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Adverse Effects of the Deepwater Horizon oil spill Amid Cumulative Disasters: A Qualitative Analysis of the Experiences of Children and Families

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Abstract

Limited research has examined the ramifications of the Deepwater Horizon oil spill (DHOS) on children and their families. This study builds on secondary data analysis and representative survey findings from the multi-method, multi-phase Gulf Coast Population Impact (GCPI) project. Specifically, this phase of the GCPI research draws on in-depth, semi-structured interview and focus group data to illuminate the social conditions that influenced poor child health outcomes in the aftermath of the DHOS and amid other disasters. These qualitative data were collected two years after the spill with caregivers, teachers, faith- and community-based leaders in five highly impacted Gulf Coast communities. Exploratory qualitative analysis revealed that children were affected by the DHOS and other related challenges through exposure to familial stress emerging from livelihood disruptions. Such disruptions were the result of ongoing poverty, damage to

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Ethical approval All qualitative and survey study procedures were approved by the Columbia University and Colorado State University Institutional Review Boards. The authors adhered to best practices for ethically collecting perishable data in the aftermath of disaster (Adams et al., 2024).

Informed consent All participants in survey, in-depth interview, and focus group procedures provided written informed consent.

the fishing industry, and exposure to cumulative and compounding environmental disasters. In cases of severe familial stress, children may have experienced toxic stress because of caregivers' displaced distress; ambiguous loss through caregivers' physical and/or emotional absence; and the children's recognition of their families' dire financial situations. Toxic stress was most often expressed through acute and chronic physiological, emotional, and behavioral health challenges. This study expands current understandings of the impact of technological disasters and cumulative environmental disasters on children and families. It underscores the importance of investing in harm prevention strategies to reduce threats to the health and wellbeing of young people living in ecologically and socioeconomically insecure environments prone to intensifying technological and climate-fueled disasters.

Keywords

Deepwater Horizon oil spill; Children; Family stress; Cumulative disaster exposure; Gulf Coast

On April 20, 2010, the British Petroleum (BP) Macondo oil well blew out in mile-deep water 50 miles off the Gulf of Mexico. The blowout prompted the explosion of the *Deepwater Horizon* oil rig, killing 11 and injuring 17 of the 126 workers onsite. Over the next five months, as BP failed repeatedly to cap the leaking well, 206 million gallons of crude oil containing toxic polyaromatic hydrocarbons and volatile organic compounds spread out over 68,000 square miles and spilled into the biodiverse Gulf. An additional 1.8 million gallons of toxic dispersant were used in cleanup efforts and 310 miles of be aches and marshland along the coast were moderately to severely polluted (Adams, 2015; Hale et al., 2010).

The Deepwater Horizon oil spill (DHOS), which still remains the most destructive offshore environmental disaster in U.S. history, had a profound impact on the ecological, socioeconomic, and cultural landscape of fishing communities throughout the Gulf Coast (Peres et al., 2016). Lucrative commercial and recreational fisheries that harvested over 100 species of aquatic life accounting for nearly 40% of U.S. seafood were devastated by mass die-offs, species deformities, and precautionary closure of an estimated 37% of federal and 85% of state waters to fishing activities (National Research Council, 2013; McCrea-Strub et al., 2011; U.S. Small Business Administration, 2013; Sumaila et al., 2012). Early "estimates of lost tourism and 'brand damage' due to the oil spill were projected to cost the entire Gulf Coast economy up to $22.7 billion through 2013" (Adams, 2015, p. 7). Subsequent studies suggested that Gulf Coast fisheries lost an additional $4.2 billion in revenues and more than 25,000 jobs by the end of 2020 (Court et al., 2020). Due to its deleterious impact on the Gulf's ecosystem and economy, the oil spill impacted upwards of 7.3 million businesses employing 34.4 million workers, many of which never reopened nor received compensation due to a poorly managed claims process (Conversations for Responsible Economic Development, 2013; Pallardy, 2020; U.S. Small Business Administration, 2013). BP ultimately paid $61.6 billion in penalties, compensation for damages, cleanup costs, and legal fees (Mufson, 2016).

Given the scope and scale of the disaster, public health research to date has focused on the short-, medium-, and longer-term physical, mental, and behavioral health outcomes associated with exposure to DHOS among different population groups. For example, adverse physical and reproductive health has been documented among cleanup workers (Alexander et al., 2018; D'Andrea & Reddy, 2018; Krishnamurthy et al., 2019), those employed in the fishing and seafood sectors (Cope et al., 2013), and both pregnant and non-pregnant women (Beland & Oloomi, 2019; Peres et al., 2016). Research has also documented associations between economic and/or physical exposure to the oil spill and a variety of mental disorders including, for example, depression (Kaufman et al., 2019; Kwok et al., 2017; Lee et al., 2016; Parks et al., 2019), stress (Hansel et al., 2015; Mong et al., 2012), and anxiety (Buttke et al., 2012; Grattan et al., 2011). Oil spill-related stress from income loss, prolonged unemployment, health uncertainty, and involvement in protracted legal battles has been associated with self-reported family dysfunction (Ngo et al., 2014), as well as affiliated indicators of poor behavioral health outcomes such as domestic conflict (Rung et al., 2016), avoidant stress coping mechanisms (Bell et al., 2018; Ritchie & Long, 2021), and new or increased drug, tobacco, and alcohol use (Buckingham-Howes et al., 2019; Wang et al., 2022).

Contributions of the Current Study

As ilumulate regarding the consequences of the DHOS, few studies have focused on the health and behavioral ramifications of exposure to the DHOS among children and adolescents. This represents a major gap in knowledge, as young people comprise nearly one-quarter of the Gulf Coast population and research suggests that this age group may be especially vulnerable to lifecourse disruptions and other negative outcomes (Peek et al., 2018). The limited research that is available on children in the spill's aftermath has shown that both physical and economic exposure to the event was associated with adverse outcomes, primarily posttraumatic stress and other mental and behavioral health problems (King et al., 2015; Osofsky et al., 2015, 2016; Schulenberg et al., 2016; Weems et al., 2018). These studies describe significantly worse outcomes among those who were also heavily impacted by previous and subsequent hurricanes and other stressful life events (Gavenus et al., 2013; B. Gilbert, 2019; B. R. Gilbert, 2013; Mohammad & Peek, 2019). Given the number of disasters that have affected young people along the Gulf Coast, including the devastating DHOS, the present study builds on quantitative findings to offer an exploratory qualitative analysis of in-depth data collected from community leaders and caregivers regarding children's health. This work aims to provide preliminary evidence of the psychosocial and environmental pathways through which the DHOS affected Gulf Coast children's and adolescents' physical, mental, and behavioral health.

Methods

Data Collection - Phase 1 Secondary Data Analysis

In 2012, academic and community-based researchers launched the mixed-methods, multi-phase Gulf Coast Population Impact (GCPI) project with the objective of exploring the effects of DHOS on child and adolescent physical, mental, and behavioral health (Abramson

et al., 2013). As shown in Fig. 1 and described in more depth in Abramson et al. (2013) and Beedasy et al. (2020), highly impacted communities were identified using standardized z-scores based on both an area's number of individual and business compensation claims filed with BP and rates of crude oil that had washed ashore. Analysis of these secondary data allowed the research team to focus subsequent survey and qualitative data collection efforts on communities that were most disrupted by the effects of the oil spill.

