

## **PSYCHOLOGICAL RESPONSES AND RESILIENCE OF PEOPLE AND COMMUNITIES IMPACTED BY THE DEEPWATER HORIZON OIL SPILL**

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### **ABSTRACT**

On April 20, 2010, the BP Deepwater Horizon oil platform in the United States Gulf of Mexico exploded, killing 11 persons and resulting in a 5-month spill of more than 206 million gallons of oil, affecting more than 950 miles of shoreline. Our initial studies in Baldwin County, Alabama, and Franklin County, Florida, conducted while the oil spill was still in progress, showed high levels of clinically significant anxiety and depression in persons living in coastal communities. Income loss was the most significant driver of anxiety and depression, rather than direct influx or contact with oil. Ongoing studies of these groups and their communities have been conducted under the auspices of the National Institute of Environmental Health Sciences (NIEHS) Deepwater Horizon Research Consortium. A year after the spill, there was no significant change in levels of anxiety or depression in our cohort. Income loss continued to be associated with higher levels of psychopathology; findings were not associated with age, gender, education, or psychiatric history. Media exposure was associated with persistent hyperarousal. Findings support a model of chronic psychological disruption after the oil spill disaster. Community studies underscored the “corrosive” nature of this type of man-made disaster (as compared with natural disasters that have hit the region), with particular concerns expressed about the compensation process administered by British Petroleum and the parties that followed. Our research highlights the very real and long-lasting impact of such disasters on individuals and communities, extending well beyond the areas where there was direct exposure to oil.

### **INTRODUCTION**

The Deepwater Horizon oil platform exploded on April 20, 2010, initiating a massive oil spill which continued for the next 5 months (the

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Deepwater Horizon Oil Spill [DWHOS]). During this time, an estimated 4.9 million barrels of oil was released into the Gulf of Mexico, reaching more than 600 miles of the gulf coast shoreline in Florida, Alabama, Louisiana, and Texas (1–3). It was the largest off-shore spill in US history (2). The extent of the area closed to fisheries as a result of the spill is reflected in Fig. 1: the size of the closure area peaked on June 22, with 88,522 square miles (36.6% of Federal waters within the Gulf of Mexico) off-limits to fishing (4).

To address these questions, and to provide a baseline for subsequent studies, our research group at University of Florida (UF) initiated preliminary community-based studies along the Alabama and Florida Gulf coasts during the time of the actual spill (5). These early studies indicated that spill-related income loss was a stronger driver of mental health problems than place of residence and/or presence of oil on the adjacent coastline (Fig. 2). As the region and nation moved forward after successful capping of the well, a host of questions remained about the ongoing impact of the oil spill on individuals and their communities along the Gulf Coast, with particular concerns centered on possible psychological impact following studies after other recent man-made

