



## Research article

# Forming a Critical Race Theory of Environmental Disaster: Understanding social meanings and health threat perception in the Flint Water Crisis

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## ABSTRACT

A *Critical Race Theory of Environmental Disaster* can aid researchers in better contextualizing racially disproportionate environmental disasters and their intricate social meanings to survivors. Such a theory, as proposed and operationalized here, incorporates interpretations of the causes and consequences of environmental disaster. In so doing, this theory weighs the racial and economic stratification often preceding environmental disaster and that which reflexively becomes more embedded in the aftermath. Focusing on the water crisis in the racially diverse, socioeconomically diminished city of Flint, Michigan, this article examines survey data from research conducted with city residents. The analysis considers residents' attitudes and beliefs around the crisis' scope and its intentionality and residents' health outcomes. Results suggest that various institutional and community-level mechanisms contribute to processes of meaning-making during crisis, or "crisis-making," finding consistent variation in residents' understanding of the nature and scope of the water crisis that is associated with specific cultural and health-related experiences. This construction substantiates that a *Critical Race Theory of Environmental Disaster* must consider not only race, but class in the context of race, as instrumental in developing social understandings of, and experiences with, environmental disaster.

## 1. Background

The 2014 water crisis in the socioeconomically distressed city of Flint, Michigan emerged through a series of austerity measures fomented by the state government. The initial wave of contamination of Flint's water supply with elevated levels of lead (Pb), a neurotoxin, coliform, and fecal bacteria, occurred just days after the city's water sourcing system was switched from Lake Huron to the Flint River (Masten et al., 2016). The switch was approved as part of a sweeping and ravenous series of cost-saving measures in Flint that were devised and greenlit by the city's then-"emergency manager" without public debate or procedurally codified support from publicly elected Flint officials (Fasenfest, 2019).

In considering the social-cum-ecological meanings of the FWC, one is challenged to consider two complementary ideas. The first is that there was *something* about Flint that made it especially ripe for an environmental crisis. The second is that the crisis would *not* have happened in cities that were unlike Flint. These hypotheses illumine a Du Boisian

precept on spatial stratification and speak to environmental injustice—environmental hazards disproportionately and often deliberately situated among particular populations—as delineated by Bullard (2018). Problematization of interactions between Flint residents and officials following the crisis further underscore the deep skepticism that such communities often receive from government and industry actors when raising concerns on environmental issues (Mohai and Bryant, 1998; Harrison, 2017). In consideration of adjoining facets of *racial capitalism* (Melamed, 2015), or economic devaluation based on race, the destruction of racially marginalized peoples' political and social capital would invariably instigate both the causes and effects of a crisis.

But what is a crisis, and to what extent can the FWC be regarded as one? Analyzing data collected in Flint several years after the crisis began, this article shows that Flint residents' characterization of crisis consisted of the following three primary criterion, elements in a proposed *Critical Race Theory of Environmental Disaster* model: 1) a perception of the environmental event(s) being of unusual type, magnitude, or recurrence; 2) a perception that the environmental event(s), or

Abbreviations: CRT, Critical Race Theory; FWC, Flint Water Crisis.

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extensions of it, have been, are or will be deleterious to human or communal health; and 3) a perception of some objectively preventable mechanism(s) at play in the initiation of the environmental event(s). Heuristically treated in each criterion is the degree to which the event(s) had racist and/or classist policy antecedents or other dynamics associated with social disenfranchisement (e.g., age, gender, etc.).

## 2. An overview of the Flint Water Crisis

The FWC reached its supposed apex as heightened volumes of lead began leaching off Flint's aging water infrastructure into the water supply alongside carcinogenic trihalomethanes and fecal coliform bacteria (Pieper et al., 2017; Martin et al., 2020). Additional reports confirm an increase in *legionella*, which gives rise to pneumonia-inducing Legionnaires' disease, that potentially resulted in up to 100 deaths (Binney et al., 2019). During the initial wave of the water crisis, many Flint residents also reported severe skin rashes, hair loss, and intestinal issues possibly tied to harsh chemicals and bacteria in the city's new water source (Peplow, 2018; Ezell and Chase, 2021). It is estimated that many of Flint's roughly 96,000 residents were also exposed to high levels of lead (Pb) and other hazardous heavy metals, chemicals, and bacteria during the crisis (Masten et al., 2016). Lead, highly associated with neurocognitive and developmental disorders in children (Banks et al., 1997; Daneshparvar et al., 2016) and cardiovascular disease in adults (Navas-Acien et al., 2007; Vaziri, 2008), is increasingly recognized as a preeminent contributor to social inequality (Muller et al., 2018).

The Flint Water Crisis was stoked through the Michigan state government's hyper-local austerity politics, this paradigm—at the surface level—brought on by the city's dwindling tax-base and Flint's resultant inability to adequately provide civic services and maintain key public resources, including K-12 schooling, transportation, streets, policing, and water and sanitation management (Fasenfest and Pride, 2016; Stanley, 2017). At the time, the city was under the leadership of an unelected, state-appointed fiscal "emergency manager," creating questions around regulatory ruptures in the city and the legality of the decision-making that ultimately led to the water source switch (Stanley, 2017; Krings et al., 2019). In response to the crisis, large civic protests and Congressional hearings and criminal trials were held and a \$641 million civic settlement was reached, while multiple civil action suits are pending at the time of this writing (Ezell, 2021).

This stark combination of social action and institutional enagement contrasts with attitudes that view Flint's public health "crisis" as not rising to the level of crisis at all, but as representing *toxicohistronics*, or "overreactions to substances in our ... environment where real risk has been exchanged for theoretical risk" (Banner, 2018). This rhetorical tension is made more visceral by the tautological nature of this "crisis"<sup>1</sup> and its socio-linguistic framing. This begs consideration of whether its introduction into the lexicon as the "Flint Water Crisis" has arbitrarily cemented its status as such in the popular imaginary. With this in mind, despite Flint's water being declared "safe" to use by the Environmental Protection Agency in June 2018, today, some seven years after Flint's return to its original water source, guidance around the use of city tap water remains ambiguous (Hughes, 2020). With commentary from federal officials, local government, and healthcare providers on their water's portability often at odds, residents' household-level decision-making related to water consumption is frequently a tortured space (Kruger et al., 2017; Pauli, 2020). Accordingly, both the lived

experiences associated with the FWC and understanding of its scope—e.g., how severe the effects of the water contamination are and how many people are known to be, may be, or will be impacted—remain fluid. This dynamic contributes to an ongoing instability of judgments among Flint residents on the meaning of crisis—and indeed whether *their* crisis is a crisis at all, these dynamics being refracted chiefly at the axes of race and class

## 3. Toward a Critical Race Theory of Environmental Disaster

Focusing on Flint residents' attitudes and beliefs around the genesis, meaning, and implications of the water crisis, this research merges Critical Race Theory (CRT) with the sociology of disaster—two often siloed fields of literature—to examine the broader psychosocial interpolations that influence situational and everyday understandings of what constitutes a crisis. CRT is most fundamentally associated with the study of race as it is activated through racism and via imbalances in power and privilege thus created in education, law/criminal justice, healthcare, housing, and the economy (Ford and Airhihenbuwa, 2010; Ladson-Billings and Tate, 2016; Delgado and Stefancic, 2017). Moreover, CRT emphasizes the role that race and, by extension, class play in encoding meaning to social structures (Denzin, 2001). In consideration of environmental disasters and acts of cognitive mapping (Auyero and Swistun, 2008), this process is operationalized here as *crisis-making*, an interpolation of CRT and disaster sociology theory that focuses on meaning-making during (presumed) crisis.

Several years after the FWC, the state-appointed Michigan Civil Rights Commission launched a year-long investigation (Michigan Civil Rights Commission, 2017), providing one window into how structural racism may have factored into the events. The 8-person "nonpartisan" committee was co-chaired by two appointees of then-governor Rick Snyder, a second-term Republican. Though the commission's report delivered a scorching indictment of the state's legacy of environmental disenfranchisement of Black communities (Dorsey, 1999; Duvall et al., 2012; Benz, 2019), the marketing of the report was far more measured. In a preamble to its release, the report's authors used conspicuously equivocal language, declaring:

We strongly believe that the actions that led to the poisoning of Flint's water and the slow response resulted in the abridgment of civil rights for the people of Flint. *We are not suggesting that those making decisions related to this crisis were racists, or meant to treat Flint any differently because it is a community of color* (emphasis added). Rather, the response is the result of implicit bias and the history of systemic racism that was built into the foundation of Flint (Levegood, 2017).

Stallings (2002) emphasizes that "disasters provide opportunities to examine aspects of social structures and processes that are hidden in everyday affairs." The increasing recurrence and intensity of disasters, those of both natural and so-called "man-made" varieties (namely viz climate change), prompt the need for a new theory on the social meanings of environmental disaster. Given the racially and socioeconomically unequal burden of morbidity and mortality associated with environmental disaster (Adam et al., 2001; Ryder, 2017; Jacobs, 2019), it is particularly pivotal that such a theory decentralize the event(s) and focus on the formative impacts of race, *and* class in the context of race, on the manifestation of and lived experiences associated with disaster. Such a theory is well-positioned to advance a culturally responsive understanding of the formative antecedents to environmental disasters that rapidly and dramatically forge health and social disparities. As an environmental management cognate focused on social disruption, this "Critical Disaster Theory" has a direct correspondence with theories of social organization, social change, and social order (Stallings, 2002). In the case of the FWC, Critical Disaster Theory helps empirically link dimensions of Flint's deindustrialization with the broader processes of racial and political disenfranchisement and natural resource devaluation that appear to have induced the water crisis *and* the uneven response to it—and that, in turn, have shaped civic perceptions.

