to structural racism and may have influenced respondents' opinions about the Flint water crisis. This likely had a greater effect on the responses of women with less prior knowledge of structural racism, potentially resulting in smaller racial/ethnic differences in opinions and beliefs about the water crisis than might have been observed one year earlier.

Despite these limitations, this study has several strengths. First, to our knowledge, this is the first study to explore how people in communities outside of Flint experienced the Flint water crisis. Findings suggest that the water crisis was a racialized stressor. More work is needed to understand whether indirect exposure to the Flint water crisis increased racial/ethnic health disparities. Future analyses using the survey data will explore opinions and beliefs about the water crisis as potential mechanisms underlying racial/ethnic differences in emotional reactions to the water crisis, as well as trust in water and beverage consumption practices. Another strength of this study is the large, sociodemographically diverse sample. The large sample size increases power to detect group differences in women's experiences of the Flint water crisis, while the sociodemographic diversity ensures adequate representation according to race/ethnicity and socioeconomic status.

## Conclusions

This study revealed that Black women in Michigan communities outside of Flint experienced the Flint water crisis differently than women in other racial and ethnic groups. Five years after the emergency declaration, Black women were more likely to

know someone who was directly affected by the water crisis; they perceived themselves to be more knowledgeable about the water crisis; and they were more likely to believe that the water crisis was an intentional act of harm resulting from anti-Black racism among government officials. We conclude that the Flint water crisis was a racialized stressor that may have negatively impacted the health and well-being of Michigan women who were not directly harmed by the lead-tainted water. More work is needed to understand the effects of vicarious exposure to the Flint water crisis — and vicarious exposure to structural racism, more generally — on minority health and health disparities in Michigan and throughout the USA.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s40615-022-01287-6>.

**Author Contribution** Conceptualization: Katherine W. Bauer, Cleopatra M. Abdou, and Belinda L. Needham; formal (quantitative) analysis: Sidonie K. Kilpatrick; qualitative analysis: Darya Dokshina; investigation: Katherine W. Bauer, Heidi M. Weeks, and Belinda L. Needham; data curation: Heidi M. Weeks; writing — original draft: Sidonie K. Kilpatrick and Belinda L. Needham; writing — review and editing: Sidonie K. Kilpatrick, Katherine W. Bauer, Nia Heard-Garris, Anita M. Malone, Cleopatra M. Abdou, Heidi M. Weeks, Michelle Clayson, Kristi L. Allgood, Darya Dokshina, and Belinda L. Needham; project administration: Michelle Clayson; funding acquisition: Katherine W. Bauer, Cleopatra M. Abdou, and Belinda L. Needham.

**Funding** This research was supported by the National Institute on Minority Health and Health Disparities (5R21MD012683, MPI: Needham & Abdou) and Healthy Eating Research, a national program of the Robert Wood Johnson Foundation (PI: Bauer).

## Declarations

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

**Conflict of Interest** The authors declare no competing interests.

## References

1. U.S. Census Bureau. U.S. Census Bureau QuickFacts: Flint city, Michigan [Internet]. [cited 2021 Aug 23]. Available from: <https://www.census.gov/quickfacts/flintcitymichigan>
2. Hanna-Attisha M, LaChance J, Sadler RC, Champney Schnepf A. Elevated blood lead levels in children associated with the flint drinking water crisis: a spatial analysis of risk and public health response. *Am J Public Health* [Internet]. American Public Health Association; 2016 [cited 2019 Mar 4];106:283–90. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26691115>
3. Zahran S, McElmurry SP, Sadler RC. Four phases of the Flint water crisis: evidence from blood lead levels in children. *Environ Res* [Internet]. 2017 [cited 2018 Dec 5];157:160–72. Available