Data Collection - Phase 2 Survey Component

Phase 2 of GCPI drew a representative sample of adult residents throughout impacted states in the Gulf Coast region, including Louisiana, Mississippi, Alabama, and Florida (Abramson et al., 2013). The four-state survey across the region aimed to identify the proportion of children who were adversely impacted by the oil spill, understand the prevalence of physical and mental health effects among these children and their families, and assess available health services and potential targeted interventions or healthcare improvements (Abramson et al., 2013).

The Phase 2 research team randomly selected census blocks from within each of the 15 communities identified in Phase 1 where at least 70% of households were occupied. From April to August 2012, a field team of six community interviewers and two Gulf Coast-based field coordinators knocked on 6800 doors and successfully completed in-person interviews with 1437 adult caregivers of children ages 3 to 18 living in the home. These interviews lasted an average of 10 min. The final sample included 887 adult respondents in Louisiana, 177 in Mississippi, 140 in Alabama, and 233 in Florida (Abramson et al., 2013).

Findings from the quantitative portion of GCPI show that based on adult reports, child and adolescent exposure to the oil spill through direct physical contact with crude oil or dispersants and/or household loss of jobs or income was associated with the onset of several physical and mental health issues (Beedasy et al., 2020; Hall et al., 2023; Meltzer et al., 2021; Slack et al., 2020; Stroope et al., 2021, 2022, 2023). New physical health problems were primarily respiratory, dermatological, or visual, and new mental health problems included being sad or depressed, being nervous or afraid, having difficulty sleeping, and experiencing conflict or other problems with other children (Abramson et al., 2013).

Data Collection - Phase 3 Qualitative Component

Phase 3 of the GCPI project drew on findings from the four-state survey sample to identify a subset of communities in Louisiana, Mississippi, and Alabama whose children were most highly impacted by the oil spill. As shown in Fig. 2, the qualitative study locations included Bayou La Batre, Alabama; New Orleans East, Lower Lafourche Parish, and Grand Isle, Louisiana; and Gulfport, Mississippi.

As shown in Table 1, the five communities chosen for further in-depth qualitative investigation reported disproportionately high rates of exposure and percentages of mental and physical health problems relative to the larger survey sample. Physical exposure was operationalized based on children's participation in oil cleanup activities and/or direct contact with crude oil, tar balls from the spill, or cleanup materials such as dispersant. Environmental exposure was based on a moderately to severely strong smell of oil.

Economic exposure was based on the child's household having lost income or a job because of the oil spill (Abramson et al., 2013). Table 1 also summarizes the mental and physical health burdens among children in the communities selected for the qualitative component of GCPI.

In each of the five qualitative sub-study communities, the research team carried out semi-structured key informant interviews (n = 36) and 9 focus groups (n = 52 participants) in October 2012 with community leaders including healthcare providers such as pediatricians, school nurses, mental health counselors, social workers, and health center directors; local officials, childcare providers, teachers, and school administrators; and advocates representing community groups including non-government organizations, nonprofits, and religious institutions (see Table 2). In addition, the research team conducted 10 semi-structured focus groups with a total of 64 parents and grandparents across the five qualitative sub-study communities (see Table 2). Although most of the interviews and focus groups were conducted in English, the team worked with local partners to carry out one Spanish language and two Vietnamese language focus groups with parents and grandparents. All participants were recruited by trained personnel based on expertize in the areas of interest, parent-teacher associations, word of mouth, and community and faith-based organizations (Abramson et al., 2013). We also recruited demographically diverse participants representing various occupations, organizations, and family types in order to gather as many different perspectives as possible. Children and adolescents were not included in interviews or focus groups, so caregivers and stakeholders served as proxies for their lived experiences and perspectives. We honor the need to learn from children themselves and recognize the issues associated with adults reporting on children's experiences–especially the potential for *underreporting* of emotional distress and behavioral issues (Peek & Fothergill, 2009). However, time, budget, and logistical considerations did not allow us to gather data directly from young people in this particular project.

The interviews and focus groups were informed by best practices for conducting qualitative inquiry with disaster affected populations (K. Padgett, 2012; Phillips, 2014). Focus group meetings were held at accessible public places such as schools and libraries and key informant interviews took place at respondents' places of work or other private locations to ensure confidentiality. Participants were handed an information sheet upon their arrival to the focus group or interview and given the opportunity to ask questions about the study, after which they provided written (interviewees) or verbal (focus group participants) informed consent.

We chose to rely heavily on focus groups during Phase 3 because prior work has argued that this method can be beneficial in the post-disaster context where the groups offer a "social support function" that gives "participants the opportunity to share their stories with others and to develop a sense of solidarity with people who are going through similar experiences or have similar life circumstances" (Peek & Fothergill, 2009, p. 49-50). A further methodological innovation worth noting–that also highlights the strengths of this multiphase study–is that the two lead investigators for this project began each focus group by welcoming participants and then showing them a graphical posterboard (see Fig. 3) that compared their study community to the broader GCPI sample. We found that launching the

conversation by personalizing the community where we were carrying out the interviews was important in focusing the conversation. Further, we made it clear to participants that we wanted them to help elaborate on what we came to refer to as the "story behind the numbers." This meant that we actively encouraged participants to help *explain* or to *challenge* the statistics based on their knowledge of children in the community.

The guides for the semi-structured interviews and focus groups, which lasted between 60 to 90 minutes, addressed the following broad topics: impacts on the DHOS on the health and well-being of children; resources and services that would be most beneficial to these children; and barriers to health and social services. All interviews and focus groups were audio recorded and transcribed verbatim. All procedures adhered to relevant ethical guidelines and regulations and were approved by the academic researchers' Institutional Review Boards. Focus group and interview participants were compensated with a $50 Walmart gift card for their time. Snacks and drinks were also provided at the focus group interviews.

Qualitative Data Analysis

Upon completion of data collection in 2012, the research team paid a multilingual transcription service to generate full text transcripts from all the audio recordings. Upon receipt of the transcripts, two of the researchers who were present at the interviews and focus groups cross-checked all files for completeness. We corrected minor typographical or grammatical errors and inserted notes regarding the emotional tenor of the interviews (e.g., when laughter, anger, or sadness was shared among participants or between the interviewer and interviewee). Once the transcripts were verified, we loaded the transcripts into Atlas.ti. Two members of the research team and two graduate assistants coded the transcripts and generated an initial codebook.

In preparation for writing this article, the first author recoded all transcripts in Dedoose (version 8.3.35, Socio-Cultural Research Consultants LLC, Los Angeles, CA). This process began with line-by-line open coding, which "includes labeling concepts, defining and developing categories based on their properties and dimensions" (Khandkar, 2009, p. 1). A list of approximately 200 codes were generated in the initial coding phase, which were then collapsed into 22 thematic codes through the process of constant comparative analysis. These were then organized these 22 thematic codes by sub-theme (see Supplementary Table). Once this initial process was complete, a second coder then reviewed and refined the coding methodology and rationale (Padgett, 2012).