<sup>1</sup> For the purposes of this treatment, the terms "disaster" and "crisis" are invoked with the same empirical and theoretical framing. Though environmental sociology commonly focuses on the construct of disaster, "crisis" has similar discursive value by virtue of its central placement in the modern vernacular (e.g., broadly in micro-level cases of a "crisis of faith," a "mid-life crisis," etc.; to event-specific usage, such as the "Cuban missile crisis," "Iran hostage crisis," etc.).

The technical impacts of a disaster cannot be extricated or otherwise understood from their markedly social causes and risk factors. CRT clarifies how way racialization mediates these forces, pointing to the need to consider the psychosocial aspects of disasters and the way they are understood and experienced as extensions of everyday crises in community development, environmental management, etc. Turner and Pidgeon (1997) emphasized the heuristic complexities of crisis-making in pinpointing the objective limits of safety and prevention schemes, this corresponding to a subjective threshold under which disaster can be said to be a tangible in its predictability and subsequently prevented or at least mitigated. Attitudes around preventability further correspond to understandings of one's positionality and thus one's general social vulnerability. Kelley's attribution theory establishes that individuals systematically interpret and process others' actions (and inactions), with these interpretations shaping their subsequent reactions or responses to the action/inaction (H. Kelley, 1967). These antecedents and consequences are instrumentally aligned with the likelihood of prosociality. In spaces where like Flint where systemic oppression is effectively endemic and environmental protectionism is seen as lax, institutions' actions (or inactions) are more likely to be perceived with suspicion and derision, as the hostile attribution theory explains (Walters, 2007a; Butler and Maruna, 2009).

Heretofore, there has been limited empirical investigation into the broader constellation of social and cultural forces that create meaning around the scope and nature of presumed crises, a gap this article fills through its focus on attribution. Indeed, due to joint medicalization and politicization processes, it could be said that there no longer are "natural" disasters—disasters, like those brought on by climate change, are now always ostensibly seen as anthropogenic or manmade, accruing from either institutional avarice or indifference or simply due to benign lapses in technocratic prognostication (Kreps, 1984; Fischer, 1998). This binary takes on added import in consideration of environmental injustice, where institutional greed, apathy, or incompetence are more readily entrenched and normalized (Foster, 2002; Richter, 2018). Moreover, as with healthcare and medicine, the public's expectation for peerless processes of prevention and mitigation against disaster have grown over time, thus winnowing the public's level of tolerance for human error or institutional accident-proneness. The present analysis illustrates that Flint residents understand and experience the FWC in ways that cohere to specific racialized and class-specific expectations and threat perceptions.

## 4. Methods

### 4.1. Data collection

Survey were administered to Flint, Michigan residents who lived in the city during and in the immediate years after the water crisis, focusing on their attitudes, beliefs, and health outcomes. In recognition of the fluidity of the FWC, a cross-sectional approach was undertaken to aid in an iterative process of hypothesis-generation (Mann, 2003; Levin, 2006) towards the formation of a Critical Disaster Theory (and a Critical Race Theory of Environmental Disaster, for this work's more immediate purposes). Between June and November 2019, Flint residents were surveyed about their experiences across the timeline of crisis, which was framed as beginning April 25, 2014 (the date of the water source switch) to the date of the survey and forward. To increase the prospects of obtaining a geographically representative sample, surveys were administered at nine sites in Flint, including local public libraries, a farmer's market, a café, a bus station, a gym, and a laundromat, with administration times being rotated across varying time blocks (i.e., morning, afternoon, and evening). Participants were approached upon arrival and screened for eligibility. These locations were roughly evenly distributed across the city's geography and covered six of its nine zip codes. To be eligible to participate in the survey, individuals had to 1) be at least 18 years of age; 2) have lived in Flint for at least one full year

between April 25, 2014 (the date of the water source switch) and the date of the survey; and 3) be able to provide informed consent. All study procedures were approved by the Institutional Review Board at Cornell University.

### 4.2. Predictor and outcome construction

Respondents were asked their demographics and about their attitudes and beliefs in relation to FWC, specifically regarding particular social factors that may have contributed to it. To provide additional context for the core analyses, respondents were also asked to describe their health and the demographics and health of any children under 18 years of age (at the time of the survey) who had been in their care. The primary predictors were respondent age, race, gender, political affiliation, number of years lived in Flint, zip code, receipt of public benefits/assistance status, social network size (those they went to for "venting"/information in relation to the FWC), total number of symptoms/outcomes self-reported after but not before the water source switch on April 25, 2014 (symptoms described below), and whether they had at least one child in their care experience at least one symptom after but not before the water source switch. As a "pre-post" measure, symptom characterization focused on assessing those that occurred for the individual, before and after the water source switch, and included the following symptoms, each shown to be associated with water contamination/lead exposure (Payment et al., 1993; Whelton et al., 2015; Sankhla et al., 2016): elevated BLLs, skin rashes, hair loss, nausea (adults only), emotional agitation (adults only), hyperactivity (children only), or comprehension/learning delays (children only).

Given methodological concerns related to the bias in the usage of self-report and long-term recall, several steps were taken to curb the prospects of symptom misrepresentation. To stem these broader methodological concerns and specific survey design issues (Coughlin, 1990; Schmier and Halpern, 2004; Brusco and Watts, 2015), respondents were asked if they had "regularly" experienced, *before* and *after* the date of the city's water source switch, more of a particular symptom than would be "normal" or typical for them (i.e., before the water source switch). Here, respondents were asked to specifically focus on symptom recurrence and intensity. These questions, when appropriate, were couched around references to media reports, government hearings, etc., to serve as potential memory flashpoints or "memory joggers" for the respondent (Coughlin, 1990; Schütz et al., 2003).

The primary outcomes for this paper were respondents' FWC attitudes and beliefs about the FWC and their potential water contamination/lead exposure-related symptoms and mental health outcomes (PTSD and depression/anxiety). Respondents were asked to indicate how much they agreed with various statements, each corresponding to either views commonly expressed in popular media or to counterfactuals to these views (Carey and Lichtenwalter, 2020):

1. *People have made the water issues in Flint a bigger deal than it really is.*
2. *The decision to switch the water source was intentionally meant to harm Flint residents.*
3. *The decision to switch the water source to the Flint River was discriminatory against poorer or lower-income Flint residents.*
4. *The decision to switch the water source to the Flint River was racially motivated (because there's a large Black population in Flint).*
5. *Children in Flint who drank or were exposed to the water are going to have significant health problems in the future due to this.*
6. *Three years from now, I am likely to drink primarily tap water at home.*
7. *Overall, I am likely to trust the government in preventing water or environmental issues like this (Flint Water Crisis) in the future.*

Additionally, respondents were asked to indicate how much they agreed that they were satisfied with the response of the city (Flint), state (Michigan), and federal government to the (presumed) water issues. Options for each query included the Likert choices of *Strongly Agree*,

Agree, Neutral, Disagree, and Strongly Disagree, which were subsequently collapsed to Agree, Neutral, and Disagree for modeling purposes. Respondents also responded to the PC-PTSD-5 (Prins et al., 2016) and the PHQ-4 (Löwe et al., 2010), two validated diagnostic tools for measuring symptoms associated with post-traumatic stress disorder (PTSD) and depression/anxiety, respectively. The PC-PTSD-5 instrument consists of Yes/No responses to the five questions, with modifications to account for the event-specific nature of PTSD symptomatology (here, in relation to the water crisis):

1. In the past month, have you had nightmares about the water crisis or thought about it when you didn't want to?
2. In the past month, have you tried hard not to think about the water crisis or went out of your way to avoid situations that remind you of it?
3. In the past month, have you been constantly on guard, watchful, or easily startled?
4. In the past month, have you felt numb or detached from people, activities, or your surroundings?
5. In the past month, have you felt guilty or unable to stop blaming yourself or others for the water crisis or the problems it may have caused?

The PHQ-4 instrument consists of four questions (no modifications were made to the instrument given the broader etiology of depression/anxiety):

1. In the last two weeks, how often have you been feeling nervous, anxious, or on edge?
2. In the last two weeks, how often have you not been able to stop or control worrying?
3. In the last two weeks, how often have you had little interest or pleasure in doing things?
4. In the last two weeks, how often have you felt down, depressed, or hopeless?

Respondents could answer "Not at all," "Several days," "More than half the days," or "Nearly every day" to each question.

#### 4.3. Statistical analysis

Simple descriptive statistics of all predictors and outcomes, both overall and stratified by race, were produced. To assess the unadjusted effect of race, univariable Kruskal-Wallis tests of the effect of race were conducted on all predictors and outcomes (Kruskal and Wallis, 1952).

