

ORIGINAL RESEARCH

Deepwater Horizon Oil Spill: Mental Health Effects on Residents in Heavily Affected Areas

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ABSTRACT

Background: Mental health issues are a significant concern after disasters such as the Deepwater Horizon oil spill in the Gulf of Mexico in 2010. This study was designed to assess the mental health effects on residents of areas of southeastern Louisiana affected by the oil spill.

Methods: Telephone and face-to-face interviews were conducted with residents (N=452) assessing concerns and direct impact.

Results: The results show that the greatest effect on mental health related to the extent of disruption to participants' lives, work, family, and social engagement, with increased symptoms of anxiety, depression, and post-traumatic stress. Given the location of the oil spill affecting communities that had been devastated by Hurricane Katrina, results also revealed that losses from Hurricane Katrina were highly associated with negative mental health outcomes. Conversely, the ability to rebound after adversity and place satisfaction were highly associated with better mental health outcomes.

Conclusions: Enhanced understanding of mental health effects after the Deepwater Horizon oil spill will help in determining directions for much-needed mental health services after the disaster and in contributing to the knowledge of complex traumatization and the ability to rebound after adversity.

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Key Words: disaster, mental health, oil spill

To understand the effects of the Deepwater Horizon (DWH) oil spill in the Gulf of Mexico in 2010, it is critical that the historical context surrounding individuals and families in southeastern Louisiana be described.¹ On August 29, 2005, Hurricane Katrina struck Louisiana and Mississippi and breached the levees there, causing extensive damage. In some areas, everything was lost, including homes, businesses, schools, hospitals, and communities, and all of the residents had to evacuate. Families that lost everything were displaced for months, some even for years. Children were forced to attend multiple schools to continue their education. Parents often had to live apart for employment and income to survive and support their families. From a mental health perspective, the increased symptoms of anxiety, depression, posttraumatic stress, and mental illness were substantial and ongoing for adults, children, and families.²⁻⁶ Although considerable resilience was noted, mental health symptoms persisted at elevated levels after Hurricane Katrina. Less than 5 years later, after often heroic efforts in rebuilding and partial recovery, some of the areas that were hit hardest by Hurricane Katrina also were hit hard by the DWH oil spill.

The DWH oil spill, caused by an offshore oil platform explosion approximately 50 mi southeast of the mouth of the Mississippi River, occurred on April 20, 2010. DWH spewed an estimated 5 million barrels of oil for 3 consecutive months and is the largest marine oil spill

in history.⁷ The repeated traumatic experiences resulting from previous disasters and adversities increased the vulnerability of the population affected by the DWH oil spill.¹ During the first 3 months after the initial explosion, the Department of Psychiatry of the Louisiana State University Health Sciences Center implemented interviews with and focus groups of residents living in the most heavily affected areas to better understand what types of resources, interventions, and services would be most helpful in supporting individuals and families.¹ The interviews and focus groups were conducted with fishermen and their families, oil industry workers, hospitality service workers, and other community stakeholders. Individuals interviewed in Louisiana in the early months after the oil spill reported symptoms including suspiciousness and mistrust, the beginning of dissension in communities, uncertainty about the future, anger, anxiety, symptoms of generalized anxiety, and acute stress reactions with early symptoms of post-traumatic stress disorder. Informal focus groups also revealed increased alcohol, drug, and cigarette use; fighting and domestic violence; higher levels of impatience; and, at times, harsh behaviors toward children. Many respondents reported worrying that those symptoms may increase over time, especially when the cleanup ended and those jobs left, if tourism did not return, and if oil industry jobs were lost as a result of the moratorium. At the same time, many in the focus groups described strengths and the desire to support programs that helped

build individual, family, and community resilience. Families and individuals were faced with uncertainties about the time frame for recovery of industries that defined both identities and livelihoods. As one person stated, “With Katrina, we knew what to do. We needed to rebuild. With the oil spill, we don’t know how long the recovery will take or if we will be able to recover.” Similar concerns, such as the impending end of recovery payments and uncertainties about future livelihood and culture, were expressed.⁷