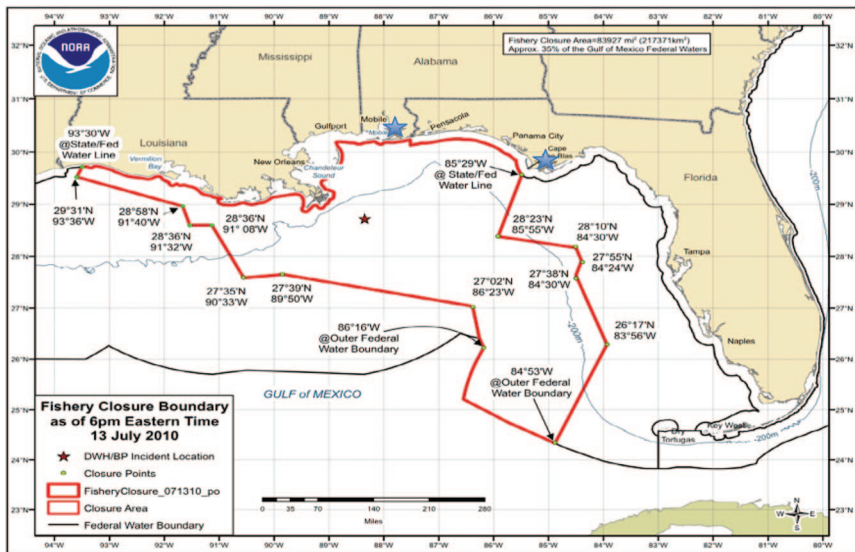


FIG. 1. Fishery closure boundary as established by National Oceanic and Atmospheric Administration (NOAA), effective July 13, 2010; this reflects closure of 83,927 square miles, or 34.7% of the Gulf of Mexico federal waters. Maximal closure area was on June 22, when 88.522 square miles were closed to fishing, representing 36.6% of the federal waters in the Gulf of Mexico (2). Major study sites for the current study are indicated by blue stars.

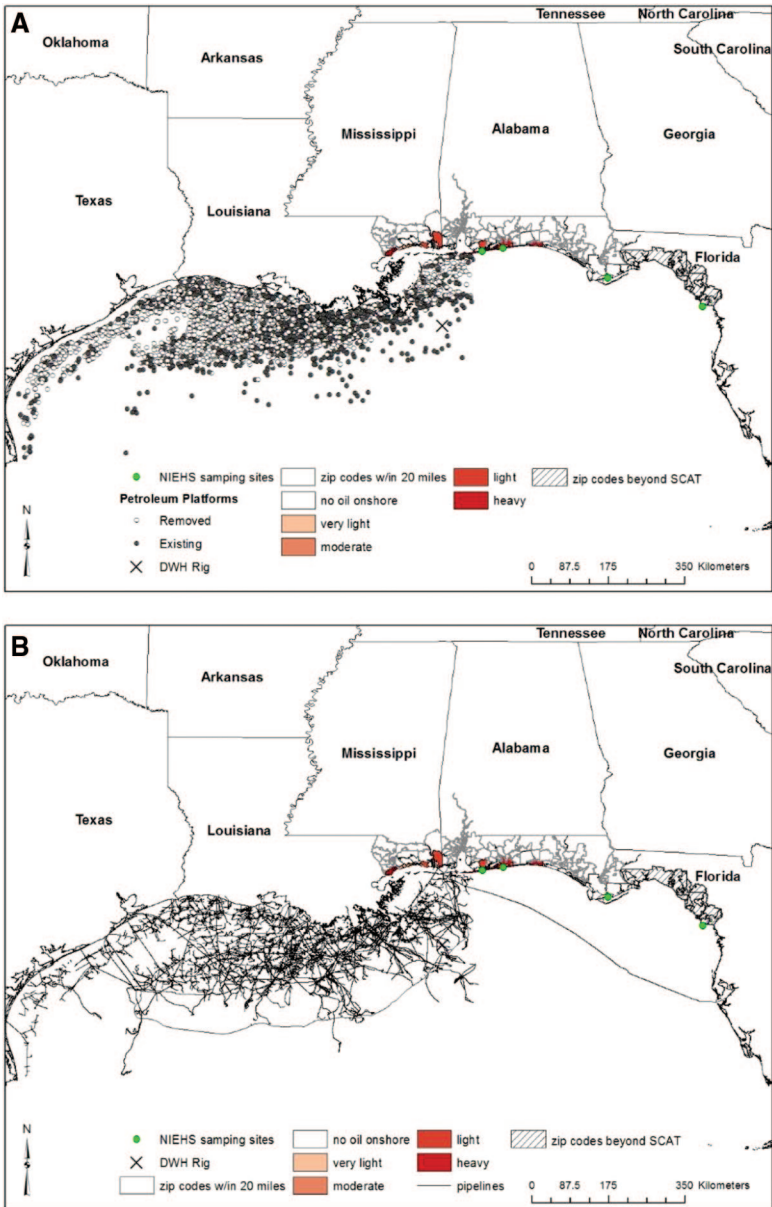


FIG. 2. GIS data (as of 3/22/2012) on existing and removed historical platforms in the Gulf of Mexico (A), and on pipelines in the Gulf of Mexico (B). (Data from Bureau of Ocean Energy Management [BOEM]). Figures also show the degree of oil on shorelines, based on data from Shoreline Cleanup and Assessment Technique (SCAT). Study sites for the community data reported in this manuscript are marked in green.