Results

This section describes the connections between the preexisting conditions in the Gulf Coast, the exacerbation and creation of stress caused by the DHOS, and the attendant familial and child-specific stressors that followed. As the data illustrate, this stress, in turn, manifested in several child-specific health challenges.

Acute Shocks and Chronic Stressors in the Focal Communities

Prior to the DHOS, the five focal communities in this qualitative sub-study all were subject to a variety of acute shocks as well as more chronic stressors related to generational poverty and other forms of inequality. Indeed, each of the focal communities in this study have long been affected by issues with chronic poverty, lack of public and private sector support for citizens, and other social and health disparities. Participants commented on the most visible manifestations of these historically rooted and deeply intertwined contemporary stressors, including "drugs and crime," poor health insurance or lack thereof, "horrible schools" with no running water, and large percentages of children eligible for free or reduced lunches. The shock of disasters such as Hurricane Katrina only intensified these pre-existing issues. As the director of a mental health nonprofit reflected:

I saw the big change after Katrina when people got dislocated. A lot of families sent their kids off somewhere, to relatives out of the state. And then when the kids came back, there were a lot of issues about being abandoned or left with somebody else. And then the parents still weren't back on their feet, not back in their homes, there weren't homes to go to. Or the people who lived here before can't afford the insurance so they can't even go back to the home that they had if it did get fixed. So just that kind of turmoil. And when you're poor and you have no resources, no savings, it's just horribly stressful.

Katrina caused lasting and devastating damage in the focal communities. Even still, Gulf Coast residents were accustomed to storms that, as a board member for the Association of Family Fishermen described, "flattened the parish to the ground," but "as long as we could get in a boat, and go, and fish, we could make a living." The DHOS took a profound economic toll on their communities, deepening already existing challenges. A nurse coordinator commented that, unlike Hurricane Katrina, which "took homes" and "took lives," the oil spill "took a whole community of jobs." Indeed, the combination of "species displacement," widespread public concern regarding seafood contamination, and federal and state fishing moratoria after the spill all combined to drastically reduce natural supplies and fiscal resources available to those engaged in the fishing industry. Middle-class families that had earned steady and even lucrative incomes for generations through commercial fishing and seafood enterprises suddenly found themselves in precarious financial positions and were forced to give up their assets to make ends meet. As one retired oysterman explained:

I had the house, I was making the payments, I got three kids, I was trying to put a roof over their heads, make sure the house was paid for, make sure everything was intact like it's supposed to be as being the man of the household. And I made good money, I made real good money, I had three boats running and I had people working for me. Now after that, that was it. They got tied up, they got put on land and I had to sell 'em because there was no more money coming in. And after that money was gone and you didn't have no more money coming in, I had to sell the house.

The financial fallout of the oil spill not only impacted fishing families. Economic effects also reverberated through the entire fabric of coastal communities where businesses relied on both local residents—who were now exceptionally cash-strapped—and tourists—who no longer wished to visit the Gulf's oil slicked beaches. Thousands of people employed

in industrial and service industries ranging from marine carpentry and seafood shops to restaurants and casinos were laid off or had their hours and compensation reduced. The director of a fishing advocacy nonprofit remarked:

And it's not just about the fishermen, you know? […] I talk to a lot of our other business owners, whether it be our local hardware, or our gas stations, grocery store, and that shop. I spoke with them and the first question I asked them is, "How does the commercial fishery impact your business?" They said, "Greatly." I said, "What would happen to your business if the commercial fishermen just vanished from this area?" They'd shut the doors. It's a domino effect.

This "domino effect" of lost jobs and reduced income placed incredible financial strain on the primarily low- and middle-income families in these communities, many of whom had to rely on single earners who made "like a dollar too much for any assistance."

When families applied for assistance, the complicated compensation system arranged by BP resulted in similarly affected (and equally deserving) families receiving drastically different remittances from the petroleum company. As a marine carpenter who had no household income for three months commented, "People in this town ran down there gettin' money that didn't deserve a dime. And the people that deserve it, still don't have it." The uneven distribution of resources under what was perceived as an opaque compensation regime fomented widespread stress, relative deprivation, and resentment within once tightly-knit communities (Cope et al., 2020), a phenomenon that has been observed in other technological disasters where "corrosive communities" have emerged as communal conflict takes over (Erikson, 1995; Kroll-Smith & Couch, 2014).

Parents and other caregivers who participated in this study explained that they no longer had the supplemental income to afford enjoyable family rituals like taking vacations, going to the movies, getting ice cream after school, or buying toys on special occasions. Families had to reprioritize and focus on acquiring "the basics" related to gas, rent, food, and clothing. For some families, even necessities became unattainable. One middle school teacher commented:

Whatever I do, I'm trying not to embarrass them, but these kids are coming from these communities, and they don't have the basic needs, basic supplies. Some of them come to school, the only meal they get is their breakfast and their lunch at school. They don't tell us that, but you can look at them, and you can tell they have on the same uniform they had on the day before. Not being cleaned and they're starving, and they want more food.

These families' and communities' preexisting socioeconomic vulnerability was shaped by chronic poverty amidst a cascade of environmental stressors that preceded and followed the DHOS (also see Mohammad & Peek, 2019). Many families who were displaced and whose homes were destroyed during the 2005 hurricane season, for example, were finally on the verge of economic recovery and self-sustainability when the oil spill occurred in 2010, presenting yet another financial, environmental, and emotional setback. As the medical director of a community health center reflected:

A lot of it has to do, I think, with the chronic poverty down here. And it just doesn't have a chance to get better because these tragedies come along. And people are just starting to get on their feet then they are knocked down again. I have so many families where they are living with grandma because grandma is the only one that owns a house that didn't get destroyed by Katrina.

In addition to acute weather events such as numerous hurricanes and tropical storms, focus group respondents commented that they lived in contaminated communities (what are often referred to as "energy sacrifice zones") where they were regularly exposed to pollutants from the petrochemical and other manufacturing industries (Maldonado, 2018). The previously quoted nonprofit director explained:

We have the Mississippi River over in Plaquemines… that we all drink out of. Of course, the water is processed, but I'm sure it doesn't take everything out of it. We bathe in it and drink it. We have refineries all around us. We live in the middle of an oil field. And there's an oil spill here 365 days a year—365 days a year, I guarantee I can take you out in a boat and we'll find a slick somewhere… But I think it's like the cup runneth over. You take a pitcher of water, and you start pouring it in a cup, eventually, it's gonna overflow. Same thing with the human body—you keep having exposure, and keep having exposure, and you have one large exposure at one time? It's just too much.

Symptoms of Family Stress

Several parents in the study described how they and many other families in their communities had succumbed to the immense financial pressure caused by the fallout from the oil spill and other ongoing stressors. The sequelae of family dysfunction most commonly began when parents and grandparents, many of whom were sole household earners, were no longer able to provide for themselves and their loved ones and subsequently fell into deep clinical depression. One mother, for example, who lost her job in community education when students could no longer afford to take classes, recalled:

And I think it fell on me like a ton of bricks because I've never been let go before or fired so I didn't take it well. I ended up on Zoloft and Xanax because I've never been fired before. So, I go from having this job year after year to now I don't have a job. He [her husband] recently was disabled. He's had both of his knees replaced so he can't work. So, it's not like, 'Okay, I lost my job, you go get a job.' That wasn't the situation in our house. It was, 'I lost a job, I can't go get another one because he can't drive, so that means I have to take the kids to and from school.' So that was a long stressful period.