To assess more complex multivariable relationships, multivariable models for each of the outcomes listed above were fit: the ten questions about political responses, the nine questions about mental health, and the summary scores for mental health (the total PC-PTSD-5 score and PHQ-4 score), for a total of 21 different outcomes. For the political outcomes and PHQ-4 outcomes, proportional odds models to address the ordinal outcome were fit. For the PC-PTSD-5 outcomes, logistic regressions were fit; for the summary PC-PTSD-5 and PHQ-4 outcomes, linear models were fit (Agresti, 2013, 2015). Complete case analysis was used for all models, because missingness was comparatively minor.

For all models, the predictors of age, race, gender, public benefits receipt status, political affiliation, years lived in Flint, social network size, zip code, number of symptoms experienced, and if the respondent had a child in their care who experienced at least one symptom, were considered. For the seven attitudinal outcomes, respondents' PC-PTSD-5 score and PHQ-4 score were also utilized as predictors. The geographically contiguous zip codes of 48502 and 48503 were collapsed due to the small sample size in zip code 48502, which is Flint's least populous zip code, consisting mostly of businesses.

To deal with causal structure, three "layers" of models were fit: a first layer including all predictors except the health outcomes, from which

the total effect of the baseline predictors on attitudes and beliefs and water contamination/lead exposure-related symptoms/mental health was estimated; a second layer including the baseline predictors and the symptoms predictors, from which the effect of having symptoms/caring for a child who had symptoms on attitudes/mental health was estimated, adjusting for baseline predictors; and for the seven attitudinal outcomes, a third layer including all predictors, from which the effect of PC-PTSD-5/PHQ-4 scores on attitudes and beliefs was estimated, adjusting for baseline predictors and having symptoms. This strategy was adopted to deal with the fact that having symptoms/having a child with symptoms mediates the effect of baseline predictors on attitudes and beliefs/mental health outcomes, while PC-PTSD-5/PHQ-4 score mediates the effect of baseline predictors and symptoms on attitude/belief outcomes. Including the mediators would bias the estimate of the effect of the baseline predictors on the outcome of interest (Hernán and Robins, 2020).

Lastly, to address the large number of hypothesis tests conducted in this analysis (21 outcomes crossed with sixteen predictors), a false discovery rate correction was applied to all multivariable modeling to adjust for multiple testing (Benjamini and Hochberg, 1995). All analyses were conducted in R version 3.6.2 (R Core Team, 2019). A copy of the R script used to conduct this analysis can be found at [https://github.com/elizabethchase/Flint\\_Community\\_Engagement](https://github.com/elizabethchase/Flint_Community_Engagement).

## 5. Results

### 5.1. Baseline predictors

A total of 331 respondents participated in the survey. Sample characteristics are presented in Table 1. Briefly, a total of 195 of these respondents (58.9%) identified as women. The average age of participants was 47.9 years old ( $\pm 16.5$ ). Overall, 191 respondents (57.7%) identified as Black, 109 (32.9%) as White, and 31 (10.3%) were categorized as "Other" race. Most respondents had a high school education (30.5%) or some college (30.2%). In total, 62.2% of respondents were eligible for public benefits. On average, Blacks had lived in the City of Flint for significantly more years ( $38.5 \pm 16.8$ ) than Whites ( $29.0 \pm 21.0$ ) or "Other" race respondents ( $27.2 \pm 19.5$ ).

A plurality of respondents identified politically as Democrats ( $N = 142, 42.9\%$ ), with Black respondents significantly more likely to report being Democrat than White or Other race respondents ( $p < 0.01$ ). There were also racial differences in zip code, with Black respondents less likely to live in zip codes 48503, 48506, 48507, and 48532 than White/Other race respondents and more likely to live in zip code 48504 and 48505 than White/Other race respondents. Additionally, White respondents reported fewer children under 18 in their care than Black/Other race respondents (White:  $0.6 \pm 0.1$ , Black:  $0.9 \pm 1.5$ , Other:  $1.2 \pm 1.3$ ,  $p = 0.03$ ).

Overall, 225 out of the 331 (68.0%) survey respondents experienced at least one potential water contamination-related symptom after but not before the 2014 water source switch. Black respondents reported experiencing significantly more potential water contamination-related symptoms after but not before the water source switch than White and Other race respondents (White:  $1.1 \pm 1.4$ , Black:  $2.1 \pm 1.8$ , Other:  $1.8 \pm 2.0$ ,  $p < 0.01$ ). Furthermore, Black and Other race respondents were significantly more likely to be caring for a child who had experienced at least one potential water contamination-related symptom (34% of Black respondents, 41.9% of Other race respondents, and 22% of White respondents;  $p = 0.04$ ).

### 5.2. Beliefs on whether the FWC was indeed a "Crisis"

Overall, 277 respondents (83.7%) either disagreed or strongly disagreed that people had made the water issues a "bigger deal" than they really were (Table 2). Similarly, 277 respondents (83.7%, although not the same 277 respondents) agreed or strongly agreed that the children of



**Table 1**  
Demographic and contextual traits, stratified by race, of a sample of 331 adults surveyed in Flint, MI from June–November 2019.

Characteristic	Overall	Black Race	Other Race	White Race	P-value
N	331	191	31	109	
Age (mean (SD))	47.9 (16.5)	47.6 (16.2)	46.0 (16.4)	48.8 (17.1)	0.68
Men (%)	136 (41.1)	77 (40.3)	13 (41.9)	46 (42.2)	0.95
Education (%)					<0.01*
Less than high school	24 (7.3)	10 (5.2)	4 (12.9)	10 (9.2)	
High school	101 (30.5)	66 (34.6)	12 (38.7)	23 (21.1)	
Some college	100 (30.2)	60 (31.4)	10 (32.3)	30 (27.5)	
Associate's degree	47 (14.2)	30 (15.7)	2 (6.5)	15 (13.8)	
College degree or more	59 (17.8)	25 (13.1)	3 (9.7)	31 (28.4)	
Health insurance status (%)					0.79
Uninsured	23 (6.9)	13 (6.8)	1 (3.2)	9 (8.3)	
Unsure/don't know	1 (0.3)	1 (0.5)	0 (0.0)	0 (0.0)	
Insured	307 (92.7)	177 (92.7)	30 (96.8)	100 (91.7)	
Receives public benefits (%)					0.06
Yes	206 (62.2)	125 (65.4)	20 (64.5)	61 (56.0)	
No	109 (32.9)	58 (30.4)	7 (22.6)	44 (40.4)	
Don't know/unsure	16 (4.8)	8 (4.2)	4 (12.9)	4 (3.7)	
Employment status (%)					0.18
Employed	151 (45.6)	98 (51.3)	15 (48.4)	38 (34.9)	
Unemployed	78 (23.6)	45 (23.6)	7 (22.6)	26 (23.9)	
Retired	71 (21.5)	35 (18.3)	6 (19.4)	30 (27.5)	
Odd jobs	3 (0.9)	2 (1.0)	0 (0.0)	1 (0.9)	
Other	28 (8.5)	11 (5.8)	3 (9.7)	14 (12.8)	
Political affiliation (%)					<0.01*
Democrat	142 (42.9)	101 (52.9)	9 (29.0)	32 (29.4)	
Republican	24 (7.3)	9 (4.7)	2 (6.5)	13 (11.9)	
Independent	78 (23.6)	28 (14.7)	11 (35.5)	39 (35.8)	
Other	57 (17.2)	34 (17.8)	7 (22.6)	16 (14.7)	
Missing	30 (9.1)	19 (9.9)	2 (6.5)	9 (8.3)	
Years in City of Flint (mean (SD))	34.3 (19.1)	38.5 (16.8)	27.2 (19.5)	29.0 (21.0)	<0.01*
Current ZIP code (%)					<0.01*
ZIP: 48,502	7 (2.1)	2 (1.0)	1 (3.2)	4 (3.7)	
ZIP: 48,503	97 (29.3)	47 (24.6)	10 (32.3)	40 (36.7)	
ZIP: 48,504	72 (21.8)	51 (26.7)	4 (12.9)	17 (15.6)	
ZIP: 48,505	71 (21.5)	63 (33.0)	4 (12.9)	4 (3.7)	
ZIP: 48,506	37 (11.2)	9 (4.7)	5 (16.1)	23 (21.1)	
ZIP: 48,507	30 (9.1)	13 (6.8)	4 (12.9)	13 (11.9)	
ZIP: 48,532	17 (5.1)	6 (3.1)	3 (9.7)	8 (7.3)	
Number of children (mean (SD))	0.9 (1.3)	0.9 (1.5)	1.2 (1.3)	0.6 (1.0)	0.03*

**Table 1 (continued)**

Characteristic	Overall	Black Race	Other Race	White Race	P-value
Social network size (mean (SD))	3.0 (2.2)	3.1 (2.0)	2.9 (2.3)	3.0 (2.6)	0.89
Number of lead symptoms experienced (mean (SD))	1.8 (1.7)	2.1 (1.8)	1.8 (2.0)	1.1 (1.4)	<0.01*
Cared for child who experienced at least one symptom (%)	102 (30.8)	65 (34.0)	13 (41.9)	24 (22.0)	0.04*

\*Statistically significant at p < 0.05.

