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The Deepwater Horizon oil spill and factors associated with depressive symptoms among residents of the Mississippi Gulf Coast

A path analysis

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Abstract

Purpose – The purpose of the paper is to extend prior research on the psychological effects of the Deepwater Horizon oil spill disaster by developing and testing a conceptual model in which exposure to the oil spill through clean-up activity, physical symptoms, worry about the impact of the oil spill on health, and the disruption of the gulf/ocean-related lifestyle were hypothesized as predictors of depressive symptoms.

Design/methodology/approach – The analysis included a randomly selected sample of 354 subjects from the three most Southern Mississippi counties. The Center for Epidemiologic Studies Depression Scale was used to measure depressive symptoms.

Findings – Results indicated that physical symptoms since the oil spill were related to depressive symptoms directly and indirectly through worry about the impact of the oil spill on health and the disruption of the gulf/ocean-related lifestyle. Worry about the impact of the oil spill on health was related to depressive symptoms directly and indirectly through the disruption of the gulf/ocean-related lifestyle.

Originality/value – Study results highlight that uncertainty and worry about the impact of the disaster played a critical role in understanding the psychological effects of the oil spill disaster, especially among coastal residents whose lifestyles were bound up with the gulf/ocean.

Keywords Deepwater Horizon oil spill, Depressive symptoms, Gulf/ocean-related lifestyle, Worry

Paper type Research paper

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Introduction

Counties along the Mississippi Gulf Coast have struggled with the effects of the 2010 Deepwater Horizon oil spill in the Gulf of Mexico – the nation's largest marine oil spill (Cleveland, 2013). The spill was a "slow," creeping disaster and resulted in 4.9 million barrels of oil being gradually spilled into the Gulf of Mexico over a three-month period (McNutt *et al.*, 2011). The response and recovery process that began almost immediately after the breach was aimed at the advancing oil slick. To the dismay of Mississippi residents and all other responders, the millions of government and BP dollars spent to contain the oil spill were insufficient. The unrelenting oil slick slowly brought environmental degradation along with serious economic implications to coastal residents that were still questioning their capacity to rebuild after disasters. It also eroded the confidence that residents had in human systems to protect their coastline and eventually rebuild ecological systems, not only on the Mississippi Coast but also the entire Gulf Coast. To compound this problem, many residents were still adapting or coping with their recovery from the devastation of Hurricane Katrina in 2005, one of the strongest storms in US history (Adeola and Picou, 2014; Groen and Polivka, 2008).

Previous studies of natural hazards or technological disasters have indicated that people who experience a disaster appear to be at increased risk of psychological distress, such as anxiety, depression, and posttraumatic stress disorder (PTSD) (Adeola and Picou, 2014; Galea *et al.*, 2007; Morris *et al.*, 2013; Rehner *et al.*, 2000; Rhodes *et al.*, 2010). Although exposure to a disaster increases the likelihood of being psychologically distressed, psychological outcomes are affected by pre- and post-disaster factors as well as recovery immediately following the disaster (Palinkas, 2012; Sullivan *et al.*, 2013). Despite the growing body of research regarding the psychological effects of a disaster, only a few studies have examined depressive symptoms related to the 2010 Deepwater Horizon oil spill, especially among residents living in South Mississippi communities where two major and different types of disasters were "stacked up" over a short period of time. The purpose of the present study was to extend prior research on the psychological effects of the Deepwater Horizon oil spill disaster by developing and testing a conceptual model in which exposure to the oil spill through clean-up activity, physical symptoms, worry about the impact of the oil spill on health, and the disruption of the gulf/ocean-related lifestyle were hypothesized as predictors of depressive symptoms.

Literature review

Exposure to the oil spill, physical symptoms, and depression

Studies focussing on technological disasters suggest that people are exposed to toxic materials and the contaminated environment through many different means, such as physical contact, drinking or eating contaminated water or food, smelling chemical odor, and witnessing the damage or destruction, and as a result, these people are at increased risk of developing negative physical symptoms (D'Andrea and Reddy, 2013; Eykelbosh, 2014; Palinkas, 2012; Lyons *et al.*, 1999; Suárez *et al.*, 2005; Rodríguez-Trigo *et al.*, 2007; Zock *et al.*, 2012). Eykelbosh (2014) reviewed a series of oil spill studies and found that the most common short-term acute symptoms reported by those who were exposed to an oil spill were headaches, lack of appetite, respiratory effects such as sore throat and cough, itchy skin, rashes, and sore eyes. Lyons *et al.* (1999), in their study of the Sea Empress oil spill, compared people who were physically exposed to the oil spill (living in areas directly affected by the oil spill) with those who were not exposed (living in areas free of oil spill). The authors reported that people living in oil-exposed areas showed higher rates of physical symptoms, including headaches, sore eyes, sore throat,

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and so on. An even higher prevalence of physical symptoms was found among clean-up workers (D'Andrea and Reddy, 2013; Rodríguez-Trigo *et al.*, 2007). D'Andrea and Reddy (2013) reported that clean-up workers involved in the Deepwater Horizon oil spill had very high levels of physical symptoms, such as headaches (77 percent), shortness of breath (71 percent), and skin rashes (59 percent).

The relationship has been well established between exposure to toxic materials or the contaminated environment and psychological distress, including depression, PTSD, and anxiety (De Soir *et al.*, 2015; Galea *et al.*, 2005; Palinkas, 2012; Rehner *et al.*, 2000). Specifically, direct and prolonged exposure was reported to be related to higher levels of psychological distress (De Soir *et al.*, 2015; Galea *et al.*, 2005). Several studies (Drescher *et al.*, 2014; Yzermans *et al.*, 2009) found that physical symptoms after a technological disaster were associated with psychological distress.

Worry about the health impact of the oil spill, disruption of the gulf/ocean-related lifestyle, and depression

Exposure to environmental toxins (oil) has an impact on psychological well-being, along with the worry about the toxins' impact on personal and family health. Studies noted that compared to natural hazards, technological disasters created more chronic uncertainty related to their impact on personal health and quality of the community environment (Gill *et al.*, 2012; Palinkas, 2012). The qualitative study of Cherry *et al.* (2015) found that worry and uncertainty regarding the negative impact of the oil spill on personal and family health were commonly found among commercial fishermen who were exposed to the oil spill in the aftermath of the Deepwater Horizon disaster. Gill *et al.* (2012) observed that worry and concern about the impact of the oil spill on family health was significantly associated with increased psychological distress.