Parents with diminished financial resources who were able to seek employment often had to work multiple jobs or longer hours. Others sought employment opportunities further away from home to supplant their lost income. This was especially the case for those in the fishing and petroleum industries whose occupations were under moratoria following the oil spill. Even when fishing was allowed again, those employed in the fishing industries reported they had to go further and further offshore to find a suitable catch. More time spent working or "commuting" by car or boat detracted from quality time with spouses and children. This, in turn, strained marriages as parenting responsibilities fell onto a single

parent or a grandparent. Topics of conversation shifted from more joyful matters to a focus on addressing financial concerns, as a mother of three and former commercial shrimper working at McDonald's explained:

We fight all the time now because I'm working so much and he's working so much. I work overnight shifts, 10 at night until 6 in the morning, every Friday and Saturday, and he'll come up and sit up there with me while the kids are at grandma's, and they'll cry, "Well, Daddy's not working, why can't Daddy be with us?" And he'll try to tell them, "Daddy's spent some time with you, but Daddy's also got to spend time with Mommy, too." And it's not working with them. Ever since he's either there or I'm here and it's like we're not even a family anymore, we just use the house to sleep in basically… We had a very good marriage up until this happened because he can't work. He's stressed because he can't work. Where are we going to get food? How are we going to pay our bills?

Economic hardship also caused families to either sell or be evicted from their homes and move in with relatives, sometimes splitting up parents and children who had previously been separated during Hurricane Katrina. Doubling up with extended family created situations of overcrowding ripe for interpersonal conflict. The middle school teacher quoted previously remarked that 98 out of 720 of her students were homeless, "though not necessarily on the street." The medical director previously quoted described the situation after the oil spill as follows:

… And just the stress of families all living on top of each other and the parents feeling inadequate because they can't have their own place to live. And then just all the fighting that goes on among the family members all living on top of each other. And the kids that I see, none of them come from a family where there's two parents living there and taking care of them. They're with grandma, they're with aunt, they're with somebody else.

Rising tensions among family members culminated in maladaptive coping mechanisms and externalizing behaviors observed by clinicians, educators, and nonprofit service providers. For example, family tensions and frustrations manifested in reported spikes in cases of domestic violence across the focal communities. Further, community leaders in the study reported a sharp uptick in drug and alcohol abuse among parents as a form of "self-medication." Substance abuse was not limited to those who were left with no financial support. Indeed, a female caregiver told the following story about her family members who received an influx of cash through BP's compensation program:

You've got adults that get too much money so then the daddy's addicted to drugs. He has no job, he has all this money that he never would have had otherwise, so now this far out, we have an addicted daddy with his wife probably right along with him and you've got two kids that are living this life. They lived a very high life at first, you go buy all this stuff and you have all this stuff, but they didn't realize the jobs weren't coming back. The seafood jobs aren't coming back. So, then all the money's gone, then there's no work and he's addicted to drugs, so then what comes next is they go to steal.

When Children Absorb Family Stress

Caregiver and stakeholder interviews revealed three main pathways through which children absorbed their families' financial and emotional stress. First, children of depressed parents or grandparents were often the objects of displaced sadness, frustration, anger, or hostility. An Early Head Start program coordinator said that the center had seen increasing instances of "inappropriate discipline" among parents. A school nurse remarked that she saw a marked increase in Department of Human Services cases where "kids [were] being physically abused," asking to go home with her rather than return to their own homes.

Community leaders who participated in the study commented on the difficulties for children whose parents were depressed, saying that "it's hard as a child to watch your parents be depressed;" that "the attitude of the children reflects the attitude of the parents;" and "whatever mental health issues that their parents picked up, they'll be passed on to the kids." The clinically depressed mother previously quoted recalled:

I think I bit off everybody's head for about a month or so because I wasn't used to being at home… so I'm not used to a household of people. And I'm not one to want to stay home to be a stay-at-home mom so that was an adjustment for all of us. I think the kids took the brunt of it because everyone was on edge between us, with me… And sometimes, my youngest son, if I start fussing, he does this. He walks around the house with his fingers in his ears. And then he'll just look around, and if I haven't said anything in a while, he'll take his hands down and he'll go on and keep playing.

Second, as parents and grandparents became increasingly preoccupied with their financial predicaments, they became more physically and emotionally absent because they did not have the time or capacity to effectively parent their children. Many caregiver respondents referred to unattended children in their local communities as "latchkey" or "turnkey" kids because they had keys to their houses to let themselves in after school. Since parents were unavailable, children were forced to take on caregiving responsibilities for themselves and their younger siblings at a very young age. A mother who lived in a low-income neighborhood observed.

You see little five-year-olds walking home from school by their self. Like there might've been a parent that was working, had a good job and support the whole house, and the mom stay at home or the dad stay at home. Now they're both working part-time jobs, and oh well, if it's when the kids have to get out school, you know.

Parents who were physically absent from the home were aware that this created potential risks for their children who were left more frequently on their own. Yet, they felt trapped between the need to provide income for their family members while also keeping them safe. Even when they were home, some of the key informants in the study as well as the parents reported that caregivers were completely mentally" or "emotionally exhausted." The parents who were rendered unable to devote the time and energy necessary to nurture their children often were providing care for the children who needed extra support given their life circumstances and previous traumatic experiences. A nonprofit executive explained:

You've got parents who are stressed to the limit, trying to care for children who are needing more, and the parent doesn't emotionally have that to give… If the oil spill had happened in an area where there was not the economic impact and the parents could be stable economically, the children would have less of an emotional impact because things would be managed, they would be handled. Kids would still get read to; they'd still get played with. In this situation, parents, in order just to survive, were disconnecting from their children so that they could go to work or go out and find a job or whatever their hustle was.

The third pathway through which children absorbed their parents' stress was through experiencing a loss of childhood innocence. Many of the youngest survivors of the oil spill were exposed to grim details regarding their families' economic precarity and lack of recovery support. Many parents whom we interviewed told stories about their very young children who were conscious of, but could not fully comprehend, the fact that their lives had so drastically changed. A mother of two girls, ages five and six, whose husband's ship building yard was closed, described the situation.

They're still fairly young but they know what's going on and of course when you tell them that, "We ain't got the money for this, we ain't got the money for that, we ain't got the money for that," it does have an effect on them… Kids are constantly going to ask, "Why?" And you tell them, and you tell them, but they can't quite comprehend it. But they're still—they ain't as happy as they used to be. They ain't as happy and carefree. My oldest daughter, she's real sensitive… I hear her in her room real serious thinking and talking to her dolls, like, "We can't do this because of this."