**Table 2**  
Reported Flint Water Crisis beliefs and attitudes, stratified by race, of a sample of 331 adults surveyed in Flint, MI from June–November 2019.

Outcome	Overall	Black Race	Other Race	White Race	P-value
N	331	191	31	109	
The water source switch was intentionally meant to harm Flint residents. (%)					<0.01*
Agree	152 (45.9)	110 (57.6)	13 (41.9)	29 (26.6)	
Disagree	116 (35.0)	41 (21.5)	12 (38.7)	63 (57.8)	
Neutral	63 (19.0)	40 (20.9)	6 (19.4)	17 (15.6)	
People have made the water issues a bigger deal than they really were. (%)					0.27
Agree	38 (11.5)	18 (9.4)	4 (12.9)	16 (14.7)	
Disagree	277 (83.7)	167 (87.4)	25 (80.6)	85 (78.0)	
Neutral	16 (4.8)	6 (3.1)	2 (6.5)	8 (7.3)	
Children in Flint are going to have health problems in future due to the water crisis. (%)					<0.01*
Agree	277 (83.7)	171 (89.5)	24 (77.4)	82 (75.2)	
Disagree	12 (3.6)	2 (1.0)	3 (9.7)	7 (6.4)	
Neutral	42 (12.7)	18 (9.4)	4 (12.9)	20 (18.3)	
The water source switch was discriminatory against poor or lower-income Flint residents. (%)					0.04*
Agree	176 (53.2)	114 (59.7)	16 (51.6)	46 (42.2)	
Disagree	88 (26.6)	45 (23.6)	10 (32.3)	33 (30.3)	
Neutral	67 (20.2)	32 (16.8)	5 (16.1)	30 (27.5)	
The water source switch was racially motivated (because Flint has a large Black population). (%)					<0.01*
Agree	106 (32.0)	78 (40.8)	4 (12.9)	24 (22.0)	
Disagree	142 (42.9)	64 (33.5)	15 (48.4)	63 (57.8)	
Neutral	83 (25.1)	49 (25.7)	12 (38.7)	22 (20.2)	
I am likely to trust the government on water/environmental issues in future. (%)					0.05*
Agree	48 (14.5)	27 (14.1)	1 (3.2)	20 (18.3)	
Disagree	243 (73.4)	144 (75.4)	22 (71.0)	77 (70.6)	
Neutral	40 (12.1)	20 (10.5)	8 (25.8)	12 (11.0)	
Three years from now, I am likely to drink primarily tap water from home. (%)					<0.01*
Agree	63 (19.0)	40 (20.9)	6 (19.4)	17 (15.6)	
Disagree	183 (55.3)	118 (61.8)	18 (58.1)	47 (43.1)	
Neutral	28 (8.5)	17 (8.9)	4 (12.9)	7 (6.4)	
Missing	57 (17.2)	16 (8.4)	3 (9.7)	38 (34.9)	
I am satisfied with the federal government's role in addressing the Flint water issues. (%)					<0.01*
Agree	48 (14.5)	25 (13.1)	5 (16.1)	18 (16.5)	
Disagree	225 (68.0)	145 (75.9)	18 (58.1)	62 (56.9)	
Neutral	58 (17.5)	21 (11.0)	8 (25.8)	29 (26.6)	
I am satisfied with the Michigan government's role in addressing the Flint water issues. (%)					0.1
Agree	38 (11.5)	18 (9.4)	2 (6.5)	18 (16.5)	
Disagree	252 (76.1)	154 (80.6)	23 (74.2)	75 (68.8)	
Neutral	41 (12.4)	19 (9.9)	6 (19.4)	16 (14.7)	
I am satisfied with the Flint government's role in addressing the Flint water issues. (%)					0.34
Agree	65 (19.6)	42 (22.0)	2 (6.5)	21 (19.3)	
Disagree	220 (66.5)	125 (65.4)	23 (74.2)	72 (66.1)	
Neutral	46 (13.9)	24 (12.6)	6 (19.4)	16 (14.7)	

\*Statistically significant at p < 0.05.

**Table 3**  
Trauma, depression, and anxiety outcomes, stratified by race, of a sample of 331 adults surveyed in Flint, MI from June–November 2019.

Outcome	Overall	Black Race	Other Race	White Race	P-value
N	331	191	31	109	
In the last month, I have thought about the water crisis when I did not want to/had nightmares about it. (%)	103 (31.1)	63 (33.0)	9 (29.0)	31 (28.4)	0.69
In the last month, I have avoided thinking about the water crisis or avoided situations that reminded me of it. (%)	147 (44.4)	97 (50.8)	12 (38.7)	38 (34.9)	0.02*
In the last month, I have been constantly on guard/watchful. (%)	130 (39.3)	84 (44.0)	11 (35.5)	35 (32.1)	0.12
In the last month, I have felt numb/detached from my surroundings. (%)	110 (33.2)	68 (35.6)	13 (41.9)	29 (26.6)	0.16
In the last month, I have felt guilty about the water crisis. (%)	49 (14.8)	31 (16.2)	4 (12.9)	14 (12.8)	0.7
In the last two weeks, how many days have you felt nervous? (%)					0.19
Not at all	145 (43.8)	85 (44.5)	15 (48.4)	45 (41.3)	
Several days	84 (25.4)	39 (20.4)	11 (35.5)	34 (31.2)	
More than half the days	32 (9.7)	20 (10.5)	2 (6.5)	10 (9.2)	
Nearly every day	49 (14.8)	30 (15.7)	3 (9.7)	16 (14.7)	
Missing	21 (6.3)	17 (8.9)	0 (0.0)	4 (3.7)	
In the last two weeks, how many days have you worried uncontrollably? (%)					0.04*
Not at all	126 (38.1)	65 (34.0)	15 (48.4)	46 (42.2)	
Several days	87 (26.3)	45 (23.6)	10 (32.3)	32 (29.4)	
More than half the days	44 (13.3)	24 (12.6)	3 (9.7)	17 (15.6)	
Nearly every day	53 (16.0)	40 (20.9)	3 (9.7)	10 (9.2)	
Missing	21 (6.3)	17 (8.9)	0 (0.0)	4 (3.7)	
In the last two weeks, how many days have you felt little interest/pleasure in doing things? (%)					0.3
Not at all	174 (52.6)	93 (48.7)	17 (54.8)	64 (58.7)	
Several days	71 (21.5)	42 (22.0)	9 (29.0)	20 (18.3)	
More than half the days	34 (10.3)	20 (10.5)	4 (12.9)	10 (9.2)	
Nearly every day	31 (9.4)	19 (9.9)	1 (3.2)	11 (10.1)	
Missing	21 (6.3)	17 (8.9)	0 (0.0)	4 (3.7)	
In the last two weeks, how many days have you felt depressed? (%)					0.31
Not at all	147 (44.4)	76 (39.8)	18 (58.1)	53 (48.6)	
Several days	84 (25.4)	49 (25.7)	8 (25.8)	27 (24.8)	
More than half the days	34 (10.3)	20 (10.5)	3 (9.7)	11 (10.1)	
Nearly every day			2 (6.5)		

**Table 3 (continued)**

Outcome	Overall	Black Race	Other Race	White Race	P-value
Missing	45 (13.6)	29 (15.2)		14 (12.8)	
PC-PTSD-5 Score (mean (SD))	21 (6.3)	17 (8.9)	0 (0.0)	4 (3.7)	
PHQ-4 Score (mean (SD))	1.6 (1.6)	1.8 (1.6)	1.6 (1.6)	1.4 (1.5)	0.06
	3.5 (3.5)	3.7 (3.7)	2.9 (3.2)	3.3 (3.4)	0.42

\*Statistically significant at p < 0.05

Flint would have health problems in the future as a consequence of the water source switch issues (Table 2). In multivariable modeling (Table 4), having a child who had experienced at least one symptom after but not before the water source switch was the most significant predictor of disagreeing/strongly disagreeing that the water issues had been made a bigger deal than they really were, with respondents with an affected child only 20% as likely to agree/strongly agree that the water issues had been made a bigger deal than they were as respondents without an affected child (p = 0.05). Moreover, with each additional adult symptom, the respondent was 30% less likely to agree/strongly agree that the water issues had been made a bigger deal than they were (p = 0.08).

In univariable associations, Black respondents were significantly more likely to agree/strongly agree that Flint children would have future health problems associated with the water crisis (89.5% of Black respondents; 77.4% of Other race respondents; 75.2% of White respondents; p < 0.01), although this association was no longer statistically significant when adjusting for other predictors in multivariable modeling. Elevated PTSD score was also borderline significantly associated with agreeing/strongly agreeing that Flint children would have future health problems associated with the water crisis. For each additional point on the PC-PTSD-5 scale, the odds of agreeing/strongly agreeing that Flint children would have health problems increased by 60% (p = 0.08).