In framing the knowledge resulting from surveillance of the affected individuals, it also is important to review the effects of previous oil spills.⁸ In a community survey carried out 1 year after the Exxon Valdez oil spill in 1989, Palinkas et al⁹ found a significant increase in rates of anxiety disorder, posttraumatic stress disorder, and depression in residents with a high level of exposure to the spill and subsequent cleanup efforts. They also found a relation between exposure to the spill and increased alcohol and substance use, domestic violence, chronic physical conditions, and a decline in social relationships. Individuals who were the most vulnerable had significant exposure and were dependent on fishing and oil industry work for subsistence.¹⁰ Even 8 years after the spill, Picou and Arata¹¹ found elevated levels of depression, intrusive stress, avoidance, and family conflict. In these more vulnerable groups, declines in children’s school performance were evident.¹² In an earlier study of the Sea Empress oil spill off the coast of Wales,¹³ the social and economic consequences resulting from the spill were increased concerns about health, financial issues, and perceived environmental risk; all of these factors led to increases in mental health symptoms.¹⁴ The same results were reported after the 2002 Prestige oil spill off the coast of Galicia, Spain.^{15,16}

Addressing the issue of uncertainty of recovery, previous studies indicate that the impact of oil spills persists for extended periods of time.^{12,17} Lessons learned from the Exxon Valdez spill indicate that individual and community effects lasted for decades, with at least part of the fishing industry unable to recover completely. In addition, destruction of the ecosystem occurs with oil spills, which affects individuals and communities that are dependent on natural resources for their social and economic livelihoods.⁷ Disruption of the usual networks of support that communities depend on to cope with adversities and traumatic events also occurs with an oil spill. With loss of jobs and livelihood, families may have few choices; they either are forced to move or live apart.^{10,12}

Although many studies of the state of behavioral health after oil spills suggest a longer-term negative impact, a few studies after the Prestige oil spill indicate a smaller effect on mental health issues, especially for individuals with high levels of social support and satisfaction with recovery aid.^{15,19} Given the uniqueness of the DWH oil spill, especially its size and occurrence within 5 years of the worst natural disaster in US history, it is difficult to presume the impact on affected areas. The National Center for Disaster Preparedness’s²⁰ preliminary study

found that the primary social and economic consequences resulting from the spill were increases in concerns about health, financial issues, and perceived environmental risk; all of these factors caused increases in negative mental health symptoms, with almost 20% of parents reporting either mental health symptoms or a combination of mental health and physical symptoms in their children. Other preliminary studies suggest increases in depression and decreased levels of emotional health.²¹ In attempts to provide support and mitigate some of the negative effects found in the majority of previous studies, it is imperative to learn more about exposure to and the impact of the oil spill in all of the different areas of people’s lives. The present study is an attempt to explore this phenomenon using a cross-sectional analysis of residents in southeastern Louisiana. Specifically, we hypothesized that individuals with occupations directly affected by the oil spill, those reporting more concerns about the oil spill, those living in closer proximity to the coastline, and those who incurred more disruption because of the oil spill would experience more symptoms related to mental illness and posttraumatic stress. In addition, we expected that Hurricane Katrina–related losses, ability to rebound after adversity, and place satisfaction would influence the relations among these variables.

METHODS

In August 2010, the Louisiana Department of Children and Family Services funded the Louisiana State University Health Sciences Center to implement a mental health needs assessment of the most affected parishes (counties) in the state. The mental health needs assessment, developed with consultation from stakeholders, local leaders, and state and national consultants, was implemented in 4 parishes—Lafourche, Plaquemines, Terrebonne, and St Bernard—with selection based on their proximity to the oil spill release site and length (in miles) of total coastline.^{22,23} Research protocol was approved by the Louisiana State University Health Sciences Center institutional review board.

