Natural Hazards (2020) 104:959–977
https://doi.org/10.1007/s11069-020-04199-y

ORIGINAL PAPER

Disaster experience, social capitals, and behavioral health

Vanessa Parks[1] · Lynsay Ayer[2] · Rajeev Ramchand[2] · Melissa L. Finucane[3]

Received: 12 February 2020 / Accepted: 20 July 2020 / Published online: 28 July 2020

Abstract
On April 20, 2010, the Deepwater Horizon oil rig exploded, and oil spilled from the breached well-head for months, leading to an unprecedented environmental disaster with implications for behavioral health. Disasters are thought to affect behavioral health, and social capital is thought to ameliorate behavioral health impacts after disasters, though empirical evidence is mixed. One possible explanation for the discrepancy in findings relates to the activation of social capital in different contexts. In a disaster context, certain types of social capital may be more beneficial than others, and these relationships could differ between those directly affected by the disaster and those who are unaffected. The goal of this study is to assess the relationships between different forms of social capital (community engagement, trust, and social support) on different behavioral health indicators (depression, anxiety, and alcohol misuse) using data from the first wave of the Survey of Trauma, Resilience, and Opportunity among Neighborhoods in the Gulf (STRONG), a probabilistic household telephone survey fielded 6 years after the onset of the Deepwater Horizon oil spill (DHOS). We employ a structural equation modeling approach where multiple social capital and behavioral health variables can be included and their pathways tested in the same model, comparing the results between those who reported experiencing disruptions related to the DHOS and those who did not. Among those who experienced the DHOS, social support was negatively associated with both depression ($\beta = -0.085$; $p = 0.011$) and anxiety ($\beta = -0.097$; $p = 0.003$), and among those who did not experience the DHOS, social support was positively associated with alcohol misuse ($\beta = 0.067$; $p = 0.035$). When controlling for the other social capital variables, social support was the only form of social capital with a significant relationship to behavioral health, and these relationships differ based on whether or not a person experienced the disaster. This suggests that social capital does not have a uniformly ameliorative relationship with behavioral health in the aftermath of disasters.

Keywords Gulf Coast · Oil spill · Structural equation modeling · Social capital · Behavioral health

✉ Vanessa Parks
vparks@olemiss.edu

[1] Center for Population Studies, University of Mississippi, 536 Lamar Hall, University, MS 38677, USA

[2] RAND Corporation, Washington, DC, USA

[3] RAND Corporation, Pittsburgh, PA, USA

1 Introduction

On April 20, 2010, the Deepwater Horizon oil rig exploded, killing 11 workers onboard and spilling millions of gallons of crude oil into the Gulf of Mexico. In the aftermath of the spill, the Institute of Medicine recommended that researchers consider the long-term psychological impact of the Deepwater Horizon oil spill (DHOS; IoM 2010). Though exposure to oil spill run-off has direct effects on respiratory and dermatological outcomes, its impact on behavioral health typically occurs indirectly via material losses (e.g., negative shocks on the fishing and tourism industries and those who work in these industries; Gill et al. 2014; Goldstein et al. 2011), social disruption (e.g., behavior changes and lifeway disruption; Parks et al. 2019), and ontological insecurity (e.g. institutional distrust, ongoing worry; Parker et al. 2019; Ritchie et al. 2013).

To date, findings from research examining behavioral health after the DHOS are mixed; federal surveys conducted shortly after the spill suggest that behavior health indicators changed minimally after the spill (Gould et al. 2015), while cross-sectional surveys conducted in the years after the spill suggest that disaster experience and exposure is related to outcomes such as depression (Fan et al. 2015; Osofsky et al. 2011; Parks et al. 2019; Ramchand et al. 2019; Rung et al. 2016), anxiety (Osofsky et al. 2011; Ramchand et al. 2019), post-traumatic stress (Osofsky et al. 2011), and domestic conflict (Rung et al. 2016). Repeated cross-sectional surveys assessing mental and physical health (Cope et al. 2013) and behavior change (Parks et al. 2019) suggest that disaster-induced disruption may decrease over time for the general public.

One explanation for mixed findings is the potential moderating effect of one's social ties (i.e., social capital) on the impact of oil spill exposure (material, social, and ontological) on behavioral health symptoms. Broadly defined, social capital refers to the features of social organization "which act as resources for individuals and facilitate collective action" (Lochner et al. 1999). Although social capital has been theorized as modifying the relationship between disasters like oil spills and behavioral health outcomes (Norris et al. 2008; Ritchie and Gill 2007), empirical research assessing the role of different types of social capital is limited.

1.1 Disaster experiences and behavioral health

Many residents of the Gulf Coast suffered significant disruption and loss in the aftermath of the DHOS, including income loss, job loss, and changes to diet and recreational patterns (Cope et al. 2013; Drakeford et al. 2020; Drescher et al. 2014; Fan et al. 2015; Grattan et al. 2011; Lee and Blanchard 2012; Morris et al. 2013; Singleton et al. 2015; Werner and Locke 2012). Such changes and losses could place residents at risk for additional losses and subsequent behavioral health issues. This is especially true in the Gulf Coast of the United States, which has recently experienced multiple major hurricanes as well as Deepwater Horizon oil spill. Existing research in the region has in fact linked prior hurricane trauma with ongoing psychological impacts after the DHOS (Osofsky et al. 2011), underscoring the challenges Gulf Coast residents face in recovering from disaster.

According to the Conservation of Resources model, chronic resource losses, such as those faced by residents of the disaster-prone Gulf Coast, can result in a "loss cycle," in which people are "less likely to meet ongoing demands of stress or day-to-day adaptation" (Hobfoll and Lilly 1993:132). In other words, Gulf Coast residents could have been

accumulating losses and disruption stemming from disasters prior to the DHOS and incurring additional losses in the years following the DHOS.

Technological disasters, such as oil spills, as opposed to natural disasters, are the results of human error or failures of technology that lead to the destruction and contamination of the environment (Baum et al. 1983; Erikson 1994; Gill and Picou 1998; Kroll-Smith and Couch 1991; Picou et al. 2004). Technological disasters engender considerable anger when residents are unable to come to a consensus about the extent of the impacts and who is to blame (Gill et al. 2012). This stress and alienation could be offset by a person's social capital (Ritchie and Gill 2007).