The 2010 Deepwater Horizon oil spill also had a deleterious effect on the social and cultural life of local coastal residents, since the gulf/ocean is a natural source of recreation and enjoyment (Hagerty and Ramseur, 2010). Not only do coastal residents "play" (e.g. fishing, swimming, and boating) and incorporate the ocean into their everyday lifestyle, they also enjoy eating more fish than inland residents (Mahaffey *et al.*, 2009). Contamination of the physical environment in the coastal area and the perceived worry and chronic concern about the toxins' impact on health clearly disrupt and interfere with the gulf/ocean lifestyle. This means that local residents stay away from the gulf and deny themselves of their favorite foods. In 2011, Osofsky *et al.* studied victims of the Deepwater Horizon oil spill and reported that concern about the impact of the oil spill was associated with a disruption of life that was measured by three items (i.e. "employment/school work, social life/leisure activities, family life/home environment," p. 282). This study also found that the disruption of life was significantly related to psychological distress. Reduced outdoor recreational or physical activities due to the oil spill may contribute to increased depressive symptoms. Although the recreational/physical activity and depression link has not been empirically examined among victims of technological disasters, several longitudinal studies of the general population have found an inverse relationship between physical or recreational/leisure activities and depression (Chang *et al.*, 2014; Lee *et al.*, 2012; Yang *et al.*, 2014).

Confounding factors

Numerous studies indicate that adverse psychological health problems after a disaster are more prevalent among racial/ethnic minorities (Adeola and Picou, 2014; Elliott and

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Pais, 2006; Picou and Hudson, 2010), women (Adeola and Picou, 2014; Picou and Hudson, 2010), and those with lower income or financial difficulties (Drescher *et al.*, 2014; Paxson *et al.*, 2012; Picou and Hudson, 2010). Knight *et al.* (2000) and Person *et al.* (2006) studied psychological adjustment to disasters by age groups and found that young- or middle-aged adults were more likely to experience psychological distress than older adults. In contrast, Paxson *et al.* (2012) reported that older adults were more likely to experience psychological distress following a disaster when compared with younger adults. Pre-existing conditions, such as mental health problems, also negatively affect psychological health after a disaster (Boscarino and Adams, 2009; Sullivan *et al.*, 2013). Sullivan *et al.* (2013) observed that pre-existing mental health disorders strongly increased the likelihood of developing new mental health disorders following a disaster.

Hypotheses

The purpose of the present study was to investigate the psychological effects of the 2010 Deepwater Horizon oil spill disaster. Specifically, the aim was to develop and test a conceptual model in which exposure to the oil spill through clean-up activity, physical symptoms since the oil spill, worry about the impact of the oil spill on health, and the disruption of the gulf/ocean-related lifestyle were hypothesized predictors of depressive symptoms (Figure 1). Prior studies (e.g. D'Andrea and Reddy, 2013; Drescher *et al.*, 2014; Eykelbosh, 2014; Gill *et al.*, 2012; Osofsky *et al.*, 2011; Palinkas, 2012; Zock *et al.*, 2012) provided a conceptual framework and guided the direction of relationships among study variables.

The following hypotheses were proposed:

H1. Exposure to the oil spill through clean-up activity would be related to depressive symptoms directly and indirectly through worry about the impact of the oil spill on health and the disruption of the gulf/ocean-related lifestyle.

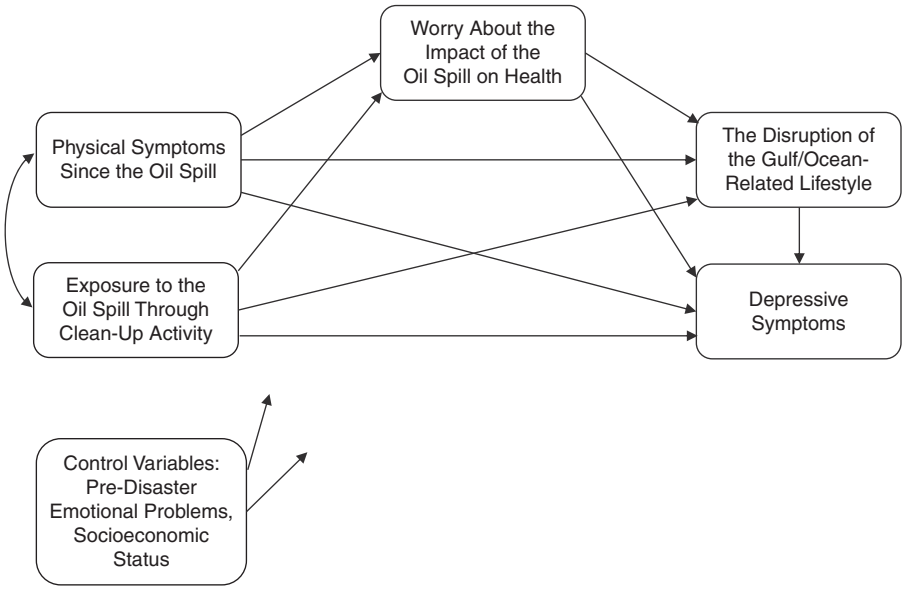

Figure 1.
Proposed model of factors associated with depressive symptoms

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H2. Physical symptoms since the oil spill would be related to depressive symptoms directly and indirectly through worry about the impact of the oil spill on health and the disruption of the gulf/ocean-related lifestyle.

H3. Worry about the impact of the oil spill on health would be related to depressive symptoms directly and indirectly through the disruption of the gulf/ocean-related lifestyle.

H4. Exposure to the oil spill through clean-up activity would be correlated to physical symptoms since the oil spill.