Sample

Our study used both random and purposive sampling techniques. Random sample telephone surveys were conducted using publicly available telephone directories, and face-to-face interviews were conducted using purposive sampling to allow for more detailed sampling of individuals in the fishing, tourism, and oil/drilling-related industries. Face-to-face interviews were conducted at various events throughout the 4 parishes. In-person interviews were considerably longer and participants were mailed a \$20 check after participation. Purposive sampling techniques also were used as a multimode sampling strategy to address a presumed low telephone response rate.^{24,25}

Surveys were conducted from August 18, 2010, to December 17, 2010. For telephone surveys, 1243 individuals were recruited and 306 voluntarily consented to participate, constituting a 25% response rate. Participants were included in the study if they reported a valid parish or zip code, resulting in the omission of 19

cases. An additional 81 cases were omitted because their zip codes fell outside the 4 targeted parishes. A total of 452 participants were included in the analyses. Two hundred six (45.6%) participants responded by telephone and 248 (54.4%) responded in person. The margin of sampling area for the full sample, based on 2009 census estimates,²⁶ is ± 4.6 percentage points, with 95% certainty.

The number of participants residing in the selected parishes was 127 (28.1%) in Lafourche, 78 (17.3%) in Plaquemines, 99 (21.9%) in St Bernard, and 148 (32.7%) in Terrebonne. Three hundred five (67.6%) participants were women and 146 (32.4%) were men; 85 (18.9%) were between the ages of 18 and 30, 71 (15.8%) were 31 to 40, and 294 (65.3%) were 41 or older. The majority of participants were married/cohabitating ($n = 296$, 65.5%), white ($n = 348$, 77.0%), and reported a 2009 annual income of $< \$40,000$ ($n = 265$, 65.9%). Of the 192 (42.5%) participants reporting having children younger than 18 years living in their home, 79 (41.1%) reported that at least 1 child in the home had difficulties in the past month with emotions, concentration, behavior, or ability to get along with others. Seventy-one participants (15.7%) reported working in occupations affected by the oil spill, including the hospitality and tourism industries, seafood-related industries, fishing industry, and oil/drilling support; 102 (22.6%) participants lived in zip codes in closer proximity to the coastline.²³ One hundred thirty-five (31.3%) participants endorsed that they would be interested in speaking with a counselor if such services were offered.

Measures

The Deepwater Horizon Psychosocial Assessment comprised sections measuring sociodemographics, Hurricane Katrina impact, oil spill concerns and disruption, resilience and life satisfaction, and mental health.

Hurricane Katrina Impact. Respondents were asked whether they had experienced the following events as a result of Hurricane Katrina or the 2005 hurricane season: friends or family members' house destroyed/damaged, loss of personal property other than house, loss of income, own house damaged, own house destroyed, loss of business, friends injured, serious illness, friends killed, family members injured, family members killed, victimized (eg, robbed, physically assaulted), or injured. A Hurricane Katrina impact index was created in which 1 point was given for endorsement of each variable. The minimum score was 0 and the maximum was 12 (mean 3.48, standard deviation [SD] 2.02).

Oil Spill Concerns and Disruption. Respondents were asked whether they had concerns about or problems with the following as a result of the DWH oil spill: damage to wildlife and environment, health and food concerns, loss of usual way of life, loss of job opportunities, loss of tourism, effects on personal health, loss of personal or family business, and need to relocate.

An oil spill concern index was created in which 1 point was given for endorsement of each variable. The minimum score was 0 and the maximum was 7 (mean 3.90, SD 1.99). A modified version of the Sheehan Disability Scale was used to assess overall disruption of life as a result of the oil spill.²⁷ Participants were asked to rate the extent of how the oil spill disrupted their employment/school work, social life/leisure activities and family life/home responsibilities on a 5-point Likert scale ranging from 1 (not at all) to 5 (extremely). The minimum score was 3 and the maximum was 15 (mean 7.39, SD 4.01). Cronbach alpha for the current sample showed good internal consistency of responses ($\alpha = .82$).

Rebound Resilience and Satisfaction. Rebound resilience was assessed by adapting 2 items from the Connor-Davidson Resilience Scale: able to adapt to change and tend to bounce back.²⁸ Items were measured on a 5-point Likert Scale ranging from 1 (not true) to 5 (true all of the time). The minimum score was 2 and the maximum was 10 (mean 7.87, SD 2.04). Place satisfaction was assessed using selected items from the World Health Organization Quality of Life Scale.²⁹ Specific items included rating quality of life, satisfaction with living conditions, access to health services, and access to mental health services. Items were measured on a 5-point Likert scale, ranging from 1 (very poor/dissatisfied) to 5 (very good/satisfied). The minimum score was 4 and the maximum was 20 (mean 14.79, SD 3.50). Cronbach alpha for the current sample showed good internal consistency for both rebound resiliency ($\alpha = .81$) and place satisfaction ($\alpha = .78$).