1.2 Social capital and behavioral health

Research consistently points to social capital as a resilience-building capacity that can foster better health outcomes after a disaster (Aldrich and Meyer 2015; Norris et al. 2008; Ritchie and Gill 2007). Social capital is a broadly used term that refers to the benefits derived from a person's social ties (e.g. Aldrich and Meyer 2015; Kawachi et al. 1999; Lin 1999; Lochner et al. 1999; Portes 1998). There is a large body of literature tying social capital to positive effects on a wide variety of health outcomes in stressful circumstances, such as disasters. However, existing research results are inconsistent. Sometimes no evidence has been found for a relationship between social capital and health outcomes; in other cases, social capital has been shown to have a relationship with or to modify relationships between other constructs and adverse health outcomes (Beaudoin 2011; Parks et al. 2019; Weil et al. 2012) or with behaviors that may increase health risks during a disaster, such as failing to evacuate even when ordered to do so (Ricchetti-Masterson and Horney 2013).

Social capital can be conceptualized in a number of ways (e.g., psychosocial vs. material, individual-level vs. community-level, horizontal ties vs. vertical ties) and in survey research, operationalized in various ways as well. Consequently, researchers tend to examine one or two facets of social capital, and then make generalizations about the larger concept of social capital (for a recent exception, see Rung et al. 2016). This approach, though sometimes warranted by survey constraints, often ignores the complexities of social capital and how differently each of its facets might operate within the context of a disaster; the various forms of social capital may not have a uniformly positive effect on all post-disaster outcomes. For example, having the social ties needed to talk with someone about disaster-related distress or to find a place to stay when displaced due to a disaster could be helpful in some circumstances (Rung et al. 2016). On the other hand, others might experience additional stress from this connectivity. For instance, in two studies after Hurricane Katrina, social connection was associated with poor behavioral health indicators. In the first, individuals who were more socially embedded initially tended to feel more stress about helping those around them, though this social connectivity was found to protect against stress as time progressed (Weil et al. 2012). In the second, "neighborliness" was associated with alcohol consumption over time after Hurricane Katrina, though disaster exposure was not associated with increased alcohol consumption (Beaudoin 2011), suggesting that alcohol use may be a form of coping for socially connected people. As such, there may be situations in which particular forms of social capital are more beneficial for some people than others, and these differences may also apply to different forms of behavioral health (e.g. depression, anxiety, alcohol misuse).

Within the social capital literature, there is debate about whether social cohesion [i.e., psychosocial social capital, as suggested by Putnam (2000) and others] or resources [i.e., resource-based social capital, as suggested by Bourdieu (1986) and others] are key to promoting better outcomes (Carpiano 2006; Ritchie and Gill 2007). The former conceptualization suggests that intangible connectedness to community through norms of reciprocity, trust, and even, more tangibly, social and civic engagement, are what constitute social capital and its benefits. The latter focuses on resources that can be activated and distributed through social networks. Psychosocial approaches to social capital such as organizational membership and sentiments related to belongingness in one's community are widely used to predict health outcomes after disasters (Beaudoin 2007, 2011; Cope et al. 2013; Lee and Blanchard 2012; Weil et al. 2012). Networks and resource-based social capital measures are less common (Drakeford et al. 2020; Parks et al. 2019; Weil et al. 2012), though may be particularly relevant to disaster contexts, as tangible resources are important when trying to offset the threats of resource loss and subsequent loss spirals induced by disasters.

Attempts to parse out the effects of types of social capital on behavioral health after disasters suggest that different social capitals are related to one another (Rung et al. 2016). There is even evidence to suggest that social capital as measured by an individual's social networks and the resources available through these networks may in part explain the relationships between psychosocial social capital and health (Carpiano and Hystad 2011). However, additional research is needed to understand the effects different social capitals have on behavioral health outcomes in tandem.

The relationship between social capital and behavioral health may be further complicated in disaster contexts because of varying characteristics of disaster exposure. Technological disasters like the DHOS are not acute events; they are social processes that persist longer than the hazard itself because of litigation (Picou et al. 2004; Ritchie et al. 2018) and long-term health issues (Lowe et al. 2019; Ramchand et al. 2019). While the links between disaster exposure and health and the links between social capital and health have been explored in existing research, what is less understood is the effect of social capital on health in different exposure contexts. A recent study on religion and alcohol misuse in the DHOS context suggests that, as county-level religious adherence increases, differences in alcohol misuse emerge between low religiosity individuals depending on their disaster exposure (Drakeford et al. 2020). Results from a multilevel model that examines a three-way interaction between individual factors (religiosity and disaster experience) and county-level religious adherence showed that among those who did not consider themselves to be religious, alcohol misuse scores increased as county-level religious adherence increased if the individuals had experienced disaster-related social disruption, whereas the alcohol misuse scores decreased among low religiosity individuals in increasingly religious contexts. This suggests that disaster-affected individuals residing in contexts with social networks and resources available may not receive those benefits if they themselves are not somehow connected to those networks and opportunities.

While many studies have included social capital and disaster exposure in their analyses to predict health and well-being, the relationships between social capital and behavioral health across different types of exposure are not well understood. However, the frameworks and findings from existing studies may help elucidate these relationships. The Social Support Deterioration Model (Kaniasty and Norris 1993), tested in Rung and colleagues' recent paper (2016), suggests that disaster exposure may negatively impact social support (a form of resource social capital). This process has similarly been described by researchers examining *corrosive community* (Freudenburg and Jones 1991; Gill 1994). Feelings of anger, blame, and distrust stemming from a technological disaster can erode social capital

(Ritchie and Gill 2007). In other words, disaster exposure may be associated with lower levels of social capital, and lower social capital may be associated with worse health outcomes, but which aspects of social capital affect different behavioral health outcomes needs further exploration.

Based on some existing research on social capital and health after disasters, we might expect social capital to be associated with better health outcomes (Aldrich and Meyer 2015; Norris et al. 2008; Ritchie and Gill 2007). However, other studies suggest that those exposed to disaster will have less social capital or that they may not benefit from it in the same way because of the additional stresses stemming from the aftermath of a disaster (Drakeford et al. 2020; Ritchie and Gill 2007; Rung et al. 2016). Furthermore, resource social capital may provide more benefits than psychosocial social capital (Carpiano and Hystad 2011).

In this paper, we bring together two existing bodies of research that address health and disasters: the research connecting social capital and behavioral health and the research connecting disaster experience and behavioral health. Specifically, we test (1) whether different social capital constructs are consistently negatively related to behavioral health outcomes and (2) if there are differences in the relationships between social capital and behavioral health between those who reported experiencing the DHOS and those who did not. In doing so, we provide nuance to the discourse on social capital and health, and we explore how the relationships between social capital and behavioral health may be different (both in direction and strength) within disaster-exposed and unexposed populations.