and natural disasters (6–10). With funding from the National Institute of Environmental Health Sciences (NIEHS), our group at UF, as well as research groups at Tulane University School of Public Health, Louisiana State University School of Public Health, New Orleans, and University of Texas, Galveston (collectively designated as the Deep-water Horizon Research Consortium) have continued to monitor individuals and communities affected by the DWHOS. With current funding, we anticipate being able to continue this follow-up through at least 2016. This article summarizes results of the ongoing studies conducted by the UF group through the first year after the oil spill, with a continued focus on Baldwin County, Alabama (including areas in close proximity to the site of the 2012 ACCA Annual Meeting), and Franklin County, Florida.

## INDIVIDUAL PSYCHOLOGICAL RESPONSES

### Methods

Ninety-three participants from communities in two coastal regions (Baldwin County, AL, and Franklin County, FL) were followed for 1 year after the oil spill. Sampling, recruitment, psychometric methods and procedures, criteria for clinical impairment, and demographic characteristics of the study groups have been previously described by Grattan et al (5). The measures administered 1 year after the spill included a background and history questionnaire as well as the Profile of Mood States [anxiety, depression (11)], Impact of Event Scale [post-traumatic stress symptoms: avoidance, intrusion, and hyperarousal (12)], the Connor-Davidson Resilience Scale [self-reported resilience (13)], within the context of a broader psychological and neuropsychological examination (5). In addition, a media survey was constructed and administered to assess the amount of time engaged with various media sources.

### Results and Discussion

Findings indicated that mental health problems persisted 1 year after the spill, particularly for people who continued to sustain spill-related income loss. Anxiety and depression remained increased in this population, with 89.66% of the people in the income loss group having anxiety scores in the clinically significant range, and 83.7% having scores suggestive of clinically significant depression (Table 1). These percentages are higher than those observed among persons with lost

TABLE 1  
*Psychosocial Scores 1 Year Post-DWHOS for Participants by Income Group (n = 93)*

Psychosocial Measure	Stable Income (n = 25)	Lost Income (n = 68)	P Value
Profile of Mood States (POMS) <sup>a,b</sup>			
Tension/Anxiety	52.96 ± 9.47	60.94 ± 11.34	.002*
Depression	54.44 ± 11.37	59.76 ± 12.90	.072
Anger	53.64 ± 11.54	58.75 ± 13.74	.101
Fatigue	51.20 ± 11.09	55.41 ± 12.13	.133
Confusion	56.28 ± 12.62	59.74 ± 11.66	.218
Vigor	44.44 ± 10.87	38.46 ± 6.54	.015*
Total Mood Disturbance	54.88 ± 11.20	61.34 ± 11.46	.017*
POMS Suspected Clinical Impairment <sup>c,d</sup>			
Tension/anxiety	3 (10.34%)	26 (89.66%)	.015*
Depression	5 (16.13%)	26 (83.87%)	.098
Connor-Davidson Resilience Scale <sup>e,b</sup>	29.08 ± 7.45	26.06 ± 5.82	.076

<sup>a</sup>Data are presented as mean ± SD for age corrected t-scores.

<sup>b</sup>Probability associated with an Independent Samples t-test (two-tailed distribution).

<sup>c</sup>Data are presented as frequency (percent) for POMS suspected clinical impairment which is defined by a cut-off score 1.5 standard deviations above the mean.

<sup>d</sup>Probability associated with chi-square (two-tailed distribution).

<sup>e</sup>Data are presented as mean ± SD for raw total score.