**5.3. Perceptions of socio-racial and economic intentionality in the crisis/crisis response**

A plurality of respondents (N = 152, 45.9%) agreed or strongly agreed that the water source switch was intended to harm Flint residents (Table 2). A majority (N = 176, 53.2%) agreed/strongly agreed that the water source switch was discriminatory against poor or lower-income Flint residents, while 106 respondents (32.0%) agreed/strongly agreed that the water source switch was racially motivated (because Flint has a large Black population). In univariable associations, Black respondents were significantly more likely to believe the water source switch was intentionally meant to harm Flint residents (57.6% of Black respondents, 41.9% of Other race respondents, and 26.6% of White respondents; p < 0.01) and more likely to agree/strongly agree that the water source switch was discriminatory against poor or lower-income respondents (59.7% of Black respondents, 51.6% of Other race respondents, and 42.2% of White respondents, p = 0.04). Furthermore, Black respondents were more likely to agree/strongly agree that the water source switch was racially motivated (because Flint has a large Black population) (40.8% of Black respondents, 12.9% of Other race respondents, and 22.0% of White respondents, p < 0.01).

In multivariable modeling (Table 4), White respondents had 30% the odds of Black respondents agreeing/strongly agreeing that the water source switch was intentionally meant to harm Flint residents (p < 0.01). For each additional potential water contamination/lead exposure-related symptom that the respondent experienced after the water source switch, their odds of agreeing/strongly agreeing that the

**Table 4**  
 Estimated effect sizes (95% confidence intervals) from multivariable modeling results for water crisis beliefs and attitude outcomes, fit in a sample of 331 adults surveyed in Flint, MI from June–November 2019.

Predictor	The water source switch was intended to harm Flint residents.	People have made the water issues a bigger deal than reality.	Children in Flint are going to have health problems in future due to the water crisis.	The water source switch was discriminatory against lower income Flint residents.	The water source switch was racially motivated.	I am likely to trust the government on water/ environmental issues in future.	Three years from now, I am likely to drink primarily tap water at home.	I am satisfied with the federal government's role in addressing the Flint water issues.	I am satisfied with the Michigan government's role in addressing the Flint water issues.	I am satisfied with the Flint government's role in addressing the Flint water issues.
<b>Age</b>	1, (1, 1)	1, (1, 1.1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1.1)*
<b>Male</b>	1, (0.6, 1.5)	1.6, (0.8, 3.1)	1, (0.5, 2)	1.1, (0.7, 1.7)	1.2, (0.7, 1.8)	2.2, (1.3, 3.8)	3.3, (1.9, 5.8)*	1.2, (0.7, 1.9)	1, (0.6, 1.8)	1.8, (1.1, 3)
<b>Other Race</b>	0.5, (0.2, 1.1)	1.4, (0.5, 4.1)	0.5, (0.2, 1.3)	0.6, (0.3, 1.3)	0.4, (0.2, 0.8)	0.8, (0.3, 2)	0.9, (0.4, 2.3)	2.3, (1, 5.2)	1.5, (0.6, 3.9)	0.6, (0.2, 1.5)
<b>White Race</b>	0.3, (0.1, 0.5)*	1.3, (0.6, 2.8)	0.6, (0.3, 1.4)	0.6, (0.3, 1)	0.4, (0.2, 0.7)*	0.8, (0.4, 1.6)	0.9, (0.4, 1.9)	2, (1.1, 3.7)	1.9, (1, 3.6)	0.8, (0.4, 1.5)
<b>Receives public benefits</b>	1.6, (1, 2.6)	1.5, (0.8, 3.1)	1.1, (0.6, 2.2)	1.2, (0.7, 1.9)	1.2, (0.7, 1.9)	1.2, (0.7, 2)	0.9, (0.5, 1.7)	1.8, (1, 3.1)	2.4, (1.3, 4.5)	1.7, (1, 2.8)
<b>Republican</b>	0.6, (0.2, 1.5)	0.5, (0.1, 1.9)	0.5, (0.2, 1.5)	0.6, (0.3, 1.5)	0.5, (0.2, 1.3)	1.3, (0.5, 3.3)	0.8, (0.2, 2.4)	2.3, (1, 5.5)	1.2, (0.4, 3.2)	0.6, (0.2, 1.6)
<b>Other political party</b>	1.1, (0.7, 1.9)	1, (0.5, 2)	0.8, (0.4, 1.7)	1.2, (0.7, 2)	1, (0.6, 1.6)	0.9, (0.5, 1.7)	0.7, (0.4, 1.3)	1, (0.6, 1.8)	0.6, (0.3, 1.1)	0.6, (0.4, 1.1)
<b>Years in Flint</b>	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)
<b>Number of confidants</b>	1, (0.9, 1.1)	0.9, (0.8, 1.1)	1, (0.9, 1.2)	1, (0.9, 1.2)	1, (0.9, 1.2)	1, (0.9, 1.1)	1, (0.9, 1.2)	0.9, (0.8, 1)	0.9, (0.8, 1)	1, (0.9, 1.2)
<b>Zipcode 48504</b>	0.5, (0.3, 1)	0.4, (0.1, 1.1)	1.3, (0.5, 3.3)	0.4, (0.2, 0.8)	0.6, (0.3, 1.1)	0.6, (0.3, 1.2)	0.5, (0.2, 1.2)	0.6, (0.3, 1.2)	0.6, (0.3, 1.4)	0.7, (0.4, 1.4)
<b>Zipcode 48505</b>	0.8, (0.4, 1.7)	0.4, (0.1, 1)	1.8, (0.6, 5.2)	1.3, (0.6, 2.5)	1.1, (0.6, 2)	0.3, (0.1, 0.8)	0.6, (0.3, 1.4)	0.6, (0.3, 1.4)	0.4, (0.2, 0.9)	0.5, (0.2, 1)
<b>Zipcode 48506</b>	0.6, (0.3, 1.4)	1.6, (0.6, 3.9)	0.7, (0.3, 1.8)	0.8, (0.4, 1.8)	0.7, (0.3, 1.6)	0.6, (0.2, 1.5)	1, (0.4, 2.7)	0.6, (0.3, 1.4)	0.4, (0.1, 1)	0.5, (0.2, 1.3)
<b>Zipcode 48507</b>	1, (0.4, 2.4)	0.7, (0.2, 2.7)	1.6, (0.4, 6.3)	2.6, (1, 6.9)	1.8, (0.8, 4.3)	0.9, (0.3, 2.3)	1, (0.3, 3.2)	0.6, (0.2, 1.7)	0.4, (0.1, 1.3)	1.2, (0.5, 3)
<b>Zipcode 48532</b>	0.6, (0.2, 1.9)	1.2, (0.3, 4.5)	1.5, (0.3, 7.4)	0.8, (0.3, 2.2)	0.6, (0.2, 1.8)	0.9, (0.3, 3.1)	1.7, (0.5, 5.8)	0.6, (0.2, 1.9)	0.5, (0.1, 1.8)	1.2, (0.4, 3.8)
<b>Number of adult symptoms</b>	1.3, (1.1, 1.5)*	0.7, (0.6, 0.9)	1.2, (1, 1.5)	1.4, (1.2, 1.7)*	1.2, (1, 1.3)	1, (0.8, 1.2)	0.8, (0.6, 0.9)	0.9, (0.8, 1.1)	1, (0.8, 1.1)	0.9, (0.8, 1.1)
<b>Had child report at least one symptom</b>	1.2, (0.7, 2.1)	0.2, (0.1, 0.6)*	1.3, (0.5, 2.9)	0.9, (0.5, 1.6)	0.7, (0.4, 1.2)	0.8, (0.4, 1.6)	0.9, (0.4, 1.7)	1.1, (0.6, 2.1)	1, (0.5, 2)	0.4, (0.2, 0.8)
<b>PTSD score</b>	1.1, (0.9, 1.4)	0.8, (0.6, 1.1)	1.6, (1.1, 2.2)	1.6, (1.2, 1.9)*	1.3, (1.1, 1.6)*	1, (0.8, 1.3)	0.8, (0.6, 1)	0.8, (0.7, 1)	1, (0.8, 1.3)	0.9, (0.7, 1.2)
<b>PHQ score</b>	1, (1, 1.1)	1.1, (0.9, 1.2)	1, (0.8, 1.1)	1, (0.9, 1.1)	1, (0.9, 1)	0.9, (0.8, 1)	1.2, (1, 1.3)	1, (0.9, 1.1)	0.9, (0.8, 1)	1, (0.9, 1.1)

\*Statistically significant at  $p < 0.05$ .

water source switch was intentionally meant to harm Flint residents increased by 30% ( $p = 0.02$ ). For each additional symptom experienced, adults had a 40% increase in the odds of agreeing/strongly agreeing that the water switch was discriminatory against poor respondents ( $p < 0.01$ ). Even when adjusting for other predictors, Black respondents were still significantly more likely to agree/strongly agree that the water switch was racially motivated, with White and Other race respondents about 40% as likely to agree/strongly agree as Black respondents (Black vs. White  $p = 0.01$ , Black vs. Other  $p = 0.08$ ).