2 Methods

2.1 Data

Data were drawn from the Survey of Trauma, Resilience, and Opportunity among Neighborhoods in the Gulf (STRONG). The STRONG was designed to assess the current health and well-being among residents of the Gulf Coast region and sampled adults (≥ 18 years) living in 56 counties/parishes on or near the Gulf of Mexico coast across five states (TX = 16 counties, LA = 12, MS = 3, AL = 2, FL = 23) from April to August 2016, 6 years after the DHOS. The total sample includes 2520 adult Gulf Coast residents. This total includes a traditional landline telephone sample yielding 1617 respondents, combined with a sample of cell phone users yielding 903 respondents. More detailed information about sampling procedures and response rates has been published elsewhere (Ayer et al. 2018; Drakeford et al. 2020; Parks et al. 2019; Ramchand et al. 2019).

2.2 Measures

2.2.1 Dependent variables

Depression was measured using the Patient Health Questionnaire (PHQ-2), a depression screener assessing the frequency with which respondents experienced a lack of interest/pleasure (i.e., anhedonia) and depressed mood (Kroenke et al. 2003). Items were scored on a 0–3 scale and summed for a total score (range = 0–6).

Anxiety was assessed with the Generalized Anxiety Disorder (GAD-2) screener (Kroenke et al. 2007). The GAD-2 measures how often respondents experience

nervousness, anxiety, and worry. Items were rated on a 0–3 scale and summed for a total score (range = 0–6).

Alcohol misuse was measured using the three-item Alcohol Use Disorders Identification Test (AUDIT-C), a self-report screening measure for hazardous drinking and alcohol use disorders (Bradley et al. 2013; Bush et al. 1998). The AUDIT-C is an adapted version of the 10-item AUDIT and assesses drinking frequency and quantity. Items were scored on a 0–4 scale and summed for a total score (range = 0–12).

2.2.2 Independent variables

Three dimensions of social capital were examined in this study: community engagement, trust, and social support.

Community engagement reflects the degree to which a person belongs to organizations within their community. We measured community engagement by asking respondents to report the number of organizations they belong to (e.g. job-related organizations, religious-oriented groups, volunteer organizations). This was then coded into a four-point categorical variable, where belonging to 0 groups = 0, belonging to 1 group = 1, belonging to 2–3 groups = 2, belonging to 4 or more groups = 3. Community engagement is thought to be a key predictor of social capital (Putnam 2000) and reflects psychosocial and structural (Rung et al. 2016) aspects of social capital.

Respondents were also asked about their level of *trust* in a number of different entities: their friends, family, and neighbors; local media; business leaders and business organizations; religious leaders and religious institutions; and academic leaders and academic institutions. Respondents indicated whether their trust in these different entities could be characterized as *a great deal*, *much*, *somewhat*, *a little*, or *none at all*. *A great deal* and *much* responses were coded as 1, whereas *somewhat*, *a little*, and *none at all* were coded as 0. These scores were summed. Responses were then coded into a four-point categorical variable where trust in zero 0 entities = 0, trust in 1 entity = 1, trust in 2 entities = 2, and trust in 3 or more = 3. Trust in information is integral after technological disasters, as an erosion of such trust may be an indicator of corrosive community (Freudenburg 1997). Trust is characterized as cognitive psychosocial social capital (Rung et al. 2016).

To capture respondents' perceptions of their local *social support* networks, respondents were asked to first make a list of the twenty people they felt closest to, emotionally (McCarty et al. 2007). They were then asked, "How many of the twenty people emotionally closest to you live near you?" Responses range from 0 to 20, and these responses were broken into quintiles. Social support derived from local ties may be beneficial for the activation of resources in times of need, and though this variable measures perceived versus enacted resources, it captures a resource-based social capital.

Oil spill experience was measured as a dichotomous variable (experienced the DHOS = 1, did not experience the DHOS = 0). Respondents who reported living in the region at the time of the spill were asked a series of questions about their experiences and losses during and after the DHOS. Respondents indicated whether they worked on any shoreline or water cleanup activities. Respondents also indicated whether the spill had caused property loss or damage, financial loss, or loss of a job or hours at a job, and whether they had filed a claim as a result of the spill. Respondents were also asked whether they or their family fish commercially and, if so, did the oil spill damage areas where they fish. Finally, respondents indicated whether the oil spill affected hunting, fishing, or gathering activities; exercise or recreational patterns; and dietary or eating patterns. If

respondents answered "yes" to any of the nine questions related to oil spill experience, they were coded as having experienced the DHOS (DHOS experience = 1). Those who were not living in the region at the time of the spill or who did not answer "yes" to any of these nine questions were coded as not having experienced the DHOS (no DHOS experience = 0).

2.2.3 Covariates

We also included a series of control variables in our analyses, including education, sex (female = 1, male = 0), a dichotomous variable for race (white = 1, other race = 0), a dichotomous variable for whether or not the respondent is married (married = 1, not married = 0), a dichotomous variable to indicate whether the person is employed full time (employed full time = 1, not employed full time = 0), and age (measured as a continuous variable).

2.3 Analytic strategy

Descriptive analyses were conducted in Stata version 15.1 (StataCorp 2017). We present the means and standard deviations or percentages for the full sample, the no DHOS experience group, the DHOS experience group, as well as the results of t-tests determining statistical differences between the two groups.

Path analyses were conducted using Mplus version 8.0 (Muthén and Muthén 1998). Missing data were estimated in order to use all available data in Mplus with full information maximum likelihood (FIML) procedures as described by Asparouhov and Muthén (2010).

First, we conducted a path analysis, estimating all path coefficients simultaneously in a single-group framework to test the associations between social capital variables and behavioral health variables in the overall sample (Fig. 1). Next, a multigroup framework was used to estimate the path model within two groups: those who did not report experiencing the DHOS and those who did. To test cross-group invariance, we compared two nested models: (1) a model where all paths were constrained to be equal across the two groups and (2) a model where all parameters could vary between groups. We used a robust nested Chi-square test to compare the nested models in Mplus.