\*Statistically significant.

income during the oil spill [62% depression, 65% anxiety (5)] as well as regional base rates (5). There was also a trend for the income loss group to subjectively feel less resilient. These findings cannot be explained by age, gender, education, or psychiatric history. With respect to media involvement, there was a significant decrease in media exposure across the two times (during the spill versus 1 year after the spill,  $t = 5.23$ ,  $P = .001$ ). Nevertheless, total media exposure had a moderate correlation with persistent hyperarousal, one symptom of post-traumatic anxiety disorder (Table 2).

Our findings emphasize the persistence of mental health problems among northeastern Gulf Coast residents studied for at least 1 year after the oil spill, with income loss a significant source of distress. Depression and anxiety disorders, in particular, have been previously associated with oil spill disasters, with many factors contributing to their onset and persistence. With this in mind, the health consequences of disasters cannot be studied without addressing the role of mass media (14). Uncertainty, fear arousal, or hypervigilance often lead to continued information seeking. At a practical level, gaining information through media outlets may assuage concerns about safety or provide needed guidance or direction to promote recovery. However,

TABLE 2  
*Correlations Between Total Media Exposure and Psychosocial Variables 1 Year  
 post-DWHOS (n = 92)*

Psychosocial Construct	r	P Value
Total Mood Disturbance (POMS) <sup>a</sup>	.19	.078
Resilience (CD-RISC) <sup>b</sup>	-.12	.271
Post-traumatic Symptoms (IES-R) <sup>c</sup>	.19	.081
Avoidance	.19	.077
Intrusion	.11	.286
Hyperarousal	.21	.047*

Data presented are correlations between psychosocial constructs and total media exposure post oil spill (television, radio, and newspaper) with probability associated with a two-tailed distribution.

<sup>a</sup>Age-corrected t score on the Profile of Mood States (POMS).

<sup>b</sup>Total raw score on the Connor-Davidson Resilience Scale (CD-RISC).

<sup>c</sup>Total raw scores on the Impact of Events Scale-Revised (IES-R) and three corresponding subscales.

\*Statistically significant.

findings of this study also support the theory that persistent viewing of graphic or disturbing images in an aroused state may lead to potentially negative psychological ramifications (15), i.e., persistent anxiety. Within the context of existing disaster recovery models (16), the persistent symptoms we found 1 year post-DWHOS suggests a chronic disruption of normal functioning and places northeastern Gulf Coast residents at risk of further mental health problems. Further studies are needed to identify factors that may break the cycle of chronic functional disruption and maximize adaptation and adjustment to the oil spill disaster.

## COMMUNITY RESPONSE AND RESILIENCE

### Methods

Four coastal communities in the northeastern Gulf Coast region were selected for their dependence on tourism and seafood harvesting and potential for socioeconomic disruption after the DWHOS (Fig. 2A). Nonprofit civic organizations in each of the four communities served as partners in the research process, using a method referred to as community-based participatory research (CBPR). CBPR promotes active collaboration and participation at every stage of the research process and benefits both researcher and community (17). Through these partnerships, research questions focusing on the role of community resilience after the DWHOS were developed. Semi-structured qualita-

tive interviews (n = 90) and focus groups (n = 19) were conducted in 2011 and 2012 to identify social and economic impacts after the spill, challenges in the compensation process, and potential strategies for recovery.

## **Results and Discussion**

Findings from the qualitative component of this project suggest significant social and economic impact in all the four communities, regardless of distance from the site of the DWHOS. As both the tourist population and markets for seafood products extend beyond the Gulf of Mexico area, the perception that the entire Gulf was polluted and that all seafood was contaminated led to significant downturns in local revenues despite the reality of there being little direct oil contamination in the northeastern Gulf Coast. Frustration with the national news media for perpetuating these high levels of risk perception was frequently identified in both the interviews and focus groups. As with previous research findings on the corrosive effects of technological disasters such as oil spills, high levels of concern, and stress regarding the uncertainty of the long-term ecological and economic impacts were commonly identified by respondents. These social stressors, combined with the limitations on decision-making imposed by the uncertainty of overall impact of the disaster, have produced outcomes predicted by the literature on “corrosive communities,” such as by the breakdown of social relationships, a loss of trust in social institutions, and fragmentation of social groups (18).