- from: <https://linkinghub.elsevier.com/retrieve/pii/S0013935117303717>
4. Muennig P. The social costs of lead poisonings. *Health Aff* [Internet]. Health Affairs; 2016 [cited 2021 Aug 25];35:1545. Available from: <https://www.healthaffairs.org/doi/10.1377/hlthaff.2016.0661>
  5. Hersher R. Lethal pneumonia outbreak caused by low chlorine in Flint water [Internet]. All Things Consid. (National Public Radio). 2018. [cited 2021 Aug 25]. Available from: <https://www.npr.org/sections/health-shots/2018/02/05/582482024/lethal-pneumonia-outbreak-caused-by-low-chlorine-in-flint-water>
  6. Ezell JM, Chase EC. A population-based assessment of physical symptoms and mental health outcomes among adults following the Flint water crisis. *J Urban Heal* [Internet]. Springer; 2021 [cited 2021 Aug 25];1–12. Available from: <https://link.springer.com/article/10.1007/s11524-021-00525-2>
  7. Fortenberry GZ, Reynolds P, Burrer SL, Johnson-Lawrence V, Wang A, Schnall A, et al. Assessment of behavioral health concerns in the community affected by the Flint water crisis — Michigan (USA) 2016. *Prehosp Disaster Med* [Internet]. Cambridge University Press; 2018 [cited 2019 Feb 8];33:256–65. Available from: [https://www.cambridge.org/core/product/identifier/S1049023X18000250/type/journal\\_article](https://www.cambridge.org/core/product/identifier/S1049023X18000250/type/journal_article)
  8. Cuthbertson CA, Newkirk C, Ilardo J, Loveridge S, Skidmore M. Angry, scared, and unsure: mental health consequences of contaminated water in Flint, Michigan. *J Urban Health* [Internet]. Springer; 2016 [cited 2021 Aug 25];93:899–908. Available from: <https://pubmed.ncbi.nlm.nih.gov/3126025/>
  9. Heard-Garris NJ, Roche J, Carter P, Abir M, Walton M, Zimmerman M, et al. Voices from Flint: community perceptions of the Flint water crisis. *J Urban Heal* 2017 946 [Internet]. Springer; 2017 [cited 2021 Aug 25];94:776–9. Available from: <https://link.springer.com/article/10.1007/s11524-017-0152-3>
  10. Grossman DS, Slusky DJG. The impact of the Flint water crisis on fertility. *Demography* [Internet]. Springer; 2019 [cited 2021 Aug 25];56:2005–31. Available from: <https://link.springer.com/article/10.1007/s13524-019-00831-0>
  11. Novak NL, Geronimus AT, Martinez-Cardoso AM. Change in birth outcomes among infants born to Latina mothers after a major immigration raid. *Int J Epidemiol* [Internet]. Oxford University Press; 2017 [cited 2021 Aug 25];46:839. Available from: <https://pubmed.ncbi.nlm.nih.gov/2837605/>
  12. Bor J, Venkataramani AS, Williams DR, Tsai AC. Police killings and their spillover effects on the mental health of black Americans: a population-based, quasi-experimental study. *Lancet* (London, England) [Internet]. NIH Public Access; 2018 [cited 2021 Aug 25];392:302. Available from: <https://pubmed.ncbi.nlm.nih.gov/30676989/>
  13. Alsan M, Wanamaker M. Tuskegee and the health of Black Men. *Q J Econ* [Internet]. Narnia; 2018 [cited 2019 Sep 11];133:407–55. Available from: <https://academic.oup.com/qje/article/133/1/407/4060075>
  14. Vu H. I wish I were born in another time: unintended consequences of immigration enforcement on birth outcomes. 2021 [cited 2022 Feb 3];2020. Available from: <https://trac.syr.edu/phpto/immigration/secure/>.
  15. Felton R. How Flint traded safe drinking water for cost-cutting plan that didn't work [Internet]. *Guard*. 2016 [cited 2021 Aug 23]. Available from: <https://www.theguardian.com/us-news/2016/jan/23/flint-water-crisis-cost-cutting-switch-water-supply>
  16. The Associated Press. A timeline of the water crisis in Flint, Michigan [Internet]. Assoc. Press. 2017 [cited 2021 Aug 23]. Available from: <https://apnews.com/article/1176657a4b0d468c8f35d5dbb07f12bec>
  17. Matsa KE, Mitchell A, Stocking G. Searching for news: the Flint water crisis [Internet]. *Pew Res. Cent.* 2017 [cited 2021 Aug 24]. Available from: <https://www.pewresearch.org/journalism/2017/04/27/searching-for-news-the-flint-water-crisis/>