Method

Participants and processes

This study interviewed 358 adults living in the area between Interstate 10 and the Gulf of Mexico coastline in the three most southern Mississippi counties (Hancock, Harrison, and Jackson). These areas are waterfront counties that were directly affected by the oil spill. The targeted sampling area is presented in Figure 2. The data collection began in October 2010 and was completed in December 2010. The study participants were randomly selected following a spatially stratified random sampling scheme. First, the sample was selected from each county proportionately to the total county population. Second, within each census tract, a defined number of blocks were randomly selected

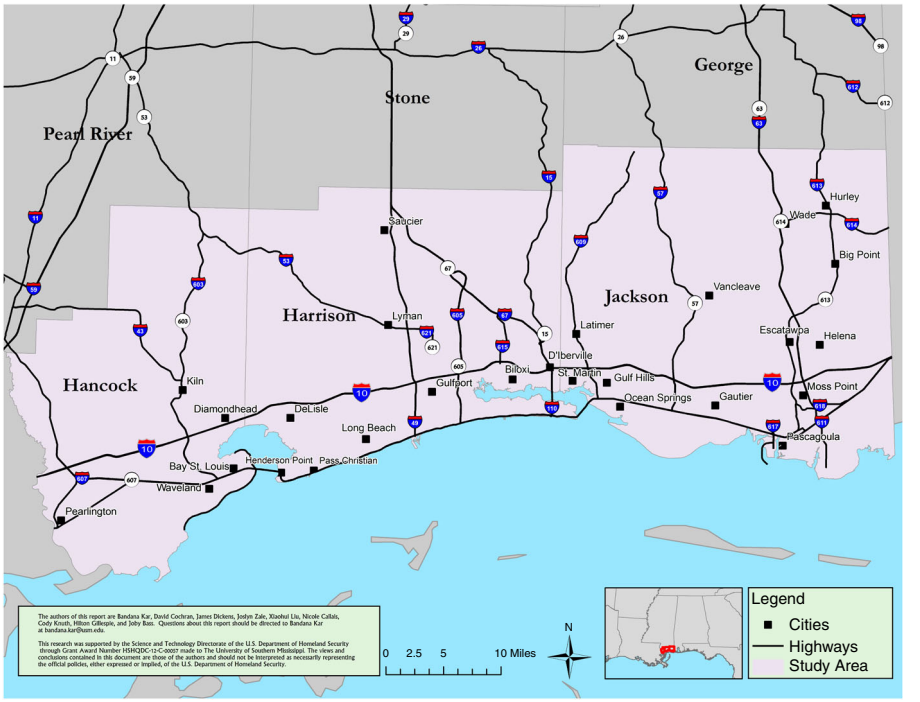

Figure 2.
The targeted sampling area

Note: Area between Interstate (I) -10 and the Gulf of Mexico coastline was the targeted sampling area

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by using ESRI ArcMap 10 software. Third, within each block, houses were chosen using random number tables, generated by the SPSS 18 software program. The heads of households living in the randomly selected houses who agreed to participate in the study were interviewed. In the event that the head of household was unavailable or declined to participate, the interviewers selected the next randomly selected household on that block until the optimal number of households per block was reached. Data collection was done through trained undergraduate and graduate students from the public university located in the southern part of state. The interviewers were trained to complete the guided interviews for consistency and cultural sensitivity. The project was reviewed and approved by the Human Subjects Protection Review Committee of the university with which authors of the present study are affiliated.

Measurements

Exposure to the oil spill through clean-up activity. Participants were asked to respond yes or no to the following three questions to measure exposure to the oil spill through clean-up activity: did you work directly and get paid in the clean-up efforts? Did you have any physical contact with the oil as a volunteer in the clean-up efforts? Did anyone in your household work directly and get paid in the clean-up efforts? Those who had experienced any one of the above were coded as 1 (yes) and all others were coded as 0 (no).

Physical symptoms since the oil spill. To measure physical symptoms, participants were asked to respond yes or no if they or their family members had experienced any of the following physical symptoms since the oil spill: skin rashes; respiratory congestion; stomach aches; scratchy eyes; or loss or gain of appetite. Those who had experienced any one of the symptoms mentioned above were coded as 1 (yes) and all others were coded as 0 (no).

Worry about the negative impact of oil spill on health. Participants were asked to rank on a five-point continuum the extent to which each had worried about negative health consequences for themselves or their family members because of exposure to the oil spill disaster. Responses were coded as 1 (none) to 5 (a lot).

Disruption of the gulf/ocean-related lifestyle. The following eight questions were asked to measure the extent to which the participants believed that their personal or family gulf/ocean-related lifestyles had been disrupted by the oil spill: I spend as much time on the beach as I always have (reversed); I spend as much time on the Gulf (in a boat) as I used to (reversed); my recreational activities are back to "normal" (reversed); I keep my kids/grandkids inside more than I used to; my kids spend as much time swimming in the Gulf as usual (reversed); I still avoid eating seafood from the Mississippi Gulf Coast; I am confident that the Mississippi Gulf seafood is safe (reversed); and the spill changed the eating habits of my family. Responses were coded as 1 (strongly disagree) to 5 (strongly agree). Scores ranged from 8 to 40, with higher scores reflecting a greater sense that their respective lifestyle had been disrupted by the oil spill. The Cronbach's α calculated in this study was 0.77.

Depressive symptoms. The Center for Epidemiologic Studies Depression Scale (CES-D) was used to measure residents' level of depressive symptoms. The 20-item CES-D scale was originally designed to measure depressive symptoms in the general population (Radloff, 1977). The CES-D uses a four-point Likert scale and subjects are asked the frequency with which they experienced depressive symptoms in the past week (i.e. 0 = rarely or none of the time (less than one per day), 1 = some or little of the time (one to two days), 2 = occasionally or a moderate amount of time (three to four days),

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or 3 = most of the time (five to seven days)). Scores range from 0 to 60. The greater the scaled score the more depressive symptoms present (Radloff, 1977). The CES-D has been found to have good internal consistency (Conerly *et al.*, 2002; Lewinsohn *et al.*, 1997). The Cronbach's α calculated for the CES-D in this study was 0.90.

Other variables. Various socioeconomic variables were asked (e.g. gender, age, and race/ethnicity). Dichotomous variables that focussed on financial and mental health conditions before the oil spill were also included: whether their financial situation after Katrina (over the last five years) was as stable as it had been before Katrina; whether they had emotional issues that required medical care before the oil spill.