The compensation process, as administered by British Petroleum, the Gulf Coast Claims Facility, or the US court system, was the most commonly identified source of frustration and hindrance towards recovery in the four communities included in this project. Approximately 60% of all the interviews collected to date have made some negative reference towards the compensation process. Frequently discussed sources of frustration included the perception that the compensation process was a zero-sum game leading to the mismanagement of the process and exploitation of inequalities in the compensation system by so-called “spillionaires” who unfairly profited while others suffered. Another common narrative applied to the compensation process referred to the perceived inequality between business owners and workers in terms of who successfully received compensation, with the perception that business owners, despite their larger valued claims, were unfairly discriminated against. The corrosive commu-

nity effect was also observed in reference to the compensation process, with individual and subgroup conflicts being exacerbated by perceived inequalities in the compensation process and leading to interpersonal conflict and jealousy atypical for these small-town communities.

### SUMMARY

Mental health problems continue to persist, and in some cases are worsening for residents of northeastern Gulf Coast communities 1 year after the DWHOS. People who sustained spill-related income loss seem to be particularly vulnerable to psychological distress. This pattern suggests a pattern of psychological disruption that is chronic in nature. Some of the anxiety symptoms, particularly hyperarousal may be associated with media exposure. However, this psychological reactivity probably has additional underpinnings, as it also takes place within a deteriorating community with weakening support systems. As the long-term corrosive effects of the DWHOS erode the social fabric, the recovery process typically facilitated by robust community connections has been inhibited to a significant degree. Community recovery efforts are currently underway and must focus both on the necessary economic recovery as well as repairing the social fabric to facilitate the distribution of the material and emotional resources needed to address the long-term mental and community health impacts.

Within a broader context, our data also emphasize the need to develop strategies for dealing with the individual and community impact of future natural and man-made disasters. Natural disasters, although intense and potentially devastating, are, to at least some degree, predictable (hurricanes happen during hurricane season), and tend to be short-lived. Communities have plans in place for such events, and respond collectively, building on social networks and past experience (i.e., everyone load the chainsaws into the pick-up trucks, and clear the tree that hit your neighbor's house). For man-made disasters, duration and response are much less certain (feeding into creation of the "corrosive community" described above), and future risk is generally unknown. As one example, Fig. 2 shows current oil platforms and pipelines in the Gulf region: although there is no *a priori* reason to assume that any of these structures will cause problems in the future, the sheer numbers of platforms and pipelines highlight the potential for accidents. It can only be hoped that lessons learned from the DWHOS about individual and community impact to such disasters



will guide local and national response strategies if and when similar events occur.

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## DISCUSSION

**LeBlond, Iowa City:** In social epidemiology communities are very, very different. So you are looking at a lot of isolated communities but you're showing this aggregate data. Do you see much dispersion between communities in terms of the frequency of anxiety and depression and the way that those communities are responding to this?

**Morris, Gainesville:** We are focusing primarily in two areas. In Apalachicola, in Franklin County, and here in Baldwin County we actually see a fairly consistent pattern. There is a certain personality type, if you will. These are people whose families have been on the water for generations, and these are the communities on which we are really focusing. I feel comfortable aggregating the data because we do see a fair amount of consistency across the communities.

**Hochberg, Baltimore:** Very nice, Glenn. One of the musculoskeletal consequences, let's say of depression, anxiety, post-traumatic stress disorder, et cetera, is this chronic widespread pain. So I am just wondering if included within your surveys in these communities is any questionnaire that might pick up chronic widespread pain syndrome.

**Morris, Gainesville:** This was a 10-minute presentation of a very large study, and the answer is yes. Preliminary analysis of our data shows evidence of somatoform disorders related to musculoskeletal pain. Some of these people are hurting, literally, along the lines of what you are describing.