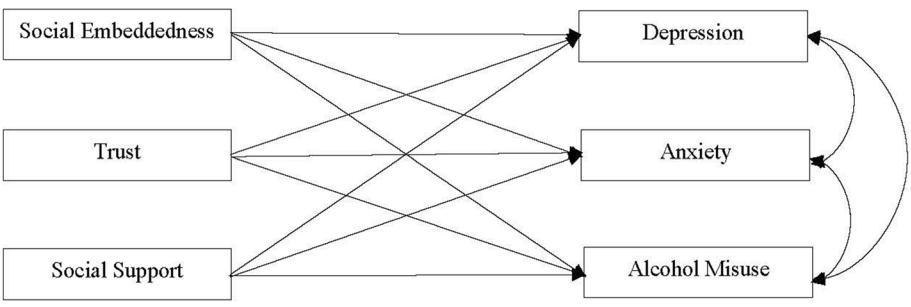

Fig. 1 Path model to assess the relationships between social and behavioral health

3 Results

Table 1 presents the characteristics of STRONG respondents in these analyses. We present descriptives for the entire sample and then among those who experienced the DHOS ($n = 980$) and those who did not ($n = 949$). We tested the differences in means and proportions between the two groups. These tests indicate that the exposed group reported significantly higher levels of depression, anxiety, and alcohol misuse relative to the no DHOS experience group. There were also differences in two of our three social capital measures: community engagement and social support. With respect to community engagement, those without DHOS experience were significantly more likely to be involved with zero community groups compared to those residents who did experience the DHOS, and those who experienced the DHOS were significantly more likely to be involved with four or more groups, compared to those who did not experience the DHOS. Regarding social support, those without DHOS experience were more likely to report having the lowest number of close ties (0–3) compared to those who did have DHOS experience. Furthermore, those with DHOS experience were more likely to have higher levels of social support (11–15 and 16–20 ties). Those without DHOS experience were significantly older with a greater proportion of white respondents relative to those who experienced the DHOS. Additional analysis (not shown) indicated that community engagement is significantly related to trust ($\chi^2(9) = 74.753$, $p = 0.000$), community engagement is significantly related to social support ($\chi^2(12) = 69.986$, $p = 0.000$), and trust is significantly related to social support ($\chi^2(12) = 53.103$, $p = 0.000$).

To begin our multivariate analysis, we first ran a path model for the entire sample, examining the relationships between our dependent variables (depression, anxiety, and alcohol misuse) on three social capital variables (community engagement, trust, and social support) with our controls. The model was "just identified" (i.e., zero degrees of freedom), so we do not interpret the fit indices (Muthén and Muthén 1998). The structure of this model is presented in Fig. 1.

As shown in Table 2, community engagement is negatively related to depression ($\beta = -0.060$; $p = 0.008$), social support is negatively related to anxiety ($\beta = -0.051$; $p = 0.022$), and trust is not significantly related to any of our control variables. Furthermore, depression is positively correlated with anxiety ($\beta = 0.600$; $p = 0.000$), and anxiety is positively correlated with alcohol misuse ($\beta = 0.057$; $p = 0.020$).

Given our interest in how social capital might operate after disasters, we also used multiple group analysis to determine whether these relationships might vary depending on disaster experience. We ran nested models, where parameters were constrained and where parameters were allowed to vary. Then, we assessed the fit indices of our models. The model with loadings constrained to be equal across the two groups (Model 1) had good fit ($\chi^2(30) = 45.013$, $p = 0.039$; CFI = 0.989; TLI = 0.978; RMSEA = 0.023). The model with all parameters freely estimated (Model 2) was also a just identified model so, again, we do not interpret the fit indices (Muthén and Muthén 1998). To determine which model (Model 1 vs. Model 2) provided a better fit to the data, we performed a Satorra–Bentler Chi-square difference test. The test statistic was significant ($p < 0.05$), indicating that constraining the parameters to be equal across groups as in Model 1 significantly worsens model fit compared to Model 2 where parameters were freely estimated and could thus vary across groups.

Table 1 Descriptive statistics

	Full sample Mean (SD) or percentage	No DHOS experience group Mean (SD) or percentage	DHOS experience group Mean (SD) or percentage	Significant difference
Depression	0.96 (1.58)	0.82 (1.48)	1.10 (1.66)	***
Anxiety	1.19 (1.76)	1.02 (1.65)	1.35 (1.85)	***
Alcohol misuse	1.82 (2.22)	1.70 (2.14)	1.94 (2.29)	*
Community engagement				
0 groups	28.82%	32.46%	25.31%	***
1 group	26.44%	27.61%	25.31%	
2–3 groups	28.93%	27.40%	30.41%	
≥4 groups	15.81%	12.54%	18.98%	***
Trust				
0 entities	24.16%	24.66%	23.67%	
1 entity	24.31%	23.29%	25.31%	
2 entities	24.00%	24.76%	23.27%	
≥3 entities	27.53%	27.29%	27.76%	
Social support				
0–3 ties	27.32%	32.77%	22.04%	***
4–5 ties	17.68%	17.81%	17.55%	
6–10 ties	22.91%	21.60%	24.18%	
11–15 ties	12.80%	11.06%	14.49%	*
16–20 ties	19.28%	16.75%	21.73%	**
Education				
Less than high school	7.31%	5.90%	8.67%	*
High school	24.31%	26.24%	22.45%	
Some college	20.79%	21.18%	20.41%	
Associate degree	9.12%	8.64%	9.59%	
Vocational/technical	4.61%	4.21%	5.00%	
Bachelor's degree	19.03%	19.39%	18.67%	

Table 1 (continued)

	Full sample Mean (SD) or percentage	No DHOS experience group Mean (SD) or percentage	DHOS experience group Mean (SD) or percentage	Significant difference
More than bachelor's	14.83%	14.44%	15.20%	
Female	61.43%	62.49%	60.41%	
Married	48.83%	48.79%	48.88%	
Employed full time	34.32%	33.51%	35.10%	
Age	56.93 (17.63)	58.07 (18.79)	55.83 (16.36)	**
White	77.24%	81.14%	73.47%	***
N	1929	949	980	

Source: STRONG, 2016

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 2 Overall model results

	B (SE)	*β*
Depression on		
Community engagement	−0.091 (0.035)	−0.060 (0.023)**
Trust	−0.053 (0.030)	−0.037 (0.021)
Social support	−0.041 (0.025)	−0.037 (0.023)
Education	−0.090 (0.017)	−0.113 (0.021)***
Female	0.059 (0.070)	0.018 (0.021)
Married	−0.349 (0.071)	−0.109 (0.022)***
Employed full time	−0.478 (0.073)	−0.141 (0.021)***
Age	−0.007 (0.002)	−0.080 (0.024)**
White	−0.192 (0.087)	−0.051 (0.023)*
Anxiety on		
Community engagement	−0.064 (0.040)	−0.037 (0.023)
Trust	−0.024 (0.033)	−0.015 (0.021)
Social support	−0.063 (0.028)	−0.051 (0.022)*
Education	−0.094 (0.020)	−0.105 (0.022)***
Female	0.321 (0.078)	0.087 (0.021)***
Married	−0.236 (0.080)	−0.066 (0.022)**
Employed full time	−0.408 (0.088)	−0.107 (0.023)***
Age	−0.018 (0.003)	−0.179 (0.024)***
White	−0.057 (0.099)	−0.013 (0.023)
Alcohol misuse on		
Community engagement	0.044 (0.051)	0.021 (0.024)
Trust	−0.071 (0.042)	−0.036 (0.021)
Social support	0.032 (0.033)	0.021 (0.021)
Education	0.099 (0.027)	0.089 (0.024)***
Female	−0.895 (0.106)	−0.196 (0.022)***
Married	0.031 (0.099)	0.007 (0.022)
Employed full time	0.421 (0.117)	0.089 (0.025)***
Age	−0.013 (0.003)	−0.103 (0.022)***
White	0.419 (0.109)	0.079 (0.021)***
Correlations		
Depression with anxiety	1.586 (0.090)	0.600 (0.020)***
Depression with alcohol misuse	−0.074 (0.069)	−0.023 (0.021)
Anxiety with alcohol misuse	0.208 (0.091)	0.057 (0.025)*
N	2076	