Statistical analysis

Data analyses were carried out as follows. First, normality and outliers for the study variables was checked. The value of the skewness and kurtosis ±1.96 was used to indicate a reasonably normal distribution (Hair *et al.*, 1998). Additionally, outliers were identified through *Z*-score, with the cut off value of 3.29 (Tabachnick and Fidell, 2001). Second, pre-disaster emotional problems and selected socioeconomic variables were examined to determine whether they should be included in the path model as control variables. Third, the proposed path model was tested with the maximum likelihood method using AMOS version 21 (Arbuckle, 2012). To assess model fit, several indices were used: the χ^2 test (χ^2), the comparative fit index (CFI), the Tucker-Lewis Index (TLI), the normed fit index (NFI), and the Root Mean Squared Error of Approximation (RMSEA) with a 90 percent confidence interval (CI). Non-significant χ^2, the CFI, TLI, and NFI of no less than 0.95, and the RMSEA of no more than 0.06 typically indicate a good fit (Hu and Bentler, 1999).

Results

Sample characteristics

The analysis included the final sample of 354 respondents. In all, 54 percent of the respondents were females, while 46 percent of the participants were males. The respondents ranged in age from 18 to 93, with an average age of 48. The preponderance of respondents were either non-Hispanic white (66 percent) or non-Hispanic black (29 percent). In total, 43 percent of the respondents had received no more than a high school diploma, 29 percent had some college or an associate's degree, and 28 percent had a bachelor's degree or higher. Table I summarizes the sample characteristics.

Preliminary analyses

As a result of the analysis of normality and outliers, a total of four cases were removed, which resulted in the final sample of 354. Then, pair-wise relationships were checked by the Pearson correlation. Pre-disaster emotional problems and socioeconomic variables (i.e. age, gender, racial/ethnic minority, and financial stability over the past five years) were examined to determine whether they should be included in the path model as control variables. Respondents' race/ethnicity was significantly associated with respondents' worry about the impact of the oil spill on health ($r = 0.22$, $p < 0.001$), the disruption of the gulf/ocean-related lifestyle ($r = 0.35$, $p < 0.001$), and depressive symptoms ($r = 0.28$, $p < 0.001$). Financial stability over the past five years was associated with physical symptoms since the oil spill ($r = -0.15$, $p = 0.006$), worry about the impact of the oil spill on health ($r = -0.21$, $p < 0.001$), the disruption of the gulf/ocean-related lifestyle ($r = -0.15$, $p = 0.008$), and depressive

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Variables	*n*	%	Mean (SD)
Gender			
Male	159	45.7	
Female	189	54.3	
Age			48.3 (16.5)
Race/ethnicity			
Black, non-Hispanic	99	28.5	
Hispanic	7	2.0	
White, non-Hispanic	228	65.5	
Asian/Pacific Islander, non-Hispanic	9	2.6	
Other	5	1.4	
Education			
< 9 grade	12	3.5	
9-12 grade no diploma	37	10.6	
High school graduate or alternate route	101	29.0	
Some college/ some Jr college	66	19.0	
Associates degree (2 yr)	36	10.3	
Bachelor's degree (4 yr)	55	15.8	
Graduate or professional degree	41	11.8	
Financial stability over the past 5 years			
Yes	169	49.1	
No	175	50.9	
Pre-disaster emotional problems			
Yes	31	8.9	
No	318	91.1	
Exposure to the oil spill through clean-up activity			
Yes	44	12.5	
No	309	87.5	
Physical symptoms since the oil spill			
Yes	76	22.2	
No	266	77.8	

Table I. Sample characteristics

symptoms ($r = -0.20$, $p < 0.001$). The pre-disaster emotional problems was found to be significantly associated with respondent's physical symptoms since the oil spill ($r = 0.22$, $p < 0.001$) and depressive symptoms ($r = 0.23$, $p < 0.001$). Based on results from bivariate analysis along with previous studies, these variables were included in the subsequent analysis as control variables. Age was not included in the subsequent analysis because it was only significantly related to exposure to the oil spill, and the relationship was weak (Table II).

Testing the proposed path model

The proposed path model was tested with the maximum likelihood method in AMOS version 21. Fit indices reflected a good fit between the model and the sample data: $\chi^2(9,\ n = 354) = 9.85,\ p = 0.363,\ \text{NFI} = 0.97,\ \text{TLI} = 0.99,\ \text{CFI} = 1.00,\ \text{RMSEA} = 0.02$ (CI: 0.00–0.06), PCLOSE = 0.85. The individual paths in the model were examined with respect to the hypotheses. As illustrated in Figure 3, after taking control variables into account, there were significant direct relationships between depressive

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Table II.
Bivariate correlations among the study variables

	1	2	3	4	5	6	7	8	9	10
1. Age	_									
2. Gender	−0.01	_								
3. Racial/ethnic minority	−0.22***	−0.02	_							
4. Financial stability over past 5 years	0.04	−0.02	−0.10	_						
5. Pre-disaster emotional problems	0.18**	0.00	0.12*	−0.01	_					
6. Exposure to the oil spill through clean-up activity	−0.14**	−0.05	0.07	−0.08	0.01	_				
7. Physical symptoms since the oil spill	0.07	0.07	0.09	−0.15**	0.22***	0.04	_			
8. Worry about the impact of the oil spill on heath	0.07	0.05	0.22***	−0.21***	0.10	0.04	0.27***	_		
9. The disruption of the gulf/ocean-related lifestyle	−0.07	0.07	0.35***	−0.15**	0.08	0.02	0.32***	0.48***	_	
10. Depressive symptoms	0.05	−0.02	0.28***	−0.20***	0.23***	0.06	0.41***	0.38***	0.44***	_