Mental Health. Mental health was assessed using both the K6³⁰ and the Posttraumatic Symptom Checklist for Civilians (PCL-C).³¹ The K6 was used to assess overall well-being and specific symptoms related to anxiety and depression. Respondents were asked to rate on a 5-point Likert scale ranging from 0 (none of the time) to 4 (all of the time) their feelings of nervousness, hopelessness, restlessness or being fidgety, depression so severe that nothing could cheer them up, everything being effortful; and worthlessness. Scores ranged from 0 to 24; the minimum score for the current sample was 0 and the maximum was 24 (mean 6.08, SD 5.91). A cutoff score of ≥ 13 was used to determine significant symptoms of serious mental illness, and 65 (14.9%) participants met the cutoff.

Mental health also was assessed using the PCL-C, a 17-item scale that measures the symptoms of posttraumatic stress. Item scores range from 1 (not at all) to 5 (extremely) and total scores can range from 17 to 85. The minimum score for the current sample was 17 and the maximum was 83 (mean 28.48, SD 14.40). A cutoff score of 50 was used to determine significant symptoms of posttraumatic stress and 50 (12.1%) participants met the cutoff. Cronbach alpha for the current sample showed good internal consistency for both the K6 ($\alpha = .92$) and PCL-C ($\alpha = .96$).

Statistical Analysis

Pearson and point biserial correlations were conducted to assess bivariate associations among rebound resilience, place satisfaction, and oil variables with PCL-C and K6 total scores. Two stepwise multiple regression analyses were conducted, in which Hurricane Katrina impact, place satisfaction, and rebound resilience were entered into the model first. Second, oil spill variables were entered into the model to assess their unique contribution to anxiety, depression (K6 scores), and posttraumatic stress scores (PCL-C). Preliminary analyses also were conducted to assess the relation among demographic variables—sex, marital status (married/cohabitating vs other), ethnicity (white vs other), age, and annual income—with K6 and PCL-C total scores. Results revealed a significant weak association among marital status and total K6 scores, suggesting that participants who were married or cohabitating $r(439) = -0.145, P < .01$, had lower K6 scores. No other significant associations were revealed; marital status was entered as a control variable in the multiple regression analyses.

RESULTS

Bivariate analyses were conducted to assess associations among occupation (oil spill related vs other), zip code proximity (zip code affected vs nonaffected), oil spill disruption, oil spill con-

cerns, Hurricane Katrina impact, place satisfaction, and rebound resilience with PCL-C and K6 total scores. Statistically significant positive associations ($P < .001$) suggest that as participants' oil spill disruption, oil spill concerns, and Hurricane Katrina impact scores increase, PCL-C and K6 scores also increase. Results also revealed that participants with zip codes in closer proximity to the oil spill had higher PCL-C and K6 scores. Statistically significant negative associations ($P < .001$) suggest that as participants' resilience and satisfaction scores decrease, PCL-C and K6 scores increase. No results were revealed among occupations with PCL-C and K6 scores. Table 1 presents the correlation matrix.

A stepwise multiple regression was conducted to assess the extent to which oil spill variables predict posttraumatic stress scores (PCL-C) after controlling for Hurricane Katrina impact, place satisfaction, and resilience. In step 1 of the regression, Hurricane Katrina impact, place satisfaction, and resilience were entered and predicted 26.9% of the variance in posttraumatic stress, $F_{3,411} = 50.31, P < .001, \Delta R^2 = 0.27$. The oil spill variables were entered into step 2 of the regression and predicted an additional 8.1% of the variance in posttraumatic stress, $F_{7,407} = 31.28, P < .001, \Delta R^2 = 0.35$. Beta coefficients are presented in Table 2,