  18. Colias M. How GM saved itself from Flint water crisis [Internet]. *Automot. News.* 2016 [cited 2021 Aug 24]. Available from: <https://www.autonews.com/article/20160131/OEM01/302019964/how-gm-saved-itself-from-flint-water-crisis>
  19. Pieper KJ, Tang M, Edwards MA. Flint water crisis caused by interrupted corrosion control: investigating “ground zero” home. *Environ Sci Technol* [Internet]. American Chemical Society; 2017 [cited 2019 Mar 4];51:2007–14. Available from: [http://pubs.acs.org/doi/10.1021/acs.est.6b04034](https://pubs.acs.org/doi/10.1021/acs.est.6b04034)
  20. Martinez M. Flint, Michigan: did race and poverty factor into water crisis? [Internet]. *CNN.* 2016 [cited 2021 Aug 25]. Available from: <https://www.cnn.com/2016/01/26/us/flint-michigan-water-crisis-race-poverty/index.html>
  21. Trounstein J. How racial segregation and political mismanagement led to Flint's shocking water crisis [Internet]. *Washington Post.* 2016 [cited 2021 Aug 25]. Available from: <https://www.washingtonpost.com/news/monkey-cage/wp/2016/02/08/heres-the-political-history-that-led-to-flints-shocking-water-crisis/>
  22. Michigan Civil Rights Commission. The Flint water crisis: systemic racism through the lens of Flint [Internet]. 2017 Feb. Available from: [https://www.michigan.gov/documents/mdcr/VFlintCrisisRep-F-Edited3-13-17\\_554317\\_7.pdf](https://www.michigan.gov/documents/mdcr/VFlintCrisisRep-F-Edited3-13-17_554317_7.pdf)
  23. Hammer PJ. The Flint water crisis, the Karegnondi Water Authority and strategic-structural racism: *Crit Soc* [Internet]. SAGE Publications; 2017 [cited 2021 Aug 25];45:103–19. Available from: <https://journals.sagepub.com/doi/full/10.1177/0896920517729193>
  24. Cassano G, Benz TA. Introduction: Flint and the racialized geography of indifference. *Crit Soc* [Internet]. SAGE Publications; 2018 [cited 2021 Aug 25];45:25–32. Available from: <https://journals.sagepub.com/doi/full/10.1177/0896920517753697>
  25. Pulido L. Flint, environmental racism, and racial capitalism. *Capital Nat Social* [Internet]. Routledge; 2016 [cited 2021 Aug 25];27:1–16. Available from: <https://www.tandfonline.com/doi/abs/10.1080/10455752.2016.1213013>
  26. Ranganathan M. Thinking with Flint: racial liberalism and the roots of an American water tragedy. *Capital Nat Social* [Internet]. Routledge; 2016 [cited 2021 Aug 25];27:17–33. Available from: <https://www.tandfonline.com/doi/abs/10.1080/10455752.2016.1206583>
  27. Highsmith AR. A poisonous harvest: race, inequality, and the long history of the Flint water crisis. *J Law Soc* [Internet]. 2018 [cited 2021 Aug 25];18:121–39. Available from: <https://heinonline.org/HOL/Page?handle=hein.journals/jls18&id=229&div=&collection=>
  28. Muhammad M, De Loney EH, Brooks CL, Assari S, Robinson D, Caldwell CH. “I think that's all a lie...I think It's genocide”: applying a critical race praxis to youth perceptions of Flint water contamination. *Ethn Dis* [Internet]. Ethnicity & Disease Inc.; 2018 [cited 2021 Aug 25];28:241. Available from: <https://pubmed.ncbi.nlm.nih.gov/306092172/>
  29. The Associated Press. A closer look at the demographics of Flint, Michigan [Internet]. Assoc. Press. 2016 [cited 2021 Sep 19]. Available from: <https://apnews.com/article/7b2bcfdcc8d74ec9e0cb167a2239745>
  30. Danagoulian S, Jenkins D. Rolling back the gains: maternal stress undermines pregnancy health after Flint's water switch. *Health Econ* [Internet]. Health Econ; 2021 [cited 2022 Feb 3];30:564–84. Available from: <https://pubmed.ncbi.nlm.nih.gov/33351261/>
  31. Roy S, Edwards MA. Are there excess fetal deaths attributable to waterborne lead exposure during the Flint water crisis? Evidence from bio-kinetic model predictions and vital records. *J Expo Sci Environ Epidemiol* [Internet]. J Expo Sci Environ Epidemiol;