Other parents expressed that they were taken aback by the extent to which their children were stressed about finances. One mother recalled that when her child was sick, he "didn't want to take his medicine anymore because his exact words were, 'Why take it if we can't afford to go to the doctor?'" Slightly older, school-aged children had a greater understanding of the implications of their families' financial position as it pertained to participation in activities and the acquisition of material possessions. Young people whose families were suffering financially often compared their situation relative to their classmates who were either unaffected by the spill or whose families had received greater compensation from BP. A Parent-Teacher Association representative explained how these dynamics played out in her school.

We've had to cut out some things. We have a Fall Festival every year. We have to do things for kids that can't afford it. "Oh, I can't afford to go to Fall Festival because my mom and dad don't have a job anymore," or "I can't afford a jacket because my mom and dad are waiting on a BP check." Now, no child should have to say they're waiting on a BP check.

School-aged children's relative deprivation had profound social implications as they and their peers navigated the post-oil spill terrain. Some of the parents and school staff whom we interviewed also noted that bullying had increased, especially when other, more fortunate peers would taunt those from lower socioeconomic backgrounds. A mother with two sons, ages 20 and seven, told the following story about her friends who went from earning $70,000 annually to $128 weekly in unemployment benefits.

The things that you used to do for your family, you couldn't do. So then, the kids would tease on the kids because you can't go and buy this name brand clothing like you were because you were making this money. And then like their car was repossessed and so kids—you know what I'm saying—where you were dropping them off, they have to ride the bus. So, it does impact them.

Teenagers anticipating their lives after high school were deeply worried about the long-term impacts of the oil spill on their own future trajectories and their families' way of life. Before the DHOS, it was common in the region for young adults to forego attending college in order to join their families' multigenerational fishing business. However, the oil spill threw these plans into jeopardy as teenagers became increasingly stressed about their own futures and their parents' and grandparents' stable retirement. A mother with three children whose husband is a commercial crabber recalled.

My oldest son is now 17 so you can count back, and it was right around his birthday and he's about to start to drive. He worked in the summer, spring break, and weekends on the boat with his dad and it put a great deal of fear in him. He's been on the boat since he could walk. My inlaws own a seafood shop. My daddy was commercial shrimping. We don't know anything else on either side. My husband's family—it's all we've ever known, and the fear that it put in my child was, "Is this going to be gone forever?" It was deep thinking, worry. I see just a change in his psychological… I mean, everything about his daily routine. He couldn't concentrate in school for worrying about what's going to happen. But if that's then a way you've ever known that your daddy's made a living since you've been born, and a good living and took good care of us, then a shop shuts down.

Child Stress Manifested in Health Problems

As noted previously, at the outset of the focus groups, the interviewers showed the respondents the data—in poster form—that captured the high incidences of health distress as reported in the respective community (see Fig. 3). The interviewers then asked the respondents, first, whether that data resonated; focus group participants were universal in their agreement that they had witnessed an increased incidence of physical, emotional, and/or behavioral health issues after the oil spill. The respondents largely attributed these issues to the buildup of absorbed family stress that was often driven by other collective challenges within the communities and the broader contexts in which families are embedded. The director of an interfaith disaster response nonprofit explained that "the body is going to absorb that [stress] and you're going to get asthma, you're going to get high levels of anxiety coming to school."

As identified in the survey and then also elaborated upon in the in-depth interviews and focus groups, the reported physical health issues among children were primarily respiratory, as parents reported major allergy issues, and stakeholders in school systems emphasized the scope and intensity of asthma cases in their student bodies. In fact, an average of over 25 percent of survey respondents in the sub-study communities stated that their children had post-oil spill respiratory health effects. A school nurse described the severity of the issues associated with an asthma diagnosis:

I've got a population of 450 and I've got 78 of those children that have been diagnosed with asthma. That's a huge number in that small of—it's not what we were seeing before. And the severity of the asthma—it's not just the, "Oh, I've got asthma." It's the amount of nebulizer treatments I'm having to give in a day and the amount of inhalers we're having to use.

A nurse coordinator picked up on a similar theme related to the increased number and severity of cases she had treated since the oil spill. Specifically, she pointed out that kids went "from having a few rounds of antibiotics in their entire lifetime prior to April of 2010," and since then were receiving "25, 30 rounds of antibiotics accompanied by steroids and breathing assistance."

Respondents also reported a variety of other health problems stemming from what caregivers mostly attributed to secondary stress following the oil spill as opposed to direct crude oil or dispersant exposure. According to survey data, an average of 19 to 21% of children across the sub-study communities experienced dermatological and visual problems, respectively. The nurse coordinators had seen many children with scabbing, rashes, nausea and abdominal pain, nosebleeds, ear bleeds, migraines, and hair loss; some of the children with visible physical issues were then also bullied by other students. The myriad physical ailments that children experienced after the spill further exacerbated their families' financial stress as parents had to spend "increased money at the pharmacist," had "increased doctor bills," and had to take off work when their children missed school on a frequent basis to take them to doctors' offices often located far away from geographically remote, small fishing communities.

Mental and behavioral health issues were also highly prevalent. Adult caregiver survey respondents in the sub-study communities reported that 24.2 to 44.4% of children experienced mental health problems after the oil spill. Common symptoms endorsed in the survey included the child being sad or depressed, being nervous or afraid, having problems sleeping, or having problems with other kids (Abramson et al., 2013). Respondents also described a significant increase in the number of children with depression and separation anxiety. Parents and other caregivers commented on shifts in their children's attitudes and behaviors, where at times they would "act out in anger," have severe "restlessness," or "completely shut down and you don't know what's going on in their head."

These mental and emotional health problems greatly impacted children's experiences in school and their overall academic performance. Parents commented that their children who had once earned good grades were suddenly failing their classes and had diminished focus and comprehension. A community advocate and mother said the following about her son and the regression he experienced after the spill:

The four-year-old, he's the one that's—he has problems like he's not communicating like he used to, he used to be very active and stuff, but now he's slowed down. He just sits up and stares at you all the time… I asked the school about trying to get me help. I wanted to go get him tested and stuff because he used to be jolly. He's always been very smart, he knows lots of things, but lately he's slowed down a lot.

At times, especially among adolescents, children and youth acted out in the school setting, then triggering a series of disciplinary referrals that sometimes involved dismissal or suspension. Respondents in some of the focal communities reported that there were some children who developed severe anxiety and would refuse to attend school. One participant described how a child would “run into the street,” at which point administrators would call on “police officers there to try to get them into the office, hold them down.” This often only served to further exacerbate the child’s distress.

Some children’s health issues manifested in suicidality or self-harm. One of the school nurses in our sample observed that not only was suicidal ideation a problem, but that it became a significant challenge among even young children after the spill. She remarked:

I am seeing such a huge increase in our mental health problems. And it’s not just depression and anxiety. I’m seeing a lot of suicidal ideation down in the second, third, fourth grade. I had children that had tried to hang themselves in middle school. I have children that will choke themselves in the middle of a classroom.

A pediatrician who participated in one of the focus groups made made connections between familial and environmental stressors and noted that they can have dire, even life ending, consequences for children:

I think some of it is increased parental discord for whatever reason, maybe not being able to pay bills, additional stress on husband and wife or boyfriend and girlfriend and that trickles down to the kids. It creates problems. And of course, asthma related problems definitely you can say it’s because of the environmental factor… it’s mainly stress levels between families that trickles down to the kids as far as them having issues like not wanting to go to school and trying to end their life.