TABLE 1

Pearson and Point Biserial Correlations								
	PCL-C	HK Impact	Oil Spill Disruption	Oil Spill Concerns	Resilience	Satisfaction	Occupation	Zip
K6	.68**	.36**	.46**	.28**	-.30**	-.44**	.04	.13**
PCL-C	—	.35**	.45**	.24**	-.26**	-.44**	-.02	.12*
Hurricane Katrina impact	—	—	.41**	.43**	-.08	-.27**	.19**	.18**
Oil spill disruption	—	—	—	.37**	-.17**	-.32**	.16**	.30**
Oil spill concerns	—	—	—	—	.01	-.18**	.12*	.12*
Rebound resilience	—	—	—	—	—	.31**	-.05	-.10*
Place satisfaction	—	—	—	—	—	—	-.10*	-.09

HK=Hurricane Katrina; PCL-C=Posttraumatic Symptom Checklist for Civilians. Zip: 1=zip code in proximity to oil spill, 0=not in proximity. Occupation: 1=occupation affected by oil spill, 0=not affected by oil spill. * $P < .05$; ** $P < .001$.

TABLE 2

Stepwise Multiple Regression Predicting Posttraumatic Stress						
Predictor	B	SE	β	<i>t</i>	<i>P</i>	
Step 1						
Hurricane Katrina impact	1.76	.32	.25	5.60	.001	
Rebound resilience	-1.03	.32	-.14	-3.26	.001	
Place satisfaction	-1.40	.19	-.33	-7.26	.001	
Step 2						
Hurricane Katrina impact	1.14	.34	.16	3.40	.001	
Rebound resilience	-.91	.30	-.13	-3.03	.003	
Place satisfaction	-1.16	.19	-.27	-6.19	.001	
Oil spill disruption	1.01	.17	.28	5.89	.001	
Oil spill concerns	.31	.33	.04	.94	.349	
Zip code affected	-4.79	1.43	-.14	-3.34	.001	
Occupation	-.01	1.66	.00	.00	.997	

SE=standard error of the mean. Zip: 1=zip code in proximity to oil spill, 0=not in proximity. Occupation: 1=occupation affected by oil spill, 0=not affected by oil spill. Ethnicity: 1=white, 0=other. Symptoms of posttraumatic stress=Posttraumatic Symptom Checklist for Civilians total scores.

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in which Hurricane Katrina impact, resilience, satisfaction, and oil spill disruption, and zip code proximity individually predicted posttraumatic stress scores.

A stepwise multiple regression was conducted to assess the extent to which oil spill variables predicted symptoms of anxiety and depression (K6) after controlling for marital status, Hurricane Katrina impact, place satisfaction, and resilience. In step 1 of the regression, marital status was entered and predicted only 1.8% of the variance in symptoms of anxiety and depression, $F_{1, 437} = 8.94, P < .01$. Impact of Hurricane Katrina, place satisfaction, and resilience were entered in step 2 and predicted 29.1% of the variance in symptoms of anxiety and depression, $F_{4, 434} = 46.04, P < .001, \Delta R^2 = 0.28$. The oil spill variables were entered into step 3 of the regression and predicted an additional 8.0% of the variance in symptoms of anxiety and depression, $F_{8, 430} = 32.71, P < .001, \Delta R^2 = 0.38$. Beta coefficients are presented in Table 3, in which marital status, Hurricane Katrina impact, resilience, place satisfaction, and oil spill disruption individually predicted symptoms of anxiety and depression.

COMMENT

As anticipated, based on knowledge of the areas most heavily affected by the DWH oil spill, the earlier impact exacted by Hurricane Katrina was associated with anxiety, depression, and posttraumatic stress, making residents even more vulnerable to the effects of the DWH oil spill. Residents again underwent a great deal of disruption in their usual way of life, which contributed uniquely to levels of anxiety, depression, and posttraumatic stress. Many experienced cumulative adversities, which influenced mental health outcomes.³²⁻³⁵ Consistent with the literature on previous oil spills, the largest effect on mental well-being was the extent of disruption that the oil spill created in

participants' lives, work, family, and social engagement, resulting in increased symptoms of anxiety, depression, and posttraumatic stress. In addition, 12% of the participants met the cutoff score for symptoms of posttraumatic stress and 15% met the cutoff score for serious mental illness; 21% of the total sample met 1 or both of the cutoff scores. With percentages well above the national prevalence rates of 3% for posttraumatic stress disorder and 6% for serious mental illness,^{36,37} the need for mental health supportive services is critical.