- 2021 [cited 2022 Feb 3];32:17–26. Available from: <https://pubmed.ncbi.nlm.nih.gov/34267307/>
32. Wang R, Chen X, Li X. Something in the pipe: the Flint water crisis and health at birth. *J Popul Econ* [Internet]. Springer Science and Business Media Deutschland GmbH; 2021 [cited 2022 Feb 3]; Available from: [https://www.researchgate.net/publication/354758829\\_Something\\_in\\_the\\_pipe\\_the\\_Flint\\_water\\_crisis\\_and\\_health\\_at\\_birth](https://www.researchgate.net/publication/354758829_Something_in_the_pipe_the_Flint_water_crisis_and_health_at_birth)
33. Abouk R, Adams S. Birth outcomes in Flint in the early stages of the water crisis. *J Public Health Policy* [Internet]. Palgrave Macmillan UK; 2018 [cited 2019 Feb 8];39:68–85. Available from: <http://link.springer.com/10.1057/s41271-017-0097-5>
34. Heard-Garris NJ, Cale M, Camaj L, Hamati MC, Dominguez TP. Transmitting trauma: a systematic review of vicarious racism and child health. *Soc Sci Med* [Internet]. 2018 [cited 2018 Dec 1];199:230–40. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/28456418>
35. Gee GC, Walsemann KM, Brondolo E. A life course perspective on how racism may be related to health inequities. *Am J Public Health* [Internet]. American Public Health Association; 2012 [cited 2021 Aug 25];102:967–74. Available from: <https://pubmed.ncbi.nlm.nih.gov/22483932/>
36. Singer T, Seymour B, O’Doherty J, Kaube H, Dolan R, Frith C. Empathy for pain involves the affective but not sensory components of pain. *Science* (80- ) [Internet]. Science; 2004 [cited 2021 Aug 25];303:1157–62. Available from: <https://pubmed.ncbi.nlm.nih.gov/14976305/>
37. Huurne ET, Gutteling J. Information needs and risk perception as predictors of risk information seeking. *J Risk Res* [Internet]. Taylor & Francis; 2008 [cited 2021 Aug 25];11:847–62. Available from: <https://www.tandfonline.com/doi/abs/10.1080/13669870701875750>
38. Hopwood TL, Schutte NS. Psychological outcomes in reaction to media exposure to disasters and large-scale violence: a meta-analysis. *Psychol Violence* [Internet]. American Psychological Association Inc.; 2017 [cited 2021 Aug 25];7:316–27. Available from: <https://psycnet.apa.org/record/2016-22453-001>
39. Helms JE, Nicolas G, Green CE. Racism and ethnoviolence as trauma: enhancing professional training: <https://doi.org/10.1177/1534765610389595> [Internet]. SAGE PublicationsSage CA: Los Angeles, CA; 2010 [cited 2021 Sep 19];16:53–62. Available from: <https://journals.sagepub.com/doi/pdf/10.1177/1534765610389595>
40. Nunnally SC. Trust in Black America: race, discrimination, and politics [Internet]. New York: New York University Press; 2012 [cited 2021 Sep 19]. Available from: <https://doi.org/10.18574/9780814759301>
41. Harris KM, Halpern CT, Whitsel E, Hussey J, Tabor J, Entzel P, et al. The National Longitudinal Study of Adolescent to Adult Health: research design [Internet]. *Natl. Longitud. Study Adolesc. to Adult Heal. Res. Des.* 2009. Available from: <https://addhealth.cpc.unc.edu/documentation/study-design/>
42. Novak NL, Geronimus AT, Martinez-Cardoso AM. Change in birth outcomes among infants born to Latina mothers after a major immigration raid. *Int J Epidemiol* [Internet]. 2016 [cited 2018 Nov 30];46:839–49. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/28115577>

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