Some of the parents and community leaders in our study reported that children across age groups were exhibiting disruptive and worrying behaviors. For example, among toddlers, their anger was sometimes directed at their caregivers or toward other children, including their own siblings. A clinical director explained:

The little children become very much more aggressive, not only to other children. We are having three-year-olds brought in… three-year-olds, four-year-olds being kicked out of kindergarten or the daycare because of their aggressive behavior with other children. The aggressive behavior towards siblings—I had one that tried to smother their younger sibling. Fifteen years ago, I didn’t have that.

The physical and emotional absence of parents who were often struggling financially as well as mentally had a profound impact on risk-taking behaviors, especially among adolescents and teens. One fifteen-year-old female who accompanied her mother to a focus group commented on the pervasive peer pressure to smoke marijuana to “get all the depression out of you.” Many other respondents also mentioned the increase in teenage drug use and sexual activity in their communities. As the director of a religious nonprofit quipped, “There are three things to do here: go fishing, get high, or get pregnant.” After the spill, when people could no longer go fishing, they were “getting high” and “getting pregnant” much

more frequently. One mother attributed the rising incidence of teen pregnancies to a lack of parental supervision and guidance:

And I don't know if you all noticed, there is a lot more teen pregnancy. You see these girls walking around with babies, pregnant. Because I really feel like they're unattended just like we were talking about. One parent was working full time, the other parent was home, or the single parent, now they're two both having to work, it doesn't matter what hours they have to work, they gotta work. They ain't gonna have a place to live. There's a lot of teenagers unattended. There are teens in my neighborhood, personally, this is just on my street, been three teen pregnancies and this is just outrageous.

Another mother in the same focus group who also lived in a low-income community ascribed teen pregnancies to broader structural issues. She commented, "Well, that's what all the adults did after Katrina when they didn't have anything better to do, so what do you think the kids are gonna do when they don't have anything better to do? But it is not that the services aren't here it's that they're not being funded." In this sense, she was emphasizing that young people's risk-taking behaviors were not unique, nor were they the sole consequence of "absent parenting." Rather, as she saw it, these behaviors emerged in a context without proper support for young people.

Discussion

Although prior work has examined the impact of DHOS on children and youth (Gavenus et al., 2013; B. R. Gilbert, 2013; Hammerli, 2013; King et al., 2015; Locke & Werner, 2013; Mohammad & Peek, 2019; Werner & Locke, 2012, 2014), this is the first research to draw on a multi-phase, multi-method study to systematically examine the impact of the oil spill on children's health from the perspective of caregivers and community leaders. This article presents the perspectives of adults who care and advocate for children in five of the Gulf Coast communities most impacted by the DHOS—New Orleans East, Lower Lafourche, and Grand Isle, Louisiana; Gulfport, Mississippi; and Bayou La Batre, Alabama. These communities were selected for further study based on the high rates of exposure to the oil spill and its impacts, and the high incidence of physical, mental, and behavioral health issues that were identified in the GCPI survey data.

Caregiver and community leader focus group and key informant interview respondents described DHOS as a chronic, ambiguous family stressor that had profound economic and social implications in local communities ravaged by Hurricanes Katrina and Rita merely five years earlier (Mohammad & Peek, 2019). In addition, these communities had long been affected by chronic stressors associated with the most deleterious effects of poverty, pollution, and climate change (Boss, 2014).

Hobfoll and Spielberger (1992) define family stress as "the state in which family members and the family as a unit are challenged by the environment in a way that takes their individual and collective resources and threatens the well-being of the family" (Hobfoll & Spielberger, 1992, p. 99). These disturbances that disrupt familial equilibrium "can emerge from the outside context (e.g., war, unemployment), from inside the family (e.g., death;

divorce), or both simultaneously" (Boss, 2014, p. 2202). Boss (2014) writes that stressor events and situations that change the family equilibrium can be classified in various ways: internal versus external, normative versus catastrophic, developmental versus situational, predictable versus unexpected, ambiguous versus clear, and volitional versus nonvolitional. In addition, the duration of stress can be chronic or acute, and the density of the stress can be cumulative or isolated. According to Boss's (2014) model of family stress, there are two types of ambiguous loss, the first being when a family member is physically absent but psychologically present, such as when a parent is away from home due to work-related obligations. The second type is when a family member is physically present but psychologically absent (Boss, 2014). Ambiguous loss thus introduces boundary ambiguity, where the family is unsure of who is in and out of the family system (Boss & Greenberg, 1984).

Based on Boss's classification system, the DHOS could be characterized as an external, unexpected, ambiguous, and chronic stressor. The disaster originated outside the family unit, its precise place and time of occurrence was mostly unpredictable, and Gulf Coast families waited years to receive compensation and return to their normal work and recreational routines—with some never receiving compensation and others never finding a renewed sense of normalcy or routine. In addition, the potential health effects associated with exposure to toxic components of crude oil and dispersants were unknown to residents at the time of the oil spill and cleanup.

Unlike the acute stressors of seasonal hurricanes, after which fishing communities could rebuild and return to work, the oil spill's damage to the Gulf's increasingly fragile ecosystem, fear of seafood contamination, and drilling and fishing moratoria resulted in severe financial loss that reverberated throughout local economies. In addition, BP's inconsistent compensation system resulted in highly disparate reparations that generated widespread resentment, including among children, which was consistent with the corrosive community model often applied to the technological disaster context (Erikson, 1995; Kroll-Smith & Couch, 2014; Mayer et al., 2015). Financial loss forced middle- as well as low-income families to give up many aspects of their lifestyles to pay for basic goods and services that suddenly became unaffordable. Widespread job loss and financial pressure created stressful household environments characterized by depression, homelessness and overcrowding, divorce and separation, substance abuse, and domestic violence.

This qualitative analysis is unique in that it revealed that children absorbed familial stress in three main ways: (1) becoming negative objects of depressed and frustrated caregivers unable to effectively parent due to their own stress; (2) the "ambiguous loss" of absent caregivers working longer hours outside the home and emotionally detaching; and (3) premature cognizance and deep-seated anxiety about their families' financial security and their own future prospects. Parents and community leaders observed that stress may have induced inflammatory conditions such as asthma, migraines, skin rashes, and gastrointestinal issues, as well as emotional dysregulation expressed through aggression, severe anxiety and depression, and suicidality. Children and adolescents also displayed reduced academic performance and engaged in risky health behaviors including illicit drug use and unprotected sex resulting in teen pregnancy.