Source: STRONG, 2016

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

We present the parameter estimates in Table 3. In Model 1, the parameters were constrained to be equal across two groups. Community engagement had a significant negative relationship with depression ($\beta = -0.059$; $p = 0.012$). Trust had a significant negative

Table 3 Multigroup analysis results

	Model 1—parameters constrained		Model 2—parameters free			
	B (SE)	*β*	*B* (SE)	*B* (SE)	*β*	*β*
			No DHOS experience	DHOS experience	No DHOS experience	DHOS experience
Depression on						
Community engagement	−0.089 (0.036)	−0.059*	−0.090 (0.049)	−0.089 (0.052)	−0.063	−0.057
Trust	−0.063 (0.030)	−0.046*	−0.052 (0.042)	−0.069 (0.044)	−0.040	−0.047
Social support	−0.062 (0.025)	−0.057*	−0.024 (0.033)	−0.097 (0.038)	−0.024	−0.085*
Education	−0.081 (0.018)	−0.102***	−0.082 (0.024)	−0.084 (0.027)	−0.109**	−0.102**
Female	0.027 (0.071)	0.008	−0.060 (0.098)	0.115 (0.104)	−0.019	0.034
Married	−0.374 (0.072)	−0.119***	−0.341 (0.096)	−0.399 (0.109)	−0.115***	−0.120***
Employed full time	−0.451 (0.074)	−0.136***	−0.352 (0.103)	−0.535 (0.107)	−0.112**	−0.154***
Age	−0.007 (0.002)	−0.085**	−0.008 (0.003)	−0.005 (0.003)	−0.104**	−0.053
White	−0.099 (0.087)	−0.025	0.032 (0.123)	−0.188 (0.124)	0.008	−0.050
Anxiety on						
Community engagement	−0.062 (0.040)	−0.037	−0.060 (0.055)	−0.062 (0.060)	−0.037	−0.036
Trust	−0.024 (0.034)	−0.015	−0.044 (0.046)	0.000 (0.050)	−0.031	0.000
Social support	−0.076 (0.028)	−0.064**	−0.027 (0.037)	−0.125 (0.043)	−0.024	−0.097**
Education	0.308 (0.079)	−0.105***	−0.067 (0.028)	−0.116 (0.030)	−0.080*	−0.126***
Female	−0.248 (0.081)	0.086***	0.299 (0.106)	0.329 (0.118)	0.088**	0.087**
Married	−0.248 (0.081)	−0.071**	−0.186 (0.108)	−0.295 (0.121)	−0.057	−0.080*
Employed full time	−0.318 (0.088)	−0.104***	−0.386 (0.120)	−0.369 (0.129)	−0.111**	−0.095**
Age	−0.018 (0.003)	−0.200***	−0.017 (0.003)	−0.019 (0.004)	−0.199***	−0.172***
White	0.052 (0.098)	0.012	0.058 (0.137)	0.057 (0.143)	0.014	0.014
Alcohol misuse on						
Community engagement	0.055 (0.052)	0.027	0.076 (0.072)	0.045 (0.077)	0.037	0.021
Trust	−0.069 (0.042)	−0.036	−0.026 (0.058)	−0.118 (0.062)	−0.014	−0.058
Social support	0.038 (0.035)	0.026	0.099 (0.048)	−0.030 (0.050)	0.067*	−0.019

Table 3 (continued)

	Model 1—parameters constrained		Model 2—parameters free			
	B (SE)	*β*	*B* (SE)	*B* (SE)	*β*	*β*
			No DHOS experience	DHOS experience	No DHOS experience	DHOS experience
Education	0.097 (0.027)	0.090***	0.094 (0.038)	0.099 (0.041)	0.087*	0.087*
Female	−0.890 (0.108)	−0.201***	−0.825 (0.151)	−0.946 (0.156)	−0.187***	−0.202***
Married	0.023 (0.102)	0.005	0.080 (0.139)	−0.024 (0.151)	0.019	−0.005
Employed full time	0.438 (0.118)	0.096***	0.481 (0.165)	0.393 (0.169)	0.106**	0.082*
Age	−0.013 (0.003)	−0.116***	−0.014 (0.004)	−0.012 (0.005)	−0.120***	−0.087*
White	0.500 (0.112)	0.091***	0.294 (0.170)	0.691 (0.151)	0.054	0.133***
Correlations						
Depression with anxiety	1.492 (0.090)	0.596***	1.252 (0.125)	1.722 (0.129)	0.549***	0.622***
Depression with alcohol misuse	−0.122 (0.071)	−0.040	−0.005 (0.101)	−0.266 (0.099)	−0.002	−0.078**
Anxiety with alcohol misuse	0.098 (0.088)	0.029	0.157 (0.113)	0.022 (0.139)	0.049	0.006
N	1929		949	980	949	980

Source: STRONG, 2016

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

relationship with depression ($\beta = -0.046$; $p = 0.038$), and social support was negatively associated with depression ($\beta = -0.057$; $p = 0.013$) and anxiety ($\beta = -0.064$; $p = 0.006$). Furthermore, depression and anxiety were significantly positively correlated with one another ($\beta = 0.596$; $p = 0.000$).

In Model 2, we allowed the parameters to estimate freely so that they could differ between the two groups. Among those who did not experience the DHOS (see Fig. 2 and Table 3), there is only one significant pathway between our independent and dependent variables of interest: a positive relationship between social support and alcohol misuse ($\beta = 0.067$; $p = 0.035$). However, consistent with our expectations, depression was significantly positively correlated with anxiety ($\beta = 0.549$; $p = 0.000$) among those who did not experience the DHOS.

Among those who experienced the DHOS (see Fig. 2 and Table 3), social support was negatively associated with both depression ($\beta = -0.085$; $p = 0.011$) and anxiety ($\beta = -0.097$; $p = 0.003$). There were also significant correlations between the dependent variables. Depression was positively correlated with anxiety ($\beta = 0.622$; $p = 0.000$), and depression was negatively correlated with alcohol misuse ($\beta = -0.078$; $p = 0.006$).