**Limacher, Gainesville:** Thanks very much for this really interesting work. By serendipity, do you happen to have preceding data on the level of these measures in communities like this? We did a study after the Gainesville murders some time back and had happened to have surveyed the same population one year prior so we had really nice comparisons.

**Morris, Gainesville:** We do not. However, what we've done and, again I didn't show the data, we've actually moved down the coast and we've studied several other communities including Cedar Key, which is in area that is completely removed from the oil spill area, and which we've been using as our control community. There are also some data available which we can use to estimate the pre-event occurrence of depression and anxiety; taken together with data from control communities, we have a fair degree of confidence that we know what the baselines are.

**Martin, New Orleans:** I was very interested in your comments about the difference between natural disasters and man-made disasters. In 2005, we had a hurricane called Katrina and immediately after, I personally suffered a great deal of anxiety and a little bit of depression following it so I was wondering where did the data come from that compare natural disasters to man-made disasters and were any similar studies done in South Louisiana following Katrina?

**Morris, Gainesville:** Katrina was obviously a unique event, and there are those who would argue that Katrina had a significant component of a man-made disaster. When I

talk about a natural disaster, our data indicate that communities know what to do. They come together, everybody gets together, they help rebuild. You know what to expect. The problem with a man-made or technological disaster is you don't know the outcome and I think Katrina drifts into that because nobody really knew what was going to happen once the levees were breached.

**Hook, Birmingham:** I too was interested in your distinction between naturally occurring and technologic disasters and wondered if you had any conjecture regarding the issues of the basis and furthermore how about interplays with the tensions regarding regulation of all of those offshore oil wells at the present time.

**Morris, Gainesville:** It raises some very interesting questions about the offshore regulation, and, obviously, the current Presidential campaign raises that issue with the call of some candidates for "drill, baby, drill." Florida has traditionally not permitted offshore drilling and I am not sure how much longer we are going to be able to maintain that stance. There clearly is a substantive risk associated with simply that many wells, that many pipelines. There is at least a possibility that it's going to happen again, and I think by doing these longitudinal studies within the communities it gives us a chance to try to better understand and then guide the communities and provide services to the communities should this happen. It's hard to know what the risks will be, however. Again, I think that's why one still sees a certain level of elevated anxiety in these areas, because there is uncertainty about what the future is going to hold.

**Alpert, Tucson:** One comment coming from a state where we have lots of sunlight. I think you've given us a wonderful argument for a lot more investment in solar energy because I agree with you that it's just a stochastic analysis that this is going to happen again. My question is, after a number of natural disasters, there has been an increase in sudden death rates. You know the earthquakes in California, the tsunami in Japan and so forth. Were there increases in sudden death rates following the oil spill?

**Morris, Gainesville:** We really didn't see that although, again, it's interesting that the only funding that has come in to look at public health after the oil spill has gone to this research consortium funding by NIEHS. NIEHS has an in-house study called the GULF Study where they are examining a large cohort of workers with known exposure to the spill. BP has put 500 million dollars into studies of the environment. They have put no dollars into studies of public health. We have actually put forward proposals to ask the question you just asked, and none of those have been funded. There is a substantive lack of data that really would allow us to address these types of long-term consequences within populations.

**Alpert, Tucson:** It has obvious liability consequences as you know about increased death rates.

**Morris, Gainesville:** Exactly. I hate to be cynical but there are those of us working in this field who are somewhat perturbed that the guys out there looking at ocean currents got 500 million and public health got nothing.

**Mackowiak, Baltimore:** One short final question, short answer. We were told that in grand rounds 2 weeks ago at University of Maryland that BP is notorious for its ignoring of safety procedures. Do you have any thoughts on that?

**Morris, Gainesville:** I can't talk about safety procedures. I can tell you that having been in the communities when BP was there, I am not impressed. We were involved in community meetings where BP was present and, at some points, were close to being concerned whether the BP rep was going to get out with his life. BP did not manage this well, and I think that there were subsistent problems that arose in these communities, particularly with the litigation process, that reflected a certain philosophy on the part of BP.