#### 5.4. Political satisfaction and trust in relation to future prevention efforts

Trust and satisfaction in government in relation to the response to the FWC were generally low (Table 2). Only 14.5% of respondents agreed or strongly agreed that they would trust the government on water/environmental issues in the future, and only 19.0% of respondents agreed or strongly agreed that they would be likely to drink tap water from home in three years. In terms of satisfaction with government-led FWC responses, overall, 14.5% of respondents said they were satisfied with the federal government's response; 11.5% of respondents were satisfied with the Michigan state government's response; and 19.6% of respondents were satisfied with the Flint city government's response. In univariable associations, Black respondents were significantly less likely than White respondents to agree/strongly agree that they would drink tap water from home in three years (from the date of the survey); 61.8% of Black respondents indicated that they would *not* drink tap water from home in three years vs. 43.1% of White respondents ( $p < 0.01$ ). Black respondents were also significantly more likely to express dissatisfaction with the federal government response, with 75.9% of Black respondents expressing dissatisfaction, compared to 56.9% of White respondents ( $p < 0.01$ ).

In multivariable modeling (Table 4), the most powerful predictor of being likely to trust the government on water/environmental issues in the future were gender, with men more likely than women to trust government on water/environmental issues in the future ( $p = 0.06$ ). Men had 3.3 times the odds of agreeing/strongly agreeing that they would drink tap water at home in 3 years as women, a statistically significant finding ( $p < 0.01$ ).

Neither respondent race nor political affiliation was significantly related to government satisfaction after adjusting for other confounders.

#### 5.5. Predictors of PTSD

Indicators of psychological trauma, per the PC-PTSD-5, were pronounced among respondents (Table 3). Almost half the sample ( $N = 147$ , 44.4%) reported avoiding thinking about the FWC or avoiding situations that reminded them of it, with Black respondents significantly more likely to report this than "Other" race and White respondents (50.8% of Black respondents; 38.7% of Other race respondents; 34.9% of White respondents;  $p = 0.02$ ). Roughly a third of the sample reported being on guard or watchful ( $N = 130$ , 39.3%), having feelings of numbness/detachment ( $N = 110$ , 33.2%), and thinking about the FWC when they did not want to/having nightmares about the FWC ( $N = 103$ , 31.1%). A total of 14.8% ( $N = 49$ ) of respondents reported feelings of guilt about the water crisis. The mean PC-PTSD-5 score was  $1.6 \pm 1.6$ ; scores were higher among Black respondents ( $1.8 \pm 1.6$ ) as compared to White respondents ( $1.4 \pm 1.5$ ,  $p = 0.06$ ).

In multivariable modeling (Table 5), experiencing symptoms and receipt of public benefits were strong predictors of experiencing PTSD symptoms. For each additional potential water contamination-related symptom experienced, respondents had 10% higher odds of thinking about the FWC when they did not want to/having nightmares about the FWC, avoiding thinking about the FWC or avoiding situations that reminded them of it, being on guard/watchful, and having feelings of numbness/detachment ( $p < 0.01$  for all four PTSD symptoms). As a result, for each additional potential water contamination-related

symptom experience, the average PC-PTSD-5 score increased by 0.4 points ( $p < 0.01$ ). Vis-à-vis individual scale items, respondents who received public benefits had 30% higher odds of avoiding thinking about the FWC/avoiding situations that reminded them of it ( $p < 0.01$ ) and 10% higher odds of feeling guilty about the FWC ( $p = 0.06$ ). Respondents receiving public benefits had an average PC-PTSD-5 score that was 0.6 points higher than that of respondents who did not receive public benefits, even when adjusting for other predictors ( $p = 0.01$ ).

Elevated PC-PTSD-5 score was also significantly associated with believing that the water crisis was racially motivated/discriminatory against Black residents or discriminatory against poor or lower-income Flint residents (Table 4). For each additional point on the PC-PTSD-5 score, the odds of agreeing/strongly agreeing that the water source switch was discriminatory against poor or lower-income residents increased by 60% ( $p < 0.01$ ), and the odds of agreeing/strongly agreeing that the water source switch was racially motivated/discriminatory against Black residents significantly increased by 30% ( $p = 0.05$ ).

#### 5.6. Predictors of depression and anxiety

Results from the PHQ-4 assessment reveal that depression and anxiety were prevalent in the sample (Table 3). More than half of the sample (55.6%) reported worrying at least several days out of the last two weeks and 49.9% reported feeling nervous. Depression indicators were also common, with 49.3% reporting feeling depressed on several days or more out of the last two weeks and 41.2% of the sample reporting loss of interest/pleasure in daily activities on several days or more out of the last two weeks. When not adjusting for other predictors, feelings of uncontrollable worry were significantly more common among Black respondents than White or Other race respondents ( $p = 0.04$ ). There were no statistically significant differences in PHQ-4 score by race.

In multivariable modeling (Table 5), once again the key predictors of depression and anxiety were number of symptoms experienced and receipt of public benefits. For each additional potential water contamination-related symptom experienced, respondents were 60% more likely to report feelings of nervousness ( $p < 0.01$ ), 50% more likely to report uncontrollable worry ( $p < 0.01$ ), 40% more likely to report lack of interest/pleasure ( $p < 0.01$ ), and 40% more likely to report feeling depressed ( $p < 0.01$ ).

Continuing, for each additional potential water contamination-lead exposure-related symptom, the total PHQ-4 score increased by 0.8 points ( $p < 0.01$ ) when adjusting for other predictors. Moreover, respondents who received public benefits had 2.1 times the odds of feeling nervous ( $p = 0.03$ ), 1.7 times the odds of experiencing uncontrollable worry ( $p = 0.19$ ), 2.5 times the odds of feeling disinterest ( $p = 0.01$ ), and 2.5 times the odds of feeling depressed ( $p < 0.01$ ) compared to respondents who did not receive public benefits. Adjusting for other predictors, respondents who received public benefits had an average PHQ-4 score that was 1.6 points higher than respondents who did not receive public benefits ( $p < 0.01$ ). Two other significant predictors were social network size—for each additional confidant in the social network, the odds of experiencing disinterest/lack of pleasure decreased by 20% ( $p = 0.04$ ). Additionally, living in zip code 48507, which is 72.1% White, increased the odds of feeling disinterest/lack of pleasure by 3.7 times compared to respondents who lived in zip codes 48502/48503 (which are 53.6% White and 50.4% Black, respectively;  $p = 0.05$ ).

There were no significant associations between PHQ-4 score and respondents' attitudes and beliefs (Table 4).

## 6. Discussion

Findings from this study of residents in Flint, Michigan, conducted five years after the initiation of the city's water crisis, showcase a complex tableau of attributions (H. H. Kelley, 1967; Walters, 2007b), one that dynamically promote a racialized and class-related experience of a "crisis" and, by extension, a crisis in environmental management.



**Table 5**  
 Estimated effect sizes (95% confidence intervals) from multivariable modeling results for trauma, depression, and anxiety outcomes, fit in a sample of 331 adults surveyed in Flint, MI from June-Dec. 2019.