Future Research and Study Limitations

According to McEwen & McEwen, toxic stress generated by adverse experiences overwhelms the body's capacity to maintain a state of homeostasis and creates an unbalanced state known as allostatic load in which the neurological systems facilitating physiological and psychological regulation are permanently damaged (McEwen & McEwen, 2017). Shonkoff et al. (2012)'s ecobiodevelopmental framework argues that these neurological changes early in life result in disruptions to the metabolic, neuroendocrine, neurodevelopmental, cardiovascular, and immune systems that shape poor adult health-related behaviors, educational achievement, economic productivity, and physical and mental health (Shonkoff et al., 2012). This theoretical architecture serves as an explanatory mechanism for how cumulative, toxic familial stressors in the absence of protective buffers can "get under the skin" of children and adolescents, resulting in inflammatory conditions and behavioral and mood dysregulation. These dynamics and processes elucidate how family stress and childhood toxic stress theories may inform how child and adolescent health is adversely affected by technological disasters like the DHOS and other major collective disruptions like Hurricane Katrina.

There are additional elements of child and adolescent stress that pertain to the DHOS that are outside the scope of this analysis. For instance, some children absorbed stress through the consumption of media as they watched the oil rig burn on television for hours on end, while others became stressed as the oil spill remained a dominant topic of conversation among their peers. Some children even developed extreme fear of water and going to the beach. It is also important to note that not all families had a uniform experience of economic loss, associated stress, and coping mechanisms, as evidenced by a qualitative study in southern Louisiana (Keating et al., 2020) (Keating et al., 2020). This was especially the case for children belonging to certain racial/ethnic minority groups, particularly those of Vietnamese and Southeast Asian descent, whose stressful experiences were culturally distinctive and warrant separate and more in-depth examination. There is a growing body of literature, for example, that explores how disasters in the Gulf Coast have uniquely impacted Vietnamese families and communities (Ngo et al., 2014; Norris et al., 2009; Patel, 2018; VanLandingham, 2017; Vu et al., 2009; Vu & Vanlandingham, 2012).

The present study is further limited by the fact that caregiver and stakeholder respondents were recruited from highly impacted communities, so their experiences may not be representative of those in the region more broadly. In addition, because a decade has passed between the initial data collection and the final analyses presented here, all of the communities that we studied have been affected by subsequent disasters as well as ongoing social, economic, and environmental changes. This only further underscores the need for long-term, sustained study of communities under stress, although these considerations are unfortunately beyond the scope of the present work.

The interviews and focus groups did not include direct conversations with children and adolescents; their caregivers and local community leaders who teach and care and advocate for children served as proxies. Although Gibbs et al. argue that it is critical to empower children and adolescents to contribute to broader understandings of disaster experiences, as it "provides an opportunity for [them] to have a meaningful influence on how their

disaster experience and recovery is shaped," (Gibbs et al., 2013, p. 137) time and resource limitations in our present study precluded the ability to gather data directly from young people. Notwithstanding the absence of children and adolescents' own voices, the study was strengthened by the inclusion of diverse caregivers and community leaders who were intimately familiar with children and adolescents' social spaces, specifically the home, school, and recreational locales. They came from communities whose youth were highly impacted by the spill and were identified through a methodologically rigorous sampling process. It is also important to note that, despite stakeholders' and caregivers' self-reports, it is impossible to ascertain a causal relationship between DHOS and children's adverse health outcomes. This is especially the case given the myriad stressors children and their families face by living in the Gulf Coast region.

Conclusion

The findings from this qualitative analysis on the role of exposure to the DHOS in addition to Hurricane Katrina and other chronic and acute stressors on various aspects of family functioning and children's health are consistent with those of the quantitative and qualitative studies summarized at the outset of this article. These findings also complement insights from qualitative research exploring the effects of the oil spill on families and children more broadly, such as Keating et al.'s (2020) examination of parents' coping mechanisms facing resource loss and Gilbert's (2013) study of how youth made sense of the event through lifestyle changes. This qualitative sub-study of the four-state GCPI survey takes the public health research on children and adolescents in the aftermath of the DHOS one step further. It employs a multiphase, mixed-methods approach to better understand the pathways through which child health disparities were exacerbated by this technological disaster in the context of social divestment, economic downturn, and more severe and frequent disasters associated with climate change.

More broadly, this qualitative analysis contributes to the growing body of literature that examines the multifaceted effects of disasters on children and adolescents' long-term health and wellbeing (Peek et al., 2018). This work, in particular, highlights the ways that children and youth may absorb toxic stress in the family context and as a consequence of major disruptions to the natural and economic environments in which young people and their families are embedded. No singular theory captures children's experiences of the DHOS oil spill in the familial context and how their exposure to this technological disaster caused the onset of short- and long-term physical, behavioral, and mental health issues. The findings from this qualitative analysis provide a clearer understanding of the complex, multilevel pathways through which technological and natural hazards affect communities, families, and ultimately, children, can help policymakers and stakeholders better prepare for and respond to the unique needs of children growing up in ecologically and socioeconomically vulnerable environments prone to repeated disaster.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- Livelihood disruptions caused by poverty, the Deepwater Horizon oil spill, and other compounding disasters intensified levels of family stress.
- Children absorbed family stress through displaced caregiver distress, ambiguous loss, and early recognition of their precarious financial situation.
- Children and adolescents' toxic stress manifested in poor physical, mental, and behavioral health outcomes.

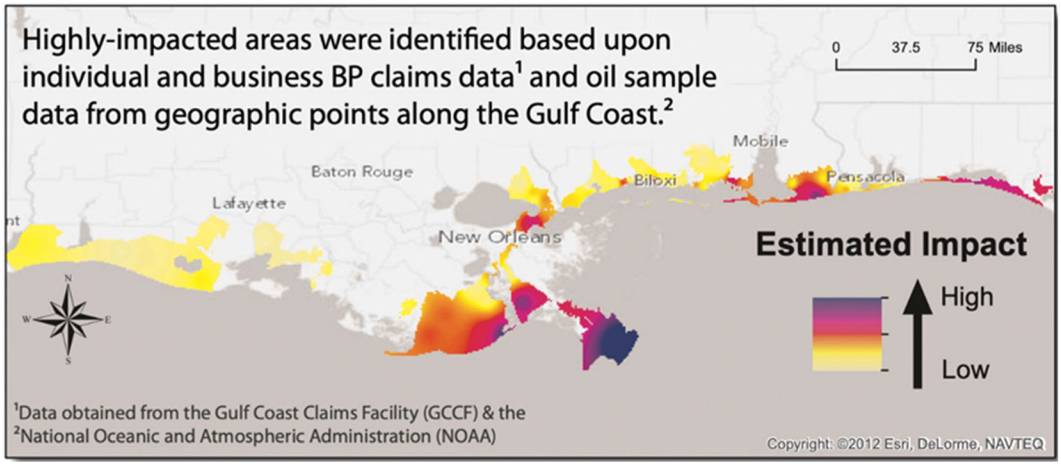

Fig. 1.