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

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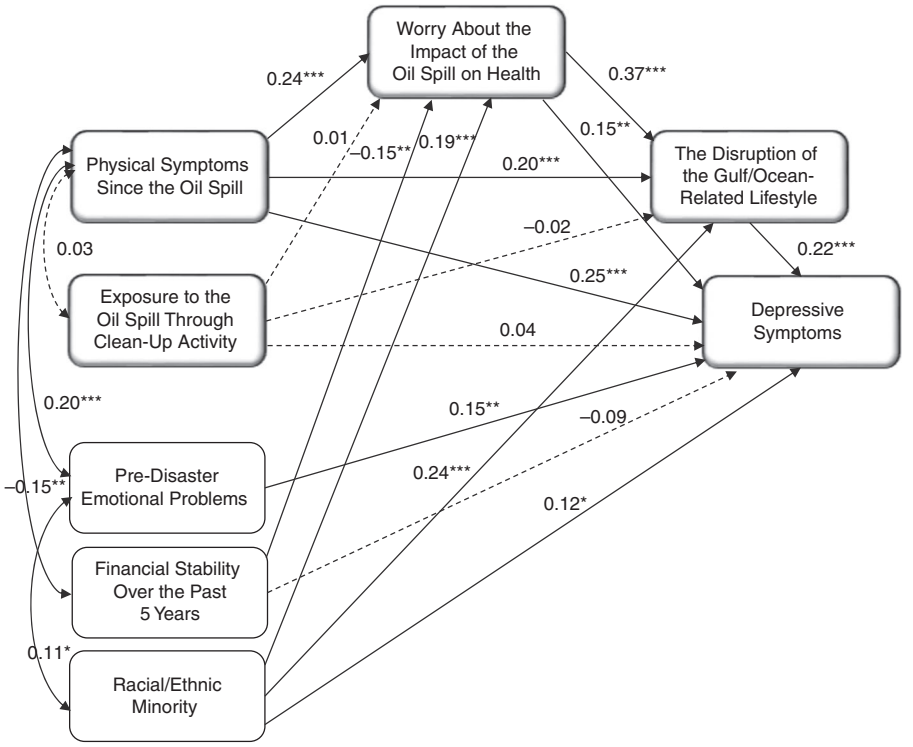

Figure 3.
Parameter estimates for the model of factors associated with depressive symptoms

Notes: $\chi^2(9, n=354)=9.85$, $p=0.363$, NFI = 0.97, TLI = 0.99, CFI = 1.00, RMSEA = 0.02 (CI: 0.00-0.06), PCLOSE = 0.85. Non-significant path are illustrated by dotted line. Standardized coefficients are presented. Pre-disaster emotional problems, financial stability over the past five years, and racial/ethnic minority are control variables. $^*p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$

symptoms and physical symptoms since the oil spill ($\beta = 0.25$, $p < 0.001$), worry about the impact of the oil spill on health ($\beta = 0.15$, $p = 0.005$), and the disruption of the gulf/ocean-related lifestyle ($\beta = 0.22$, $p < 0.001$). Physical symptoms were also related to depressive symptoms indirectly through the mediating variables. Specifically, physical symptoms were significantly related to worry about the impact of the oil spill on health ($\beta = 0.24$, $p < 0.001$), which in turn was significantly related to depressive symptoms ($\beta = 0.15$, $p = 0.005$). Additionally, physical symptoms were significantly related to the disruption of the gulf/ocean-related lifestyle ($\beta = 0.20$, $p < 0.001$), which in turn was significantly related to depressive symptoms ($\beta = 0.22$, $p < 0.001$). In addition to the direct relationship, worry about the impact on health was related to depressive symptoms indirectly through the disruption of the gulf/ocean-related lifestyle. Specifically, worry about the impact of the oil spill on health was significantly related to the disruption of the gulf/ocean-related lifestyle ($\beta = 0.37$, $p < 0.001$), which in turn was significantly related to depressive symptoms ($\beta = 0.22$, $p < 0.001$). Unexpectedly, there was neither a direct nor indirect relationship between exposure to the oil spill through clean-up activity and depressive symptoms.

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Discussion

This study tested a proposed model for depressive symptoms using a randomly selected sample of 354 Mississippi Gulf Coast residents living in the area that was directly affected by the Deepwater Horizon oil spill. The findings of the present study confirm the results of previous studies, since they continue to suggest that uncertainty and worry about long-term outcomes is the likely mechanism through which the immediate consequences of the disaster most strongly affect psychological distress (Gill *et al.*, 2012; Palinkas, 2012). In the present study, worry about the impact of the oil spill on health played a mediating role between physical symptoms and depressive symptoms. This meant that experiencing acute physical symptoms might cause greater concerns regarding the negative impact of the oil spill on their health and the health of their family and in turn this led to increased depressive symptoms. Furthermore, the greater the physical symptoms and the associated worry and concerns about their health status, the greater were the disruptions of lifestyle that were intertwined with the gulf/ocean. This process resulted in an increase in depressive symptoms. These findings are consistent with previous studies with samples of Gulf Coast residents in Alabama and Louisiana. For example, Gill *et al.* (2012) found a significant relationship between concern about the impact of the Deepwater Horizon oil spill on family health and psychological distress. Osofsky *et al.* (2011) found that although concerns related to the Deepwater Horizon oil spill were not significantly related to psychological distress, they were significantly related to the disruption of life. In addition, the disruption of life was significantly related to psychological distress.

Unexpectedly, the exposure to the oil spill through clean-up activity was neither related to physical symptoms, worry about the impact of the oil spill, the disruption of the gulf/ocean-related lifestyle, nor to depressive symptoms. One possible reason for this finding may be related to the questions used in this study. Although participants were asked whether they or anyone in their household had taken part in the oil spill clean-up activity, they were not specifically asked about the duration or severity of the exposure. This study did not confirm whether the exposure occurred through protective equipment (e.g. masks, boots, and gloves). Goldstein *et al.* (2011) indicated that "the degree to which workers are exposed to contaminants depends not only on job assignment and duration of exposure but also on the extent of worker training and the use of personal protective equipment" (p. 1336). Fan *et al.*'s (2014) study using a sample of residents of four Gulf Coast states found that exposure to the DHW oil spill through clean-up activity was not associated with psychological distress, while direct contact with the oil spill was a significant predictor for psychological distress. Suárez *et al.* (2005) in their study of the Prestige oil spill in Cantabria in Spain reported that seamen experienced higher levels of physical symptoms compared to clean-up workers and volunteers. The study authors indicated that such a difference in physical symptoms between groups was linked to the amount of education and training about health and hygiene given to workers who were paid, or were volunteers.