Predictor	In the past month, I have had nightmares about the water crisis or thought about it when I didn't want to	In the past month, I have tried hard not to think about the water crisis or went out of my way to avoid situations that remind me of it	In the past month, I have been constantly on guard, watchful, or easily startled	In the past month, I have felt numb or detached from people, activities, or my surroundings	In the past month, I have felt guilty or unable to stop blaming myself or others for the water crisis or the problems it may have caused	In the last two weeks, how often have you been feeling nervous, anxious, or on edge?	In the last two weeks, how often have you not been able to stop or control worrying?	In the last two weeks, how often have you had little interest or pleasure in doing things?	In the last two weeks, how often have you felt down, depressed, or hopeless?	PC-PTSD-5 Score	PHQ-4 Score
Age	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	0, (0, 0)	0, (0, 0)
Men	0.9, (0.8, 1)	0.9, (0.8, 1)	0.9, (0.8, 1)	0.9, (0.8, 1)	1, (0.9, 1)	0.8, (0.5, 1.2)	0.6, (0.4, 1)	1.2, (0.7, 1.9)	1.1, (0.7, 1.7)	-0.4, (-0.8, -0.1)	-0.2, (-1, 0.6)
Other Race	1, (0.8, 1.2)	0.9, (0.7, 1)	0.9, (0.7, 1.1)	1.1, (0.9, 1.3)	1, (0.8, 1.1)	0.8, (0.4, 1.7)	0.5, (0.2, 1.2)	1, (0.4, 2.2)	0.6, (0.3, 1.4)	-0.3, (-0.9, 0.3)	-1, (-2.4, 0.4)
White Race	1, (0.8, 1.1)	0.9, (0.7, 1)	0.9, (0.8, 1)	0.9, (0.8, 1.1)	1, (0.9, 1.1)	1.3, (0.7, 2.2)	0.8, (0.5, 1.3)	0.9, (0.5, 1.7)	1, (0.6, 1.8)	-0.4, (-0.9, 0)	-0.1, (-1.1, 0.9)
Receives public benefits	1.1, (1, 1.2)	1.3, (1.1, 1.4)*	1.1, (1, 1.2)	1.1, (1, 1.3)	1.1, (1, 1.2)	2.1, (1.3, 3.3)*	1.7, (1.1, 2.6)	2.5, (1.5, 4.2)*	2.5, (1.6, 4.1)*	0.6, (0.3, 1)	1.6, (0.8, 2.4)*
Republican	1.1, (0.9, 1.4)	1.2, (1, 1.5)	1.2, (0.9, 1.4)	1, (0.8, 1.2)	1.1, (0.9, 1.3)	0.8, (0.3, 1.7)	0.9, (0.4, 2.1)	0.7, (0.3, 1.7)	0.4, (0.2, 1.1)	0.5, (-0.1, 1.2)	-0.6, (-2.1, 0.9)
Other political party	1, (0.9, 1.1)	1.1, (1, 1.2)	1.1, (1, 1.3)	1, (0.9, 1.1)	1.1, (1, 1.2)	0.8, (0.5, 1.3)	0.7, (0.5, 1.2)	0.6, (0.4, 1)	0.6, (0.4, 1)	0.3, (-0.1, 0.6)	-0.6, (-1.5, 0.2)
Years lived in Flint	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	0, (0, 0)	0, (0, 0)
Number of social network confidants	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	1, (1, 1)	0.9, (0.8, 1)	0.9, (0.9, 1.1)	0.8, (0.7, 0.9)*	0.9, (0.8, 1)	-0.1, (-0.2, 0)	-0.2, (-0.4, 0)
Zip code 48,504	1.1, (0.9, 1.3)	1, (0.9, 1.2)	1, (0.9, 1.2)	1.1, (1, 1.3)	1, (0.9, 1.1)	1, (0.5, 1.8)	1.4, (0.7, 2.5)	1.8, (0.9, 3.4)	1.8, (0.9, 3.3)	0.2, (-0.3, 0.7)	0.9, (-0.2, 2)
Zip code 48,505	1.1, (0.9, 1.2)	1, (0.8, 1.1)	1.1, (0.9, 1.3)	1.1, (0.9, 1.2)	1, (0.9, 1.1)	1.3, (0.7, 2.4)	1.8, (1, 3.3)	1.4, (0.7, 2.7)	1.8, (1, 3.4)	0.1, (-0.4, 0.6)	1.1, (0, 2.3)
Zip code 48,506	1, (0.8, 1.2)	1, (0.8, 1.2)	1, (0.8, 1.2)	1, (0.8, 1.2)	0.9, (0.8, 1.1)	1, (0.5, 2.1)	1.1, (0.5, 2.5)	1, (0.4, 2.4)	0.9, (0.4, 2)	-0.1, (-0.7, 0.6)	0.2, (-1.2, 1.5)
Zip code 48,507	1, (0.8, 1.2)	1, (0.8, 1.3)	1, (0.8, 1.3)	1.1, (0.9, 1.3)	1.1, (0.9, 1.2)	0.8, (0.3, 1.8)	1.7, (0.8, 3.9)	3.7, (1.5, 9.1)*	2.6, (1.1, 5.9)	0.2, (-0.5, 0.9)	1.4, (-0.1, 3)
Zip code 48,532	0.9, (0.7, 1.2)	1.1, (0.9, 1.5)	0.9, (0.7, 1.2)	0.9, (0.7, 1.2)	0.9, (0.7, 1.1)	0.7, (0.3, 2.1)	0.7, (0.2, 2)	2.1, (0.7, 6.3)	1.5, (0.5, 4.7)	-0.2, (-1.1, 0.6)	0.2, (-1.6, 2.1)
Number of adult symptoms	1.1, (1.1, 1.1)*	1.1, (1.1, 1.1)*	1.1, (1.1, 1.2)*	1.1, (1.1, 1.1)*	1, (1, 1.1)	1.6, (1.4, 1.8)*	1.5, (1.3, 1.7)*	1.4, (1, 2, 1.6)*	1.4, (1.2, 1.6)*	0.4, (0.3, 0.5)*	0.8, (0.6, 1)*
Child report of at least one symptom	1.1, (1, 1.2)	1.1, (1, 1.2)	1, (0.9, 1.2)	1, (0.9, 1.1)	1, (0.9, 1.1)	0.6, (0.4, 1.1)	0.8, (0.4, 1.3)	0.9, (0.5, 1.5)	0.9, (0.5, 1.6)	0.2, (-0.2, 0.6)	-0.4, (-1.2, 0.5)

\*Statistically significant at p < 0.05.

Notably, the FWC was understood along different temporal planes, revealing differences in understandings on the extent to which Flint is either in, in the final throes of, or could have a recurrence of, the water crisis. In view of the fluid matter of sustainability, this finding on crisis-making could be said to be mapped onto an even more fluid understanding of the extent that the FWC has impacted, is impacting, or conceivably could impact, Flint residents in terms of individual health—or indeed, perhaps, whether a comparable environmental disaster could emerge in the future.

The Critical Disaster Theory frame that is proposed and hypothesized here describes this novel sequence as being chiefly induced through exposure to shifts in political power (e.g., the implementation of austerity policies) and one’s subsequent attributional tendencies. Potential applications of these processes, in view of this article’s key findings, are presented in Fig. 1 and described below.

6.1. Perception of the environmental event(s) being of unusual type, magnitude, or recurrence

A key precept behind the substantiation of a crisis is that it fundamentally disrupts social order—and social organization more broadly (Kreps, 1984, 1985). A plurality of respondents disagreed/strongly disagreed with the position that the FWC had been made a “bigger deal” than it really was. This challenged some media narratives and empirical research claims that the scope of the FWC had been, in practical terms,

exaggerated (e.g., that claims that the contaminated water would generate myriad lead poisoning cases among residents and eventually deepen health morbidities and inequalities in the city, etc. were overstated or embellished) (Banner, 2018; Dietrich and Gómez, 2018). Black respondents were significantly more likely to adopt the belief that the FWC had *not* been made into a bigger deal than it was. This finding both punctuates the racialized salience of the FWC and invigorates contention against claims that its impacts—in terms of population health, community image, or otherwise—were or would be functionally benign, negligible, and otherwise within the parameters of what might be regarded as a fleeting environmental management and public health problem. Moreover, this finding illustrates the sense that the water issues were indeed unique (i.e., at least relative to water potability standards in “general” communities).

In the current proposal to combine CRT and disaster sociology theory, it becomes possible to appreciate how inequity and structural racism are central to historically-embedded but fluid civilian understandings of crisis, space, and power relations (Neely and Samura, 2011). Under this theoretical paradigm, views on the magnitude of the crisis correspond to distinctive racial and/or economic stimuli that are either explicitly or implicitly rendered in prior social policy applications. Thus, hyper-local policies contributing to residential segregation, commercial decline, community disinvestment (Browning et al., 2006), or more generalized patterns of discrimination and disenfranchisement, entrench understandings of crisis both as a single and recurring

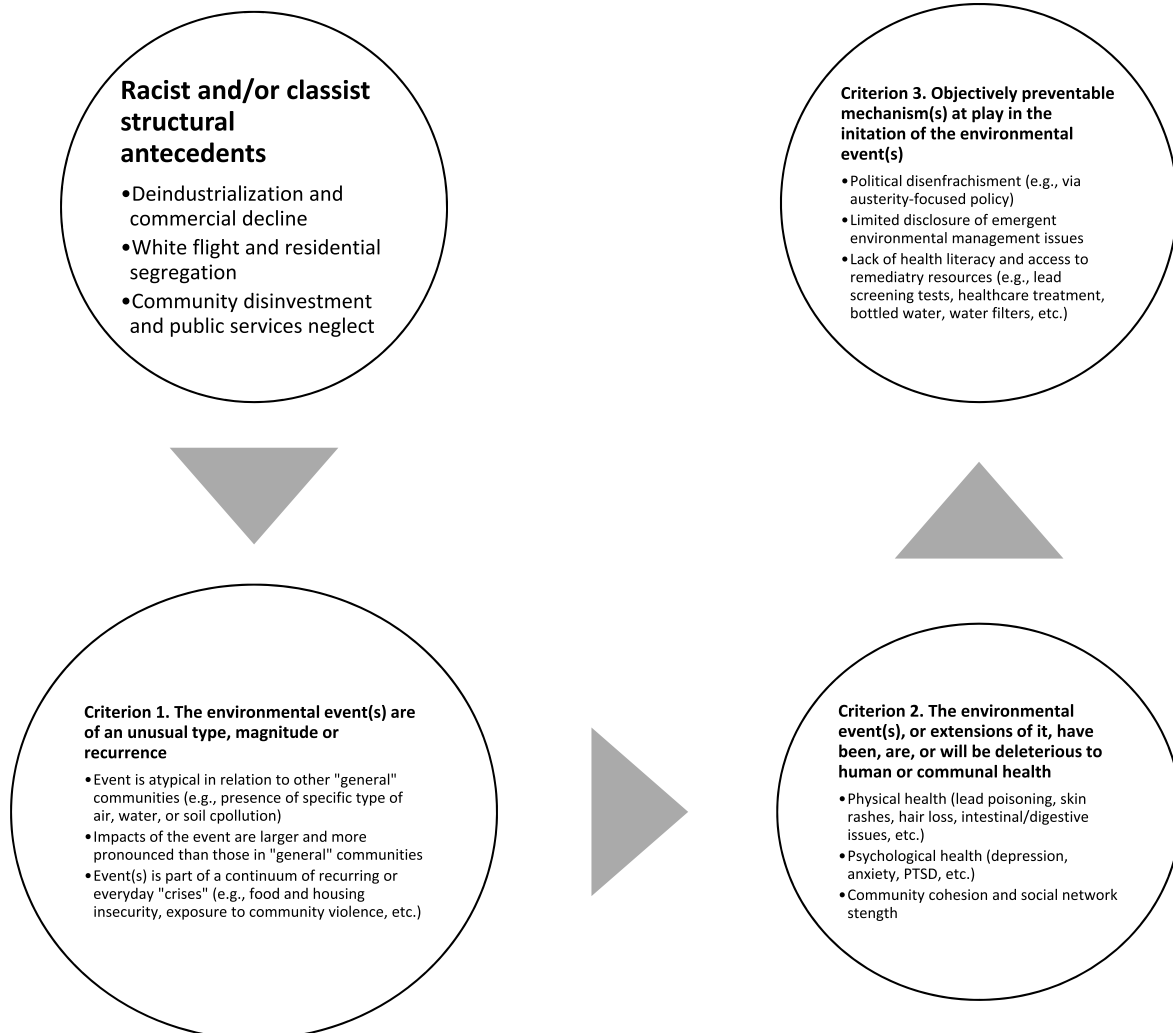


Fig. 1. Conceptualizing a Critical Race Theory of Environmental Disaster.

phenomenon.