This map was generated using secondary data to identify the 15 most highly impacted areas in the Gulf Region

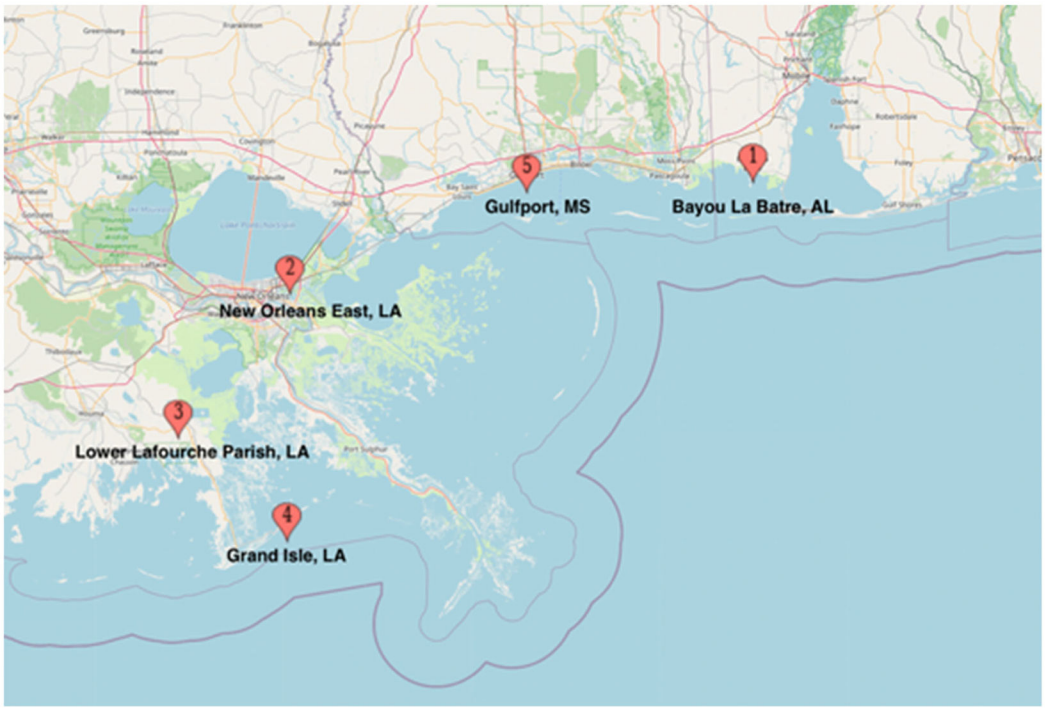

Fig. 2.
This map locates the five communities chosen for further in-depth qualitative investigation during Phase 3 of the research

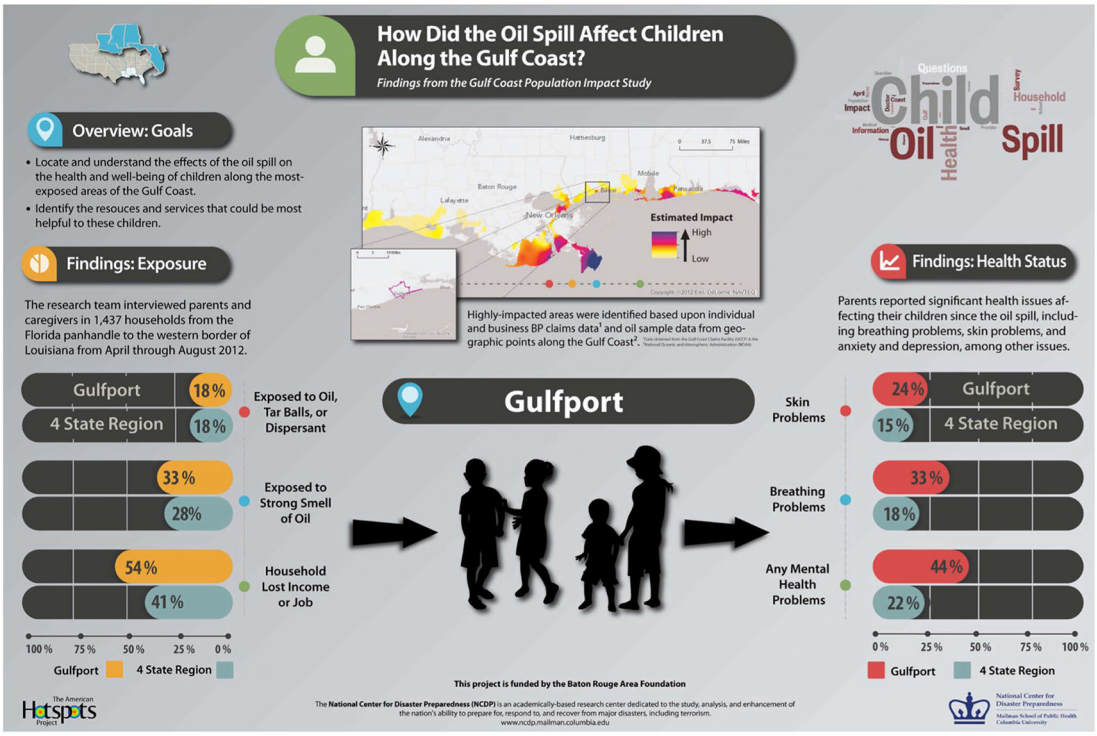

Fig. 3.

The following is an example of one of the graphical poster boards that the research team showed at the beginning of the interviews and focus groups in the qualitative sub-study community of Gulfport.*.* This poster board represents the disproportionate impacts on Gulfport relative to the larger GCPI study sample. We used this same template, but updated the data, to create site-specific poster boards for the other qualitative focal communities studied in Phase 3 of this research

Table 1

Survey Results: Child Exposures and Outcomes in the Overall GCPI Sample and the Communities Selected for Qualitative Investigation

Exposure/Outcome	Overall GCPI Sample	Bayou La Batre, AL	New Orleans East, LA	Lower Lafourche and Grand Isle, LA[a]	Gulfport, MS
Sample Size	1,437	91	121	75	72
Percent Physically Exposed	18.0	**54.6**	5.2	**21.4**	**19.7**
Percent Environmentally Exposed	28.1	**69.4**	**37.1**	**47.8**	**35.3**
Percent Economically Exposed	40.9	**65.3**	**50.8**	**57.3**	**54.9**
Percent Health Worse Since Spill	15.1	14.3	**16.5**	**21.3**	**30.6**
Percent Physical Health Effects	33.3	**36.7**	**40.5**	**40.0**	**45.8**
Percent Mental Health Effects	21.6	**34.7**	**28.2**	**26.0**	**45.7**

The bolded percentages indicate disproportionately high rates of exposure and effects relative to the overall sample population.

[a]For purposes of the survey portion of the study, Lower Lafourche and Grand Isle were combined due to the low number of respondents living in Grand Isle.

Table 2

Phase 3 Qualitative Respondents: Number of Focus Group and Interview Respondents, by Qualitative Study Community

Data Collection Method and Participant Information	Bayou La Batre, AL	New Orleans East, LA	Lower Lafource, LA	Grand Isle, LA	Gulfport, MS
Number of Community Leader Key Informant Interviewees	11	9	3	5	8
Number of Community Leader Focus Group Participants	13	13	6	8	12
Number of Community Leader Focus	2 English	2 English	1 English	2 English	2 English
Groups Conducted, by Language	Language	Language	Language	Language	Language
Number of Parent Focus Group Participants	25	17	5	5	12
Number of Parent Focus Groups	1 Vietnamese	1 Spanish	1 English	1 English	2 English
Conducted, by Language	Language	Language	Language	Language	Language
	2 English	1 Vietnamese			
	Language	Language			
		1 English			
		Language			