The direct and indirect relationship between worry about the impact of the oil spill on health and depressive symptoms required us to focus on two different aspects of exposure to the technological disaster: physical exposure and psychological exposure. Gallacher *et al.* (2007) found that psychological exposure was a more critical factor than physical exposure in relation to psychological distress. Their study reported that physical exposure (i.e. living in an oil spill affected community) was not significantly related to depression, while perceived long-term health impacts were significantly related to depression. The psychological effects of a technological disaster, an oil spill

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in this case, could be better understood if future research focusses on how victims perceive the disaster (i.e. development of physical symptoms, perceived health risk, and perceived lifestyle changes), rather than simply focussing on exposure and proximity to the disaster.

Limitations and future studies

Despite the significance of these findings, there are several limitations that should be considered when interpreting results. First, this study utilized a cross-sectional sampling approach. As a result, causality cannot be established. Although we interpreted the association between risk factors and depression in causal terms, it is possible that the relationship in fact operates in the both or reverse direction. For example, the path model suggests that worry about the impact of the oil spill on health precedes depressive symptoms, but it is possible that the relationship occurs in the reverse direction. In other words, depression could increase concern regarding the negative impact of the oil spill. A longitudinal study might clarify the causal process. Second, exposure to the oil spill through clean-up activity was measured without quantifying the amount of exposure or type of exposure (direct or indirect through protective equipment). In future research, the following questions should be incorporated into the measurement: perceived impact of duration, the severity and duration of the exposure, type of exposure, and the type of training individuals received before and after clean-up activities.

Another set of limitations of this study are related to the use of self-report assessment of both physical and psychological symptoms. Specifically, there could be the possibility of shared variance between physical symptoms – somatic symptoms, in particular – and depressive symptoms (Simms *et al.*, 2012). Future research needs to examine the relationship between physical symptoms and depressive symptoms considering the underlying factors of depressive symptoms (i.e. somatic factor vs non-somatic factors, such as affective and interpersonal problems). Muris *et al.* (2005) stated that worry can be accounted for by the personality trait of neuroticism. Future research may include neuroticism to better understand the relationship between exposure to stressor, worry, and depressive symptoms. Pre-existing emotional problems were measured by a self-reported single question (i.e. whether you had emotional issues that required medical care before the oil spill), and 9 percent said yes. This percentage was much lower compared to the study of the prevalence of mental disorders using the DSM-IV criteria (Kessler *et al.*, 2005). Future research needs to use a standardized scale to better assess emotional problems.

The present study focussed mainly on risk factors associated with depressive symptom. Future research needs to include protective factors, including community resilience (e.g. social and economic equity, partnership, efficiency, access to medical care, social networks, and group cohesion; Abramson *et al.*, 2015; Kaminsky *et al.*, 2007; Plough *et al.*, 2013; Sherrieb *et al.*, 2010) as well as individual resilience (e.g. self-efficacy, internal locus of control, coping, and perceived social support; Abramson *et al.*, 2015; Hrostowski and Rehner, 2012) and examine how these factors would affect the long-term physical and psychological health.

Implications for practice

Individuals and families living in disaster-prone communities like Gulf Coast area face significant challenges to adapt and start over while still recovering from previous

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disasters, to be resilient, to learn from previous disasters, and to manage their new realities of life, knowing that other disasters will likely face them again in the future. Adequate resources and information regarding disaster response and recovery should be provided in a timely manner in order not only to reduce physical impact, but also prevent psychological distress that might result from uncertainty and concerns. Since the effects of a disaster are far-reaching including individuals, families, and communities, disaster preparedness plans and response/recovery management need to be based on an integrated approach. In other words, services and education directly targeted toward individuals would be inadequate unless other factors (i.e. family and the community) are taken into account. Strategies that increase information sharing among community members and services targeted toward families as well as individuals should be considered. Another important point of the present study is the recognition that perceived impact of a disaster has a significant impact on mental health. This would be especially true for persons of color and those financially who were worse off after a previous disaster. The stacked negative impact of multiple disasters increases the risk of depressive symptoms.

References

Abramson, D.M., Grattan, L.M., Mayer, B., Colten, C.E., Arosemena, F.A., Bedimo-Rung, A. and Lichtveld, M. (2015), "The resilience activation framework: a conceptual model of how access to social resources promotes adaptation and rapid recovery in post-disaster settings", *Journal of Behavioral Health Services & Research*, Vol. 42 No. 1, pp. 42-57.

Adeola, F.O. and Picou, J.S. (2014), "Social capital and the mental health impacts of Hurricane Katrina: assessing long-term patterns of psychosocial distress", *International Journal of Mass Emergencies and Disasters*, Vol. 32 No. 1, pp. 121-156.

Arbuckle, J.L. (2012), *Amos 21.0 [Computer software]*, SPSS, Chicago, IL.

Boscarino, J.A. and Adams, R.E. (2009), "PTSD onset and course following the world trade center disaster: findings and implications for future research", *Social Psychiatry and Psychiatric Epidemiology*, Vol. 44 No. 10, pp. 887-898.

Chang, P., Wray, L. and Lin, Y. (2014), "Social relationships, leisure activity, and health in older adults", *Health Psychology*, Vol. 33 No. 6, pp. 516-523.

Cherry, K.E., Lyon, B.A., Marks, L.D., Nezat, P.F., Adamek, R., Walsh, S.D., Fitzgerald, K.B., Anbinder, D.R. and Bernacchio, C.V. (2015), "After the BP Deepwater Horizon oil spill: financial and health concerns among coastal residents and commercial fishers", *Current Psychology*, Vol. 34 No. 3, pp. 576-586.

Cleveland, C. (2013), "Deepwater Horizon oil spill", *The Encyclopedia of Earth,* available at: www.eoearth.org/view/article/161185 (accessed March 10, 2014).

Conerly, R.C., Baker, F., Dye, J., Douglas, C.Y. and Zabora, J. (2002), "Measuring depression in African American cancer survivors: the reliability and validity of the Center for Epidemiologic Study-Depression (CES-D) scale", *Journal of Health Psychology*, Vol. 7 No. 1, pp. 107-114.

D'Andrea, M.A. and Reddy, G.K. (2013), "Health consequences among subjects involved in Gulf oil spill clean-up activities", *The American Journal of Medicine*, Vol. 126 No. 11, pp. 966-974.