Although the findings indicated that the mental health effects of the oil spill were in general negative, it is important to note the protective factors related to resilience. The ability to rebound after experiencing adversity plays an important role in mental well-being, as was evident in the DWH survivors' strong association with decreased symptoms of anxiety, depression, and posttraumatic stress. An interpretation of this finding may be that having survived Hurricane Katrina, individuals believed that they learned from experience and were able to adapt to and cope with adversity. Considering the cumulative adversity that these individuals experienced, they may have been both sensitized to and inoculated against the impact of future disasters. Similarly, place satisfaction also was highly associated with mental health outcomes, which suggests that the level of recovery (eg, rebuilding one's home and having resources and support in the community) may serve as a protective factor in cumulative disasters.

Limitations

The primary limitation with this study concerned telephone response rates; although a 25% rate is lower than preferred, articles suggest that nonresponse rates do not necessarily alter survey estimates.^{24,38} Similarly, with the increasing use of cellular telephones as primary telephone service, data collection using

TABLE 3

Stepwise Multiple Regression Predicting Symptoms of Anxiety and Depression

Predictor	B	SE	β	<i>t</i>	<i>P</i>
Step 1					
Marital status	-1.76	.59	-.14	-2.99	.003
Step 2					
Marital status	-1.33	.51	-.11	-2.63	.009
Hurricane Katrina impact	.77	.12	.27	6.34	.001
Rebound resilience	-.52	.13	-.18	-4.13	.001
Place satisfaction	-.52	.08	-.31	-6.95	.001
Step 3					
Marital status	-1.58	.48	-.13	-3.27	.001
Hurricane Katrina impact	.42	.13	.14	3.22	.001
Rebound resilience	-.49	.12	-.17	-4.08	.001
Place satisfaction	-.40	.07	-.24	-5.51	.001
Oil spill disruption	.44	.07	.30	6.45	.001
Oil spill concerns	.21	.13	.07	1.65	.100
Zip code affected	-.79	.57	-.06	-1.39	.166
Occupation	.04	.66	.00	.06	.949

Note. Zip: 1=zip code in proximity to oil spill, 0=not in proximity. Occupation: 1=occupation affected by oil spill, 0=not affected by oil spill. Marital status: 1=married/cohabitating, 0=other. Anxiety and depression symptoms=K6 total scores.

landline telephones may limit responses. Purposive sampling techniques were used as a multimode sampling strategy to address a presumed low telephone response rate^{24,25} and to increase the representation of responses.

Additional limitations included the lack of zip code proximity and occupational effects, as found in previous oil spill studies. Zip code proximity was not highly associated with mental health outcomes, which may be explained by the migration of individuals from the coast to inner parts of cities to achieve levee protection from future hurricanes. This issue may have contributed to measurement and what determines “affected” regions.²² Lack of occupation effects, possibly resulting from sampling or measurement errors, also are noted.

Future Directions

It is clear that there is a need for services to address cumulative traumas and there was disruption from the DWH oil spill. Services should be geared toward individuals who experienced disruption in their usual way of life. With 40% of the participants who had children reporting that at least 1 child had current emotional or behavioral difficulties, services addressing the entire family are needed. Regardless of whether these problems preexist or were a result of the oil spill, they compound the stressors within the family unit. Community resilience-building programs also are needed to address disruptions in the familiar and accepted way of life. The lessons learned from the Exxon Valdez spill suggest that indirect effects may be long-term effects and that a slow recovery with setbacks can be anticipated. The mental health effects we are seeing now seem to be only the tip of the iceberg, because the infusion of funding to compensate residents for their losses has deferred the effects of negative longer-term outcomes; data from the Exxon Valdez oil spill confirms this expectation.^{9,10,17,18}

An important future direction for both research and outreach services after the DWH oil spill is to carry out longitudinal assessments with individuals and families,^{39,40} especially because recovery and compensation funds are no longer available. For future studies, special attention should be given to identifying and meeting gaps in available resources, interventions, and services for individuals and families, with a continued focus on the effect of previous disasters, complex traumatization, and the ability to rebound after adversity.

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