Many of the covariates also had statistically significant relationships with the dependent variables, and these relationships tended to be somewhat similar in the two groups (see Table 2).

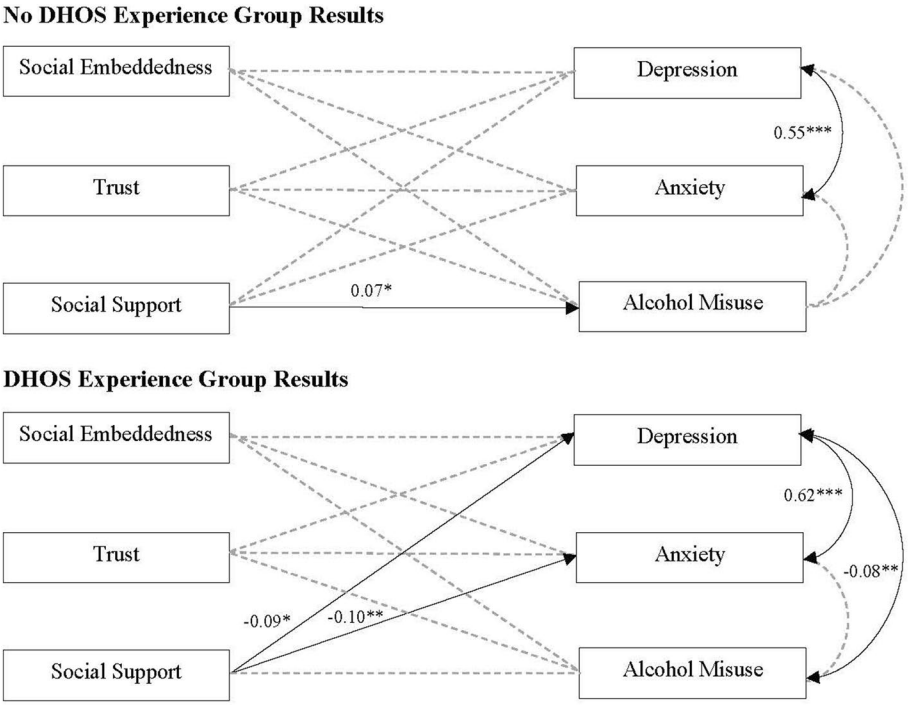

Fig. 2 No DHOS experience group results. DHOS experience group results

4 Discussion

In this paper, we examined whether different social capital constructs were consistently negatively related to behavioral health outcomes and if there were differences in the relationships between social capital and behavioral health between those who reported experiencing the DHOS and those who did not. We found that different forms of social capital did not have a consistent relationship with behavioral health outcomes. We also found that these relationships differed between those who experienced the DHOS and those who did not. These findings speak to larger debates about social capitals' relationships to health (Carpiano 2006; Carpiano and Hystad 2011; Ritchie and Gill 2007) and contribute to existing research on disasters and health by addressing the connections to social capital and health (e.g., Beaudoin 2011; Rung et al. 2016), the connections between disaster exposure and health (e.g., Ayer et al. 2018; Drakeford et al. 2020; Drescher et al. 2014; Fan et al. 2015; Lee and Blanchard 2012; Werner and Locke 2012), and most importantly, by bringing these areas of research together.

In our descriptive analysis, we found that there are important, significant differences between respondents who experienced the DHOS and those who did not. Respondents who did experience the DHOS were significantly more likely to report symptoms of depression, anxiety, and alcohol misuse than respondents who did not experience the DHOS. This echoes previous findings that disaster experience is linked to behavioral health issues (Arata et al. 2000; Drakeford et al. 2020; Fan et al. 2015). We also observed significant differences in community engagement and social support. Respondents who did not experience the DHOS were more likely to not belong to any community group, and respondents who did experience the DHOS were more likely to belong to more than four groups. Also, respondents who did not experience the DHOS were more likely to have 0–3 close social ties, whereas those who did experience the DHOS were more likely to have 11–15 and 16–20 ties. These differences in social capital somewhat differ from past research, which suggests that disaster experience erodes social capital (Ritchie and Gill 2007; Rung et al. 2016).

In our multivariate analysis, we found that the three aspects of social capital we captured did not have a consistent relationship with health outcomes. When controlling for other factors, community engagement and trust did not have significant relationships with depression, anxiety, or alcohol misuse. So, when including both resource social capital (in the form of social support) and psychosocial social capital (in the form of social embeddedness and trust), only the resource social capital had a direct significant relationship with health outcomes among both those who did and did not experience the DHOS. Social support was beneficial for those who experienced the DHOS, as it was negatively related to depression and anxiety. However, among respondents who did not report experiencing the DHOS, social support was associated with increased alcohol misuse, but not with anxiety or depression.

These findings suggest that not all social capitals are the same and that social capitals related to networks and resources may be more beneficial than psychosocial social capitals among those facing hardships like recovering from disasters. This supports the literature suggesting that resources are what is key to social capital (Carpiano 2006; Carpiano and Hystad 2011), as well as the research on the benefits of social capital after disasters (Aldrich and Meyer 2015; Ritchie and Gill 2007). This also underscores the importance of resources in off-setting potential further losses (Hobfoll 1989; Hobfoll and Lilly 1993; Norris and Kaniasty 1996), that those with a more robust social support network report fewer indicators of depression and anxiety.

However, among those who did not experience the DHOS, social support was associated with an increase in alcohol misuse. This finding suggests that Gulf Coast residents who were not affected by the DHOS and who have more friends and family nearby whom they can rely on are more likely to misuse alcohol. While some research has shown that social capital can protect against alcohol misuse (Weitzman and Chen 2005; Weitzman and Kawachi 2000), there are certain contexts in which this may not be the case. For example, research in Scandinavia has found that social capital is associated with heavy drinking behaviors (Demant and Jarvinen 2011; Lindstrom 2005), suggesting that different places may have different norms around drinking. By extension, having a large social network in a place with a drinking culture could encourage drinking behaviors, or at the least, there might be fewer prohibitions against alcohol misuse in a place where people tend to drink more. For the most part, the Gulf Coast is an alcohol-permissive environment, where alcohol misuse has been flagged as a potential issue (Drakeford et al. 2020; Ramchand et al. 2019). Furthermore, research from Hurricane Katrina that suggested disaster exposure was not related to increased alcohol consumption over time but that neighborliness was (Beaudoin 2011). Therefore, we speculate that residents not dealing with the effects of the DHOS may be more engaged in social drinking, which may be exacerbated in an alcohol-permissive environment.