De Soir, E., Zech, E., Versporten, A., Oyen, H.V., Kleber, R., Mylle, J. and van der Hart, O. (2015), "Degree of exposure and peritraumatic dissociation as determinants of PTSD symptoms in the aftermath of the Ghislenghien gas explosion", *Archives of Public Health*, Vol. 73 No. 1, pp. 21-29.

Downloaded by TASHKENT UNIVERSITY OF INFORMATION TECHNOLOGIES At 22:49 15 November 2016 (PT)

Drescher, C.F., Schulenberg, S.E. and Smith, C.V. (2014), "The Deepwater Horizon oil spill and the Mississippi Gulf Coast: mental health in the context of a technological disaster", *American Journal of Orthopsychiatry*, Vol. 84 No. 2, pp. 142-151.

Elliott, J.R. and Pais, J. (2006), "Race, class and Hurricane Katrina: social differences in human responses to disaster", *Social Science Research*, Vol. 35 No. 2, pp. 295-321.

Eykelbosh, A. (2014), "Short- and long-term health impacts of marine and terrestrial oil spills", available at: www.vch.ca/media/VCH-health-impacts-oil-spill.pdf (accessed January 15, 2015).

Fan, A.Z., Prescott, M.R., Zhao, G., Gotway, C.A. and Galea, S. (2014), "Individual and community-level determinants of mental and physical health after the Deepwater Horizon oil spill: findings from the Gulf States population survey", *Journal of Behavioral Health Services & Research*, Vol. 42 No. 1, pp. 23-41.

Galea, S., Nandi, A. and Vlahov, D. (2005), "The epidemiology of post-traumatic stress disorder after disasters", *Epidemiologic Reviews*, Vol. 27 No. 1, pp. 78-91.

Galea, S., Brewin, C.R., Gruber, M., Jones, R.T., King, D.W., King, L.A., McNally, R.J., Ursano, R.J., Petukhova, M. and Kessler, R.C. (2007), "Exposure to hurricane-related stressors and mental illness after Hurricane Katrina", *Archives of General Psychiatry*, Vol. 64 No. 12, pp. 1427-1434.

Gallacher, J., Bronstering, K., Palmer, S., Fone, D. and Lyons, R. (2007), "Symptomatology attributable to psychological exposure to a chemical incident: a natural experiment", *Journal of Epidemiology and Community Health*, Vol. 61 No. 6, pp. 506-512.

Gill, D.A., Picou, J.S. and Ritchie, L.A. (2012), "The Exxon Valdez and BP oil spills: a comparison of initial social and psychological impacts", *American Behavioral Scientist*, Vol. 56 No. 1, pp. 3-23.

Goldstein, B.D., Osofsky, H.J. and Lichtveld, M.Y. (2011), "Current concepts: the Gulf oil spill", *The New England Journal of Medicine*, Vol. 364 No. 14, pp. 1334-1348.

Groen, J.A. and Polivka, A.E. (2008), "Hurricane Katrina evacuees: who they are, where they are, and how they are faring", *Monthly Labor Review*, Vol. 131 No. 3, pp. 32-51.

Hagerty, C.L. and Ramseur, J.L. (2010), "Deepwater Horizon oil spill: selected issues for Congress", CRS Report for Congress No. R41262, Congressional Research Service, available at: www.fas.org/sgp/crs/misc/R41262.pdf (accessed March 10, 2015).

Hair, J.F., Anderson, R.E., Tatham, R.L. and Black, W.C. (1998), *Multivariate Data Analysis*, 5th ed., Prentice Hall, Upper Saddle River, NJ.

Hrostowski, S. and Rehner, T. (2012), "Five years later: resiliency among older adult survivors of Hurricane Katrina", *Journal of Gerontological Social Work*, Vol. 55 No. 4, pp. 337-351.

Hu, L. and Bentler, P.M. (1999), "Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives", *Structural Equation Modeling*, Vol. 6 No. 1, pp. 1-55.

Kaminsky, M., McCabe, O.L., Langlieb, A.M. and Everly, G.S. (2007), "An evidence-informed model of human resistance, resilience, and recovery: the Johns Hopkins' outcome-driven paradigm for disaster mental health services", *Brief Treatment and Crisis Intervention*, Vol. 7 No. 1, pp. 1-11.

Kessler, R.C., Demler, O., Frank, R.G., Olfson, M., Pincus, H.A., Walters, E.E., Wang, P., Wells, K.B. and Zaslavsky, A.M. (2005), "Prevalence and treatment of mental disorders, 1990 to 2003", *The New England Journal of Medicine*, Vol. 352 No. 24, pp. 2515-2523.

Knight, B.G., Gatz, M., Heller, K. and Bengtson, V.L. (2000), "Age and emotional response to the Northridge earthquake: a longitudinal analysis", *Psychology and Aging*, Vol. 15 No. 4, pp. 627-634.

Lee, C., Yeh, C., Lee, M., Lin, H., Chen, V.C., Hsieh, M., Yen, C. and Lai, T. (2012), "Leisure activity, mobility limitation and stress as modifiable risk factors for depressive symptoms in the elderly: results of a national longitudinal study", *Archives of Gerontology and Geriatrics*, Vol. 54 No. 2, pp. e221-e229.

Downloaded by TASHKENT UNIVERSITY OF INFORMATION TECHNOLOGIES At 22:49 15 November 2016 (PT)

Lewinsohn, P.M., Seeley, J.R., Roberts, R.E. and Allen, N.B. (1997), "Center for Epidemiologic Studies Depression scale (CES-D) as a screening instrument for depression among community-residing older adults", *Psychology and Aging*, Vol. 12 No. 2, pp. 277-287.

Lyons, R.A., Temple, J.M.F., Evans, D., Fone, D.L. and Palmer, S.R. (1999), "Acute health effects of the Sea Empress oil spill", *Journal of Epidemiology and Community Health*, Vol. 53 No. 3, pp. 306-310.

McNutt, M., Camilli, R., Guthrie, G., Hsieh, P., Labson, V., Lehr, B., Maclay, D., Ratzel, A. and Sogge, M. (2011), "Assessment of flow rate estimates for the Deepwater Horizon/Macondo Well oil spill", Flow Rate Technical Group report to the National Incident Command, Interagency Solutions Group, available at: www.doi.gov/deepwaterhorizon/loader.cfm?csModule = security/getfile&PageID = 237763 (accessed April 10, 2014).