### 6.2. Perception that the environmental event(s) have been or will be harmful to human or communal health

This research highlights how the experience of crisis is both a cognitive and bodily, or psychological and physical phenomenon; and further, that these two modalities work in tandem and are further reified by historic circumstances and local politics. Overall, Black respondents in the sample reported experiencing more symptoms than White and Other race individuals and were also more likely to be caring for a child who had experienced at least one potential water contamination-related symptom, corresponding to narratives on the water crisis constituting an environmental injustice (Butler et al., 2016; Brown et al., 2020). These symptoms, irrespective of if they were tied to the water contamination or not, may have undermined feelings of collective *efficacy* (Sampson et al., 1999; Browning and Cagney, 2002) and thus contributed to feelings of collective *vulnerability* (Sarewitz et al., 2003) among Black residents. As an additive consideration, individuals who believed that the crisis was racially motivated/discriminatory against Black residents, a belief more common among Black respondents, or discriminatory against low-income individuals, had higher PTSD scores.

The present research suggests that residents' mental health was acutely impacted by the FWC, with nearly half of respondents responding affirmatively to "trying to avoid thinking about the FWC or avoiding situations reminding them of it." This typology aligns with conventional PTSD symptomatology vis-a-vis propensity for denial and avoidance (van der Kolk, 1994). PTSD symptomatology, in turn, is also foundationally connected to *toxic uncertainty*, a sense of foreboding of what is to come given the fluidity and uncontrollability of social, political, and economic variables (Auyero and Swistun, 2008; Kruger et al., 2017). Interestingly, men (both Black and White) were more likely than women (Black or White) to indicate a likelihood of drinking tap water in three years. This result points to the importance of intersectionality in *Critical Race Theory of Environmental Disaster* and the study of environmental risk more broadly (Olofsson et al., 2016; Kuran et al., 2020). Masculine typologies may blunt men's feelings of vulnerability, thus prompting behaviors that reinforce their perceived—or desired—immunity to certain environmental hazards (Anderson, 2000, 2020). Such a dynamic magnifies the importance of evaluating potential impacts on subpopulations within marginalized and vulnerable populations. Relatedly, it is necessary to consider the frequently negative impacts that environmental disasters have on community cohesion, residents' sense of belonging and general safety, and social network strength (Browning and Cagney, 2002; Varda et al., 2009; Islam and Walkerdien, 2014).

### 6.3. Perception of some objectively preventable mechanism(s) at play in the initiation of the environmental event(s)

By combining CRT with disaster sociology theory, it becomes clear that research on subjective perceptions of an event's preventability and its causal elements must be understood through a critical evaluation of the broader socioeconomic positions of those involved and of local political contexts. To be sure, untangling the extent to which the FWC could have been averted requires consideration of near-infinite permutations that account for, among other variables, the likelihood of the water source switch, the likelihood of the water becoming contaminated, the likelihood of a delayed or logistically ineffective response effort, and a multitude of scenarios considering the prospective levels of resilience and political and social capital of residents. Additionally, consideration would have to be placed on residents' access to and uptake of remedial resources (e.g., lead screening tests, healthcare treatment, bottled water, water filters, etc.). Further woven into considerations of preventability is the issue of intentionality; namely, whether neglect, or technical incompetence (Turner, 1976), in fueling a crisis, is

effectively tantamount to ill-will. The majority of respondents believed that the crisis was indeed purposeful and intended to harm Flint residents; Black race and receiving public benefits were shown to be associated with the tendency to agree/strongly agree with this sentiment. Such views fit the lineage of racialized suspicion around large-scale public health events; for example, beliefs among Blacks that HIV/AIDS was implanted in Black neighborhoods in the 1980s by the CIA as a form of population control (Heller, 2015); that levees in New Orleans had been blown-up by the U.S. military during Hurricane Katrina to flood majority-Black communities (Henkel et al., 2006; Hirsch and Lee Levert, 2009); or more recently, that vaccines for COVID-19 are covert biological weapons meant to marshal Black genocide (Ferdinand et al., 2020; Warren et al., 2020). These "conspiratorial" beliefs are frequently derided as detrimental to collective efficacy and even shown to be harmful to health and social mobility (Smith et al., 2007). However, researchers point to the outsized role of collective memory and inter-generational trauma in generating such racialized views on the intentions of institutions and the need to indeed consider the protective solidarity-building dimensions of these beliefs (Adams et al., 2006; Heller, 2015; Whitlinger, 2015).

With this in mind, respondents registered significant dissatisfaction with the FWC response of each level of government—with the greatest levels of dissatisfaction angled at the state government, followed by the federal government and local (Flint) government. The comparatively higher level of dissatisfaction with state government telegraphs respondents' awareness of the state's central role throughout the continuum of the crisis, from the EM installation to the uneven response effort. Finally, only a small proportion of respondents agreed or strongly agreed that they would trust the government (broadly) on water/environmental issues in the future. Men (both Black and White) were more likely than women to affirm this sentiment, again suggesting the potentially gendered nature of threat perception in environmental disaster and the existence of intersectional patterns of socialization that may stunt concern over risk. Given the increased health risks that women have when exposed to environmental contaminants such as lead—namely, when they are pregnant or are trying to get pregnant (Shannon, 2003; Zhu et al., 2010)—they may have greater sensitivity to the implications of environmental disaster and crisis mismanagement. Furthermore, women are frequently the predominant caregiver in homes (Maldonado and Nieuwenhuis, 2015; Kramer et al., 2016), especially in minoritized and under-served communities, hence amplifying their need for a more robust form of awareness and vigilance. Thus, women such as those in this study may be more reticent to trust government following environmental disasters given the heightened risks that environmental contaminants such as lead may pose to not only them but the children in their care (Schwartz, 1994; Lanphear, 2005; Reyes, 2015).

### 6.4. Study limitations

There are some limitations to this analysis. First, the sample was not randomly selected; thus, results may not be generalizable to the broader Flint population. However, the sample traits roughly approximated U.S. Census estimates (U.S. Census Bureau, 2019). Additionally, though cross-sectional studies lack randomization, they can be potent in hypothesis-generation for further grounded empirical research (Mann, 2003; Levin, 2006), this article's goal, and this is valuable in studies of complex and indeterminant outcomes. Along these lines, the study's recruitment was broadly stratified across public venues across the city and sampling times were alternated, to improve the study's geographic reach in Flint and augment the concomitant probability of capturing the broader socioeconomic diversity of residents in the city.

Second, multiple years had passed since the presumed initiation of the water crisis, and thus respondents' inventorying of health symptoms experienced pre and post-water source switch may have been subject to recall bias (Blane, 1996). However, this study's temporally-nuanced

questions about the timing/frequency of potential symptoms (Brusco and Watts, 2015) may have facilitated more acute and precise recollection processes. Finally, it is not possible to implicate the initiation of issues with Flint's water supply as the singular or primary cause for respondents' health symptoms or to otherwise imply a causal effect based on timing alone.

## 7. Conclusion

This paper combines CRT and disaster sociology theory to understand the racially and socioeconomically-specific process of crisis-making within the boundaries of environmental justice and environmental management paradigms. This theory may help better identify, characterize, and operationalize elements of social stratification that contribute to understandings of the causes and consequences of environmental disasters. Such an orientation allows for a macrosocial assessment that goes beyond linear considerations of the technocratic fault-lines that instigate disasters and sustainability chasms. As such, this theory can yield fruit in assessment of the first and second-order impacts of other environmental disasters, and institutional responses to them, based on a variety of intersectional social identity markers.

## Author statement

Jerel Ezell was responsible for the conception of the study, data collection, and the writing and revision of the manuscript. Elizabeth Chase was responsible for all data analysis and the writing and revision of the manuscript.

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## Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Elizabeth Chase reports financial support was provided by National Science Foundation.

## Data availability

Data will be made available on request.

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