Though this study takes a novel approach to examining the relationships between social capital and health, there are a few limitations we wish to address, including the timing of the survey and the social support measure included in the analysis. The STRONG data collection effort occurred in 2016, 6 years after the onset of the DHOS. Also, these are cross-sectional data. As such, they are not meant to represent immediate post-disaster dynamics, nor can they speak to causal relationships between our variables. Instead, these data represent the health statuses of Gulf Coast resident in the medium to long-term aftermath of the DHOS.

Regarding the social support measure, we use a measure of social support that reflects an individual's close ties living nearby. In other words, we are capturing the potential for resources nearby. Our variables for community engagement and trust also capture practices and sentiments in their communities. That said, there is evidence that in the more immediate aftermath of a disaster, geographically-distant networks can be beneficial for providing aid and resources as the availability of resources within a disaster-impacted community can become scarce (Cope et al. 2018; Elliott et al. 2010). However, since this survey was fielded 6 years after the initial disaster event, we argue that this is a relatively more stable time, and resources within one's community may be of importance, especially among those still dealing with income loss, litigation, or other disaster impacts.

5 Conclusion

Moving forward, we recommend that researchers continue to be intentional in their language about social capital and precise in what they intend to measure and capture in their analyses including different social capital constructs. Social capital is a multi-faceted concept, and its different components may be related to different kinds of outcomes, which may also be specific to different groups. For example, in this paper, we show that individuals who experienced a disaster may benefit from the resources of their social networks. We also find evidence that these social networks are not universally beneficial and could be

context specific. Additional longitudinal research can help to disentangle the complex relationships between disaster exposure, social capital, and behavioral health.

Acknowledgements This research was supported by a grant from The Gulf of Mexico Research Initiative. Data are publicly available through the Gulf of Mexico Research Initiative Information and Data Cooperative (GRIIDC) at https://data.gulfresearchinitiative.org (https://doi.org/10.7266/n76971z0).

Compliance with ethical standards

Conflict of interest We have no conflicts of interest to disclose.

References

Aldrich DP, Meyer MA (2015) Social capital and community resilience. Am Behav Sci 59(2):254–269
Arata CM, Picou JS, Johnson GD, McNally TS (2000) Coping with technological disaster: an application for the conservation of resources model to the Exxon Valdez oil spill. J Trauma Stress 13(1):23–39
Asparouhov T, Muthén B (2010) Weighted least squares estimation with missing data. http://www.statmodel.com/download/GstrucMissingRevision.pdf. Accessed 27 July 2020
Ayer L, Engel C, Parker A, Seelam R, Ramchand R (2018) Behavioral health of Gulf Coast residents 6 years after the Deepwater Horizon oil spill: the role of trauma history. Disaster Med Public Health Prep 13(3):497–503
Baum A, Fleming R, Davidson LM (1983) Natural disaster and technological catastrophe. Environ Behav 15(3):333–354
Beaudoin CE (2007) News, social capital and health in the context of Katrina. J Health Care Poor Underserved 18(2):418–430
Beaudoin CE (2011) Hurricane Katrina: addictive behavior trends and predictors. Public Health Rep 126(3):400–409
Bourdieu P (1986) The forms of capital. In: Richardson JG (ed) Handbook of theory and research for the sociology of education. Greenwood, New York, pp 241–258
Bradley KA, DeBenedetti AF, Volk RJ, Williams EC, Frank D, Kivlahan DR (2013) AUDIT-C as a brief screen for alcohol misuse in primary care. Alcohol Clin Exp Res 31(7):1208–1217
Bush K, Kivlahan DR, McDonell MB, Fihn SD, Bradley KA (1998) The AUDIT alcohol consumption questions (AUDIT-C). Arch Intern Med 158:1789–1795
Carpiano RM (2006) Toward a neighborhood resource-based theory of social capital for health: can Bourdieu and sociology help? Soc Sci Med 62(1):165–175
Carpiano RM, Hystad PW (2011) Sense of community belonging in health surveys: what social capital is it measuring? Health Place 17:606–617
Cope MR, Slack T, Blanchard TC, Lee MR (2013) Does time heal all wounds? Community attachment, natural resource employment, and health impacts in the wake of the BP Deepwater Horizon disaster. Soc Sci Res 42(3):872–881
Cope MR, Lee MR, Slack T, Blanchard TC, Carney J, Lipschitz F, Gikas L (2018) Geographically distant social networks elevate perceived preparedness for coastal environmental threats. Popul Environ 39:277–296
Demant J, Jarvinen M (2011) Social capital as norms and resources: focus groups discussing alcohol. Addict Res Theory 19(2):91–101
Drakeford L, Parks V, Slack T, Ramchand R, Finucane M, Lee MR (2020) Oil spill disruption and problem drinking: assessing the impact of religious context. Popul Res Policy Rev 39(1):119–146
Drescher CF, Schulenberg SE, Smith CV (2014) The Deepwater Horizon oil spill and the Mississippi Gulf Coast: mental health in the context of a technological disaster. Am J Orthopsychiatr 84(2):142–151
Elliott JR, Haney TJ, Sams-Abiodum P (2010) Limits to social capital: comparing network assistance in two New Orleans neighborhoods devastated by Hurricane Katrina. Soc Q 51(4):624–648
Erikson K (1994) A new species of trouble: the human experience of modern disasters. Norton, New York
Fan AZ, Prescott MR, Zhao G, Gotway CA, Galea S (2015) Individual and community-level determinants of mental and physical health after the Deepwater Horizon oil spill: findings from the Gulf States Population Survey. J Behav Health Ser Res 42(1):23–41
Freudenburg WR (1997) Contamination, corrosion, and the social order: an overview. Curr Sociol 45(3):19–40