Mahaffey, K.R., Clickner, R.P. and Jeffries, R.A. (2009), "Adult women's blood mercury concentrations vary regionally in the United States: association with patterns of fish consumption (NHANES 1999-2004)", *Environmental Health Perspectives*, Vol. 117 No. 1, pp. 47-53.

Morris, J.G., Grattan, L.M., Mayer, B.M. and Blackburn, J.K. (2013), "Psychological responses and resilience of people and communities impacted by the Deepwater Horizon oil spill", *Transactions of the American Clinical and Climatological Association*, Vol. 124, pp. 191-201.

Muris, P., Roelofs, J., Rassin, E., Franken, I. and Mayer, B. (2005), "Mediating effects of rumination and worry on the links between neuroticism, anxiety, and depression", *Personality and Individual Differences*, Vol. 39 No. 6, pp. 1105-1111.

Osofsky, H.J., Osofsky, J.D. and Hansel, T.C. (2011), "Deepwater Horizon oil spill: mental health effects on residents in heavily affected areas", *Disaster Medicine and Public Health Preparedness*, Vol. 5 No. 4, pp. 280-286.

Palinkas, L.A. (2012), "A conceptual framework for understanding the mental health impacts of oil spills: lessons from the Exxon Valdez oil spill", *Psychiatry*, Vol. 75 No. 3, pp. 203-222.

Paxson, C., Fussell, E., Rhodes, J. and Waters, M. (2012), "Five years later: recovery from post traumatic stress and psychological distress among low-income mothers affected by Hurricane Katrina", *Social Science & Medicine*, Vol. 74 No. 2, pp. 150-157.

Person, C., Tracy, M. and Galea, S. (2006), "Risk factors for depression after a disaster", *The Journal of Nervous and Mental Disease*, Vol. 194 No. 9, pp. 659-666.

Picou, J.S. and Hudson, K. (2010), "Hurricane Katrina and mental health: a research note on Mississippi Gulf Coast residents", *Sociological Inquiry*, Vol. 80 No. 3, pp. 513-524.

Plough, A., Fielding, J.E., Chandra, A., Williams, M., Eisenman, D., Wells, K.B., Law, G.Y., Fogleman, S. and Magaña, A. (2013), "Building community disaster resilience: perspectives from a large urban county department of public health", *American Journal of Public Health*, Vol. 103 No. 7, pp. 1190-1197.

Radloff, L.S. (1977), "The CES-D scale: a self-report depression scale for research in the general population", *Applied Psychological Measurement*, Vol. 1 No. 3, pp. 385-401.

Rehner, T.A., Kolbo, J.R., Trump, R., Smith, C. and Reid, D. (2000), "Depression among victims of South Mississippi's Methyl Parathion disaster", *Health and Social Work*, Vol. 25 No. 1, pp. 33-40.

Rhodes, J., Chan, C., Paxson, C., Rouse, C.E., Waters, M. and Fussell, E. (2010), "The impact of Hurricane Katrina on the mental and physical health of low-income parents in New Orleans", *American Journal of Orthopsychiatry*, Vol. 80 No. 2, pp. 233-243.

Rodríguez-Trigo, G., Zock, J.P. and Montes, I.I. (2007), "Health effects of exposure to oil spills", *Archivos de Bronconeumologia*, Vol. 43 No. 11, pp. 628-635.

Sherrieb, K., Norris, F.H. and Galea, S. (2010), "Measuring capacities for community resilience", *Social Indicators Research*, Vol. 99 No. 2, pp. 227-247.

Simms, L.J., Prisciandaro, J.J., Krueger, R.F. and Goldberg, D.P. (2012), "The structure of depression, anxiety and somatic symptoms in primary care", *Psychological Medicine*, Vol. 42 No. 1, pp. 15-28.

Suárez, B., Lope, V., Pérez-Gómez, B., Aragonés, N., Rodríguez-Artalejo, F., Marqués, F., Guzmán, A., Viloria, L.J., Carrasco, J.M., Martín-Moreno, J.M., López-Abente, G. and Pollán, M. (2005), "Acute health problems among subjects involved in the cleanup operation following the Prestige oil spill in Asturias and Cantabria (Spain)", *Environmental Research*, Vol. 99 No. 3, pp. 413-424.

Sullivan, G., Vasterling, J.J., Han, X., Tharp, A.T., Davis, T., Deitch, E.A. and Constans, J.I. (2013), "Preexisting mental illness and risk for developing a new disorder after Hurricane Katrina", *Journal of Nervous and Mental Disease*, Vol. 201 No. 2, pp. 161-166.

Tabachnick, B.G. and Fidell, L.S. (2001), *Using Multivariate Statistics*, 4th ed., Allyn and Bacon, Boston, MA.

Yang, X., Hirvensalo, M., Hintsanen, M., Hintsa, T., Pulkki-Råback, L., Jokela, M., Telama, R., Tammelin, T., Hutri-Kähönen, N., Viikari, J.S.A. and Raitakari, O.T. (2014), "Longitudinal associations between changes in physical activity and depressive symptoms in adulthood: the young Finns study", *International Journal of Behavioral Medicine*, Vol. 21 No. 6, pp. 908-917.

Yzermans, C.J., van den Berg, B. and Dirkzwager, A.J.E. (2009), "Physical health problems after disasters", in Neria, Y., Galea, S. and Norris, F.H. (Eds), *Mental Health and Disasters*, Cambridge University, New York, NY, pp. 67-93.

Zock, J., Rodríguez-Trigo, G., Rodríguez-Rodríguez, E., Espinosa, A., Pozo-Rodríguez, F., Gómez, F., Fuster, C., Castaño-Vinyals, G., Antó, J.M. and Barberà, J.A. (2012), "Persistent respiratory symptoms in clean-up workers 5 years after the Prestige oil spill", *Occupational and Environmental Medicine*, Vol. 69 No. 7, pp. 508-513.

Further reading

Hansel, T.C., Osofsky, H.J., Osofsky, J.D. and Speier, A. (2015), "Longer-term mental and behavioral health effects of the Deepwater Horizon Gulf oil spill", *Journal of Marine Science and Engineering*, Vol. 3 No. 4, pp. 1260-1271.

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