Freudenburg WR, Jones TR (1991) Attitudes and stress in the presence of technological risk: a test of the Supreme Court hypothesis. Soc Forces 69(4):1143–1168
Gill DA (1994) Environmental disaster and fisher co-management in a natural resource community: impacts of the Exxon Valdez oil spill. Folk management in the world's fisheries: impactions for fisheries managers, pp 207–235
Gill DA, Picou JS (1998) Technological disaster and chronic community stress. Soc Nat Resour 11(8):795–815
Gill DA, Picou JS, Ritchie LA (2012) The Exxon Valdez and BP oil spills: a comparison of initial social and psychological impacts. Am Behav Sci 56(1):3–23
Gill DA, Ritchie LA, Picou JS, Langhinrichsen-Rohling J, Long MA, Shenesey JW (2014) The Exxon and BP oil spills: a comparison of psychosocial impacts. Nat Hazards 74(3):1911–1932
Goldstein BD, Osofsky HJ, Lichtveld MY (2011) The Gulf oil spill. N Engl J Med 364:1334–1348
Gould DW, Teich JL, Pemberton MR, Pierannunzi C, Larson S (2015) Behavioral health in the Gulf Coast region following the Deepwater Horizon oil spill: findings from two federal surveys. J Behav Health Ser 42(1):6–22
Grattan LM, Roberts S, Mahan WT, McLaughlin PK, Otwell WS, Morris JG (2011) The early psychological impacts of the Deepwater Horizon oil spill on Florida and Alabama communities. Environ Health Perspect 119(6):838–843
Hobfoll SE (1989) Conservation of resources: a new attempt at conceptualizing stress. Am Psychol 44(3):513–524
Hobfoll SE, Lilly RS (1993) Resource conservation as a strategy for community psychology. J Community Psychol 21(2):128–148
Institute of Medicine (2010) Assessing the effects of the Gulf of Mexico oil spill on human health: a summary of the June 2010 workshop. National Academies Press, Washington
Kaniasty K, Norris FH (1993) A test of the social support deterioration model in the context of natural disaster. J Pers Soc Psychol 64(3):395–408
Kawachi I, Kennedy BP, Glass R (1999) Social capital and self-rated health: a contextual analysis. Am J Public Health 89(8):1187–1193
Kroenke K, Spitzer RL, Williams JB (2003) The patient health questionnaire-2: validity of a two-item depression screener. Med Care 41(11):1284–1292
Kroenke K, Spitzer RL, Williams JB (2007) The 2-item generalized anxiety disorder scale had high sensitivity and specificity for detecting GAD in primary care. Ann Intern Med 146:317–325
Kroll-Smith JS, Couch SR (1991) What is a disaster? An ecological-symbolic approach resolving the definitional debate. Int J Mass Emerg Disasters 9(3):355–366
Lee MR, Blanchard TC (2012) Community attachment and negative affective states in the context of the BP Deepwater Horizon disaster. Am Behav Sci 56(1):24–47
Lin N (1999) Social networks and status attainment. Annu Rev Sociol 25(1):467–487
Lindstrom M (2005) Social capital, the miniaturization of community and high alcohol consumption: a population-based study. Alcohol Alchol 40(6):556–562
Lochner K, Kawachi I, Kennedy BP (1999) Social capital: a guide to its measurement. Health Place 5:259–270
Lowe SR, McGrath JA, Young MN, Kwok RK, Engel LS, Galea S, Sandler DP (2019) Cumulative disaster exposure and mental and physical health symptoms among a large sample of Gulf Coast residents. J Trauma Stress 32(2):196–205
McCarty C, Killworth PD, Rennell J (2007) Impacts of methods for reducing respondent burden on personal network structural measures. Soc Netw 29(2):300–315
Morris JG, Grattan LM, Mayer BM, Blackburn JK (2013) Psychological responses and resilience of people and communities impacted by the Deepwater Horizon oil spill. Trans Am Clin Climatol As 124:191–201
Muthén LK, Muthén BO (1998–2017) Mplus user's guide, 8th edn. Muthén & Muthén, Los Angeles
Norris FH, Kaniasty K (1996) Received and perceived social support in times of stress: a test of the social support deterioration deterrence model. J Pers Soc Psychol 71(3):498–511
Norris FH, Stevens SP, Pfefferbaum B, Wyche KF, Pfefferbaum RL (2008) Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. Am J Community Psychol 41:127–150
Osofsky HJ, Osofsky JD, Hansel TC (2011) Deepwater Horizon oil spill: mental health effects on residents in heavily affected areas. Disaster Med Public Health Prep 5(4):280–286
Parker AM, Finucane ML, Ayer L, Ramchand R, Parks V, Clancy N (2019) Persistent risk-related worry as a function of recalled exposure to the Deepwater Horizon oil spill and prior worry. Risk Anal. https://doi.org/10.1111/risa.13437

Parks V, Slack T, Ramchand R, Drakeford L, Finucane ML, Lee MR (2019) Fishing households, social support, and depression after the Deepwater Horizon oil spill. Rural Sociol. https://doi.org/10.1111/ruso.12297
Picou JS, Marshall BK, Gill DA (2004) Disaster, litigation, and the corrosive community. Soc Forces 82(4):1493–1522
Portes A (1998) Social capital: its origins and applications in modern society. Annu Rev Sociol 24(1):1–24
Putnam RD (2000) Bowling alone: the collapse and revival of American community. Simon & Schuster, New York
Ramchand R, Seelam R, Parks V, Ghosh-Dastidar B, Lee M, Finucane M (2019) Exposure to the Deepwater Horizon oil pill and long term mental and behavioral health outcomes. Disaster Med Public Health Prep 13(5–6):655–671
Ricchetti-Masterson J, Horney J (2013) Social factors as modifiers of Hurricane Irene evacuation behavior in Beaufort County. NC, PLoS Curr, p 5
Ritchie LA, Gill DA (2007) Social capital theory as an integrating theoretical framework in technological disaster research. Sociol Spectr 27:103–129
Ritchie LA, Gill DA, Farnham CN (2013) Recreancy revisted: beliefs about institutional failure following the Exxon Valdez oil spill. Soc Nat Resour 26(6):655–671
Ritchie LA, Gill DA, Long MA (2018) Mitigating litigating: an examination of psychosocial impacts of compensation processes associated with the 2010 BP Deepwater Horizon oil spill. Risk Anal 38(8):1656–1671
Rung AL, Gaston S, Oral E, Robinson WT, Fontham E, Harrington DJ, Trapido E, Peters ES (2016) Depression, mental distress, and domestic conflict among Louisiana women exposed to the Deepwater Horizon oil spill in the WaTCH Study. Environ Health Perspect 124(9):1429–1435
Singleton B, Turner J, Walter L, Lathan N, Thorpe D, Ogbevoen P, Daye J, Alcorn DS, Wilson S, Semien J, Richard T, Johnson T, McCabe K, Estrada JJ, Galvez F, Velasco C, Reiss K (2015) Environmental stress in the Gulf of Mexico and its potential impact on public health. Environ Res 146:108–115
StataCorp (2017) Stata statistical software: release 15. StataCorp LLC, College Station
Weil FD, Lee MR, Shihadeh ES (2012) The burdens of social capital: how socially-involved people dealt with stress after Hurricane Katrina. Soc Sci Res 41:110–119
Weitzman ER, Chen YY (2005) Risk modifying effect of social capital on measures of heavy alcohol consumption, alcohol abuse, harms, and secondhand effects: national survey findings. J Epidemiol Community Health 59:303–309
Weitzman ER, Kawachi I (2000) Giving means receiving: the protective effect of social capital on binge drinking on college campuses. Am J Public Health 90:1936–1939
Werner D, Locke C (2012) Experiences of chronic stress one year after the Gulf oil spill. Int J Emerg Ment Health 14